

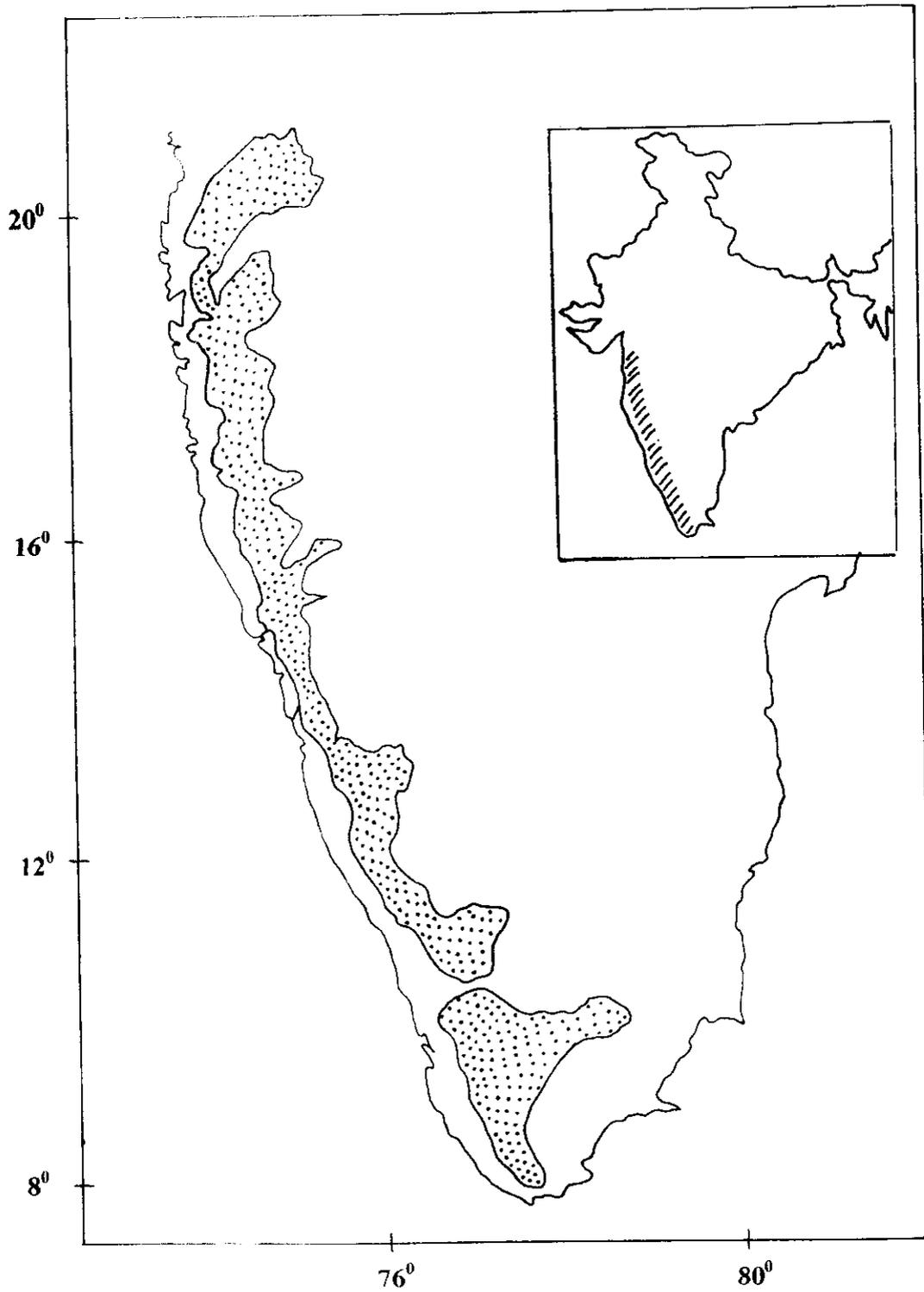
## CHAPTER II STUDY AREA

India, the seventh largest country in the world can be divided physically into four regions- the Himalayan mountains, the Gangetic river plains, the southern (Deccan) plateau and the islands of Lakshadweep, Andaman and Nicobar. The lofty Himalayan mountain range borders India in the north and contains the nations highest peak. The Indus, Ganges and Brahmaputra rivers rise in the Himalayas. Southern India consists of a triangular peninsula and much of this consists of a tableland, the Deccan plateau (Olliver, 1978). The Indian sub-continent has one of the richest biota's in the world and the great diversity of plants and animals is due to the vast geographical area extending over many degrees of latitude, varied topography climatic zones and the position of the country at the junction of many biogeographic regions and sub-regions

The most important topographic features of peninsular India is the 1,600 km long Western Ghats along its western margin (Fig.2.1). It is the main watershed in peninsular India from which all the principal rivers namely Godavari, Krishna and Cauveri originate and flow east emptying into the Bay of Bengal. A very large number of short perennial, torrential west flowing rivers also originate from it and join the Arabian sea. The average elevation of the Western Ghats is in the range of 900-1500 m and some places goes beyond 2000 m above mean sea level. Along its entire length this hill range has only one major discontinuity, the Palghat Gap in Kerala (Nair, 1991).

Kerala [ $8^{\circ} 17' 30''$  to  $12^{\circ} 47' 40''$  N and  $74^{\circ} 51' 57''$  to  $77^{\circ} 24' 47''$  E] is one of the smallest states of India. The state is flanked by the Western Ghats as a natural wall on the eastern side and the Arabian Sea on the western side. Based on the topography, the land resources of the state generally fall into well-defined natural divisions, each running almost in the north-south orientation. They are 1) Lowland (<75m above MSL) 2) Midland (75-500 m above MSL) 3) Highland (500-750 m above MSL) and 4) High Ranges (>750 m above MSL) (Ipe *et al.* 1991).

**Figure 2.1. Map of India showing the Western Ghats**



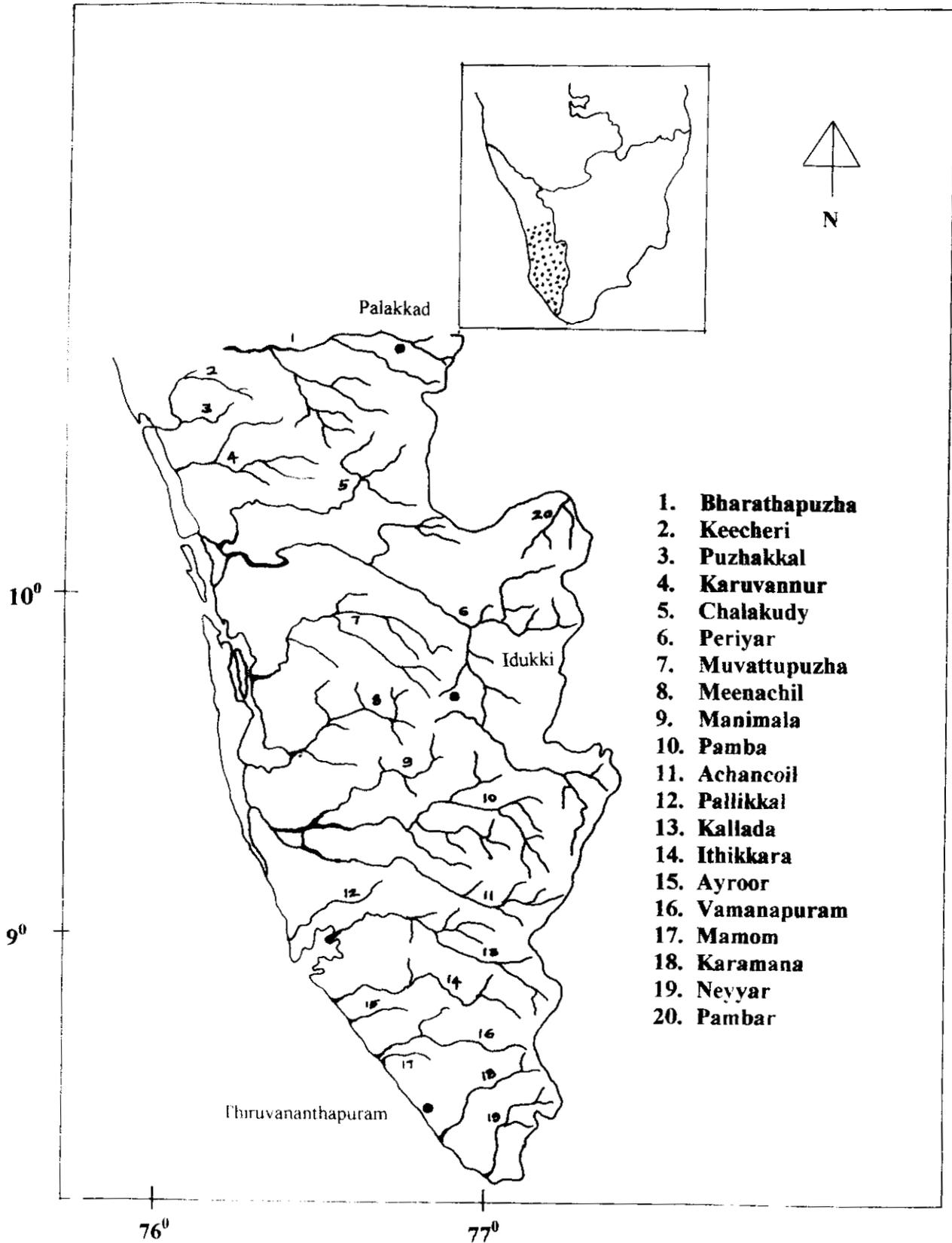
The Western Ghats protects the state from dry winds of the Eastern plateau and provide steady rainfall during winter. Due to the palghat gap, Kerala can be divided into two regions-southern Kerala (south of the Palghat Gap) and northern Kerala (north of the Palghat gap).

The present study is restricted to the southern region of the Western Ghats (south of Palghat Gap). Natural topographic features such as mountain ridges and valleys divide the southern region into: Agasthyamalai, Pandalam hills, Cardamom hills, the High ranges, Nelliampathy and Anaimalai hills (Nair, 1991). Most of the reserve forests and sanctuaries of southern Kerala are in the Highland region. Eravikulam is the only national park in this area. The study area includes the following sanctuaries: Neyyar, Chendurni, Peppara, Periyar, Idukki, Chinnar, Thattekkad, Chimmony, Parambikulam and Peechi- Vazhani. In the present study, fishes were collected from 19 rivers and also from a portion of the Bharathapuzha river (Fig. 2.2). Studies were conducted in all the rivers except Peppara sanctuary area of Karamana river, Chendurni sanctuary area of Kallada river and Periyar sanctuary area of Periyar river. Details of river systems flowing through the study area are summarized below.

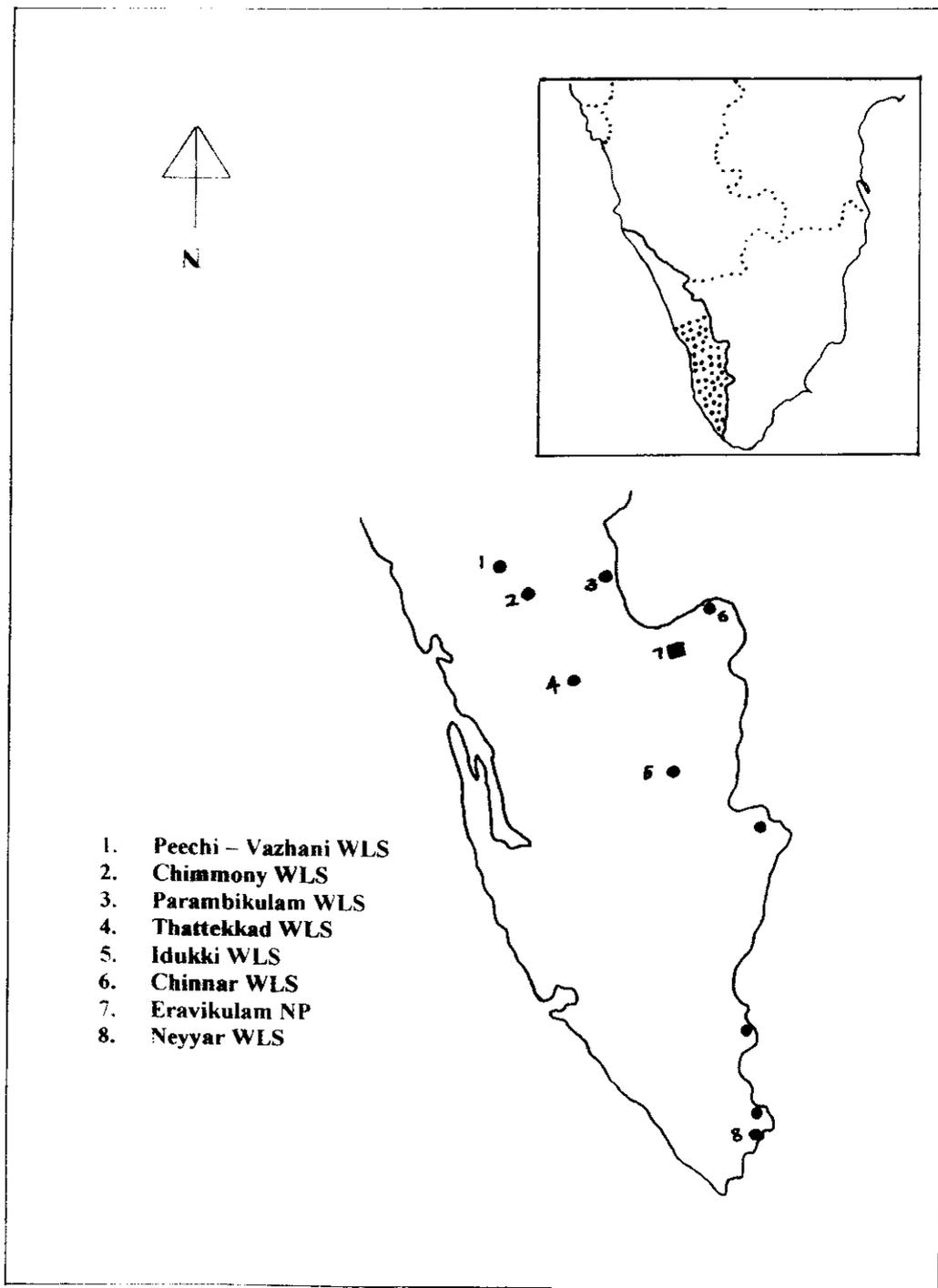
**Bharathapuzha:** The Bharathapuzha river is the second longest river in Kerala and takes its origin from the Anaimalai hills at an elevation of >1964 m above msl and flows through the districts of Coimbatore (Tamil Nadu), Palakkad, Malappuram and Thrissur and join the Arabian sea near the Ponnani town. The main tributaries are Gayathripuzha, Chitturpuzha, Kalpathipuzha and Thuthapuzha. Studies were conducted in all the streams except the Thuthapuzha. The main sub-tributaries of Gayathripuzha are Mangalam, Pothundy, Vandazhi, Meenkara and Chulliar. Streams Palar, Aliyar and Uppar combine to form Chitturpuzha. The Koraiyar, Varatar, Walayar and Malampuzha together form Kalpathipuzha. Malampuzha, the largest irrigation reservoir existing in the State, is located in this stream. The length of the main stream of Bharathapuzha is 209 km with a catchment area of 6186 sq km, out of which, 1786 sq km is in Tamil Nadu.

**Keecheri :** The Keechery river is one of the small rivers in the State and is practically dry during summer. It originates from Machad Malai at an elevation of >

**Figure 2.2. Map of southern Kerala showing various rivers**



**Figure 2.3. Map of southern Kerala showing wildlife sanctuaries and national park**



365 m above mean sea level. The Choondal thodu is the only important tributary of this river. Linked with backwaters at Enamakkal, the river empties into the Arabian Sea at Chettuval. The total length of the river is 51 km. and has a drainage area 401 sq km. The river basin is located in Thrissur district . The Vazhani part of Peechi-Vazhani wildlife sanctuary is drained by the Keecheri river. The wildlife sanctuaries and national park in southern Kerala are represented in Figure 2.3.

**Puzhakkal:** Puzhakkal river originate in the hills of Killannoor at an elevation of > 150 m above msl. The river has a length of 29 kms and a total of 234 sq.km drainage area. Puvathodu, Poomalathodu, Nadathodu and Kattachirathodu are the main tributaries of this river.

**Karuvannur:** The Manali tributary of Karuvannor originate from Vaniampara hills (>365m), and the tributaries, Chimmony and Mupli from Pumalai at an elevation of >1100 m above msl. The Peechi part of Peechi- Vazhani wildlife sanctuary is drained by Manali tributary and Chimmony wildlife sanctuary is drained by Chimmony tributary. The total length of the river is 45 km and it drains an area of 1054 sq km.

Peechi-Vazhani wildlife sanctuary is in Thrissur district and is one of the oldest sanctuaries in Kerala. This sanctuary is continuous with Chimmony wildlife sanctuary. The sanctuary area consists of parts of Paravattanimala reserve, Machadmala reserve and Bharanipachamala reserve. The total area of the sanctuary is 125 sq. km and is drained by Manali tributary of Karuvannur river (Peechi part) and Keecheri river (Vazhani part).

Chimmony wildlife sanctuary (Thrissur district ) is one of the western most segment of the proposed Anamalai -Anamudi conservation unit .This unit starts from Chinnar wildlife sanctuary in the east and stretches up to Peechi part of Peechi -- Vazhani wildlife sanctuary as a continuous belt passing through Eravikulam national park and Parambikulam wildlife sanctuary. This sanctuary is drained by Chimmony tributary of Karuvannur river

**Chalakydy:** Chalakydy river is formed by the confluence of the Parambikulam, Kuriarkutty, Sholayar, Karappara and Anakkayam streams. Of these, the

Parambikulam and Sholayar originate from the Coimbatore district in Tamil Nadu and remaining streams from hills of Palakkad district. The Parambikulam wildlife sanctuary is drained by the streams of Chalakudy river. The river originates at an altitude of >1250 m above msl. The river has a length of 130 km and it drains an area of 1404 sq km in Kerala and 300sq km in Tamil Nadu. At Elanthikara, the Chalakudy river joins the Periyar river.

Parambikulam wildlife sanctuary is in Palakkad district and is famous for its faunal wealth. The sanctuary keeps its continuity with the natural forest of Vazhachal and Chalakudy on one side extending up to Peechi. A narrow belt of grassland connects the sanctuary with the Anaimalai sanctuary of Tamil Nadu and Eravikulam national park of Kerala. There are three dams within the sanctuary harboring lot of aquatic fauna. Karimala Gopuram (1430.6 m above msl) is the highest peak. There are about 30 swamps extending over 150 ha. inside forests, which are, the favourite haunts of the wild animals.

**Periyar:** The Periyar is the longest river in Kerala. The river originates from the Sivagiri hills at an elevation of >1830 m above msl. Its major tributaries are Mullayar, Perumthurayar, Kattapanayar, Cheruthoniar, Muthirapuzhar and Edamalyar. The length of the river is 244 km, and it drains 5398 sq km area. Periyar Tiger Reserve, Idukki, Thattekkad wildlife sanctuaries and portion of Eravikulam national park are drained by the streams of Periyar river. Idukki hydro - electric project, the largest project in Kerala is constructed in Periyar. At Aluva, Periyar river bifurcates into the Mangalampuzha and Marthanda Varma puzha. The Mangalampuzha joins the Chalakudy river at Puthenvelikara and the Marthanda Varma puzha join the Vembanad lake at Varapuzha.

Periyar tiger reserve is in Idukki district and is named after the Periyar river. This protected area is the first (as wildlife sanctuary) and has the most extensive area in Kerala. It is constituted specifically for the conservation of Indian Tiger.

Idukki wildlife sanctuary (Idukki district) was constituted primarily to protect the catchment's area of the Idukki reservoir. The sanctuary is drained by Periyar river and its tributary, Cheruthoni.

Thattekad Bird sanctuary ( Salim Ali Bird sanctuary) is in Eranakulam district and is constituted to give special protection to the avi fauna and their habitats. Thattekad is the only Bird sanctuary in Kerala. World famous Ornithologist Dr. Salim Ali was the architect of this sanctuary, who had identified more than 200 birds from this area. Many migratory birds also visit this sanctuary. There are no settlements inside the sanctuary, but the disturbance from outside is very high (Basha, 1997)

Eravikulam national park is in idukki district. The Eravikulam plateau and the adjacent areas in the high ranges of Kerala were the lease lands of the Kannan Devan Hills Produce Company.

**Muvattupuzha:** Muvattupuzha river is formed by the confluence of three rivers- Thodupuzha, Kaliyar and Kothamangalam streams. It originates from Taragamkanam hills, Valiya Parattan hills, Venniyar Mudi and Neriya Mangalam hills. The length of river is 121 km and its total drainage area is 1554 sq km. At Vettikkattumukku the river bifurcates into the Murinjapuzha and Ithipuzha, and joins the Vembanad lake

**Meenachil:** River originates from Araikunnu Mudi at an altitude >1097m above msl. Kadapuzha, Minadamar, Kalathukadavu, Trikovil, Kurusumalai and Punjar are its main tributaries. The length of the river is 78 km and the total drainage area is 1272 sq km. The catchment area of this river lies within Kottayam district and the river join the Vembanad lake.

**Manimala:** The river originate from Tatamala at an elevation of >1156 m above msl and it passes through Peruvanthanam, Mundakayam, Erumeli, Manimala, Kalluppara, Kaviyoor and Thiruvalla. Its main tributaries are Kokayar and Elakkalthodu. The length of the river is 90 km and it drains an area of 847 sq km. At Neerettupuram, the river Manimala join with the Pamba river and opens into the Vembanad lake

**Pamba:** It is the third longest river in Kerala and is formed by the confluence of Kakkiyar, Arudat, Kakkadar, Kallar, Pambi and Pambiar. The river originates from

Pulachimalai, at an elevation of 1,650 m above msl. The Manimala river joins the Pamba near Neerettupuram and at Pannai, a branch of Achencoil river also joins the southern branch of Pamba river. The river falls into the Vembanad lake through several branches like Pallathuruthyar and Nedumudiyar. Pamba river is 176 km long and it drains an area of 2235 sq km. The existing hydroelectric project Sabarigiri is in Pamba river

**Achencoil:** The river originates from the Pasukidamettu at an elevation of 700 m. above msl. The major tributary is Kallar. At Veeyapuram, the main branch of Achencoil flows in a north-west direction and join the Pamba river. The length of the river is 128 km and the total drainage area is 1484 sq km.

**Pallikkal:** The river originate from the southern slopes of Kalaritarakunnu at an elevation of 60 m above msl. The only important tributary is Adikkattukulangara. The river has a length of 42 km with a drainage area of 220 sq km.

**Kallada:** River is formed by Kulathupuzha, Chendurni and Kalthuruthy streams. Its origin is from Karimalai Kadakkal at an elevation of 1524 m above msl. This river drains the Chendurni wildlife sanctuary. After Enathu the river flows in a south-west direction and join the Ashtamudi Kayal. Kallada irrigation project is a major one in Kerala. The length of the river is 121 km with drainage area of 1699 sq km.

**Ithikkara:** The river originates from Madathurikunnu at an elevation of 240 m above msl. Vattaparambu, Kundumanthodu, Vattamthodu and Kulanjethodu are its important tributaries. The river is 56 km long and has a catchment's area of 642 sq km. The river opens into the Pravoor Kayal.

**Ayroor:** It is the smallest river in southern Kerala and it originates from Navaikulam. The length of the river is 17 km and drains an area of 66 sq km. At Nadayara the river empties into the Edava- Ndayara Kayal.

**Vamanapuram:** Vamanapuram river originates from the Chemunjimotai at an elevation of 1860 m above msl. The important tributaries are Kalaiparai ar, Pannivadaï ar, Ponmudi ar and Chit ar. The river has a length of 88 km with drainage area of 687 sq km. At Chirayinkil, the river empties into the Anjengo lake.

**Mamom** This small river takes its origin from Pandalakottumalai and has a length of 27 km. It has a drainage area of 114 sq km and the river empties into the Anjengo lake near Chirayinkil.

**Karamana**: It originates from the Nedumangad hills (Chemmunji mottai and Agastyamalai ) 1860 m above msl and is formed by the confluence of Kaviar, Attaiar, Vaiyapadiyar and Todiya. The Peppara wildlife sanctuary is drained by Karamana river. The length of the river is 68 km and has a catchments area of 702 sq km. At Pachallu, the river opens into the Arabian Sea.

**Neyyar**: Neyyar is the southern most river of the State and it originate from the Agastya hills at 1860 m above msl. Kallar and Karavaliyar are the important tributaries of this river. Neyyar wildlife sanctuary is drained by this river. The length of Neyyar river is 56 km and its drainage area is 497 sq km. Near Puvar, the river empties into the Arabian sea .

Neyyar wildlife sanctuary (Thiruvananthapuram district ) is the southern most protected area in Kerala .The diversity of its flora makes the sanctuary an ideal gene pool reserve. It is very near to Peppara wildlife sanctuary (north ) and Agasthya Vanam Biological Park. The state boundaries of the sanctuary are the Mundanthurai and Kalakkad sanctuaries in Tamil Nadu (Nair, 1991). Agasthyar peak (1890 m, above msl.) is the highest point in the sanctuary. Prime wildlife habitats (about 60 sq. km.) have been earmarked as the core zone and a lion safari park is located in the buffer zone .

**Pambar**: Pambar is one of the three east flowing rivers in Kerala. It is a sub-tributary of Amaravathy, a tributary of the Cauvery river. Pambar river originates from the Benmore hills at an elevation of 1950 m above msl. Iravikulam, Myladi, Thirthmala and Chenglar are the important tributaries of this river. The Chinnar wildlife sanctuary and portion of Eravikulam national park are drained by this river. The river has 25 km long and has 384 sq km drainage area in Kerala and is the only east flowing river in southern Kerala (PWD, 1974).

## **Climate**

Kerala falls under per-humid and humid climatic types except the southern most pockets of the State and the eastern part of the Palghat region, which come under moist sub-humid climatic type. The State as a whole experiences mega thermal climate which indicates that the crop growth is not inhibited by temperature ; but governed by rainfall alone (Iype *et al.*, 1991).

## **Rainfall**

The rainfall distribution in Kerala is bimodal. The State gets heavy rains during both monsoons (South-west and North-east monsoons). The average annual rainfall of the State is 2963mm. The highest rainfall is recorded at Neriya Mangalam (Ernakulam district) and the lowest at Chinnar (Idukki district). July is the most rainy month in the northern districts. The southern parts extending from Ponnani to Thiruvananthapuram show two peaks in the months of June –July and October during south-west and north-east monsoons respectively. The effective rainfall in the northern region is about 40% and is 80% in the southern region. The mean annual number of rainy days over the State is 126 with the minimum (45 days) at Chinnar and maximum (172 days) at Neriya Mangalam. Nearly 60% of the annual rainfall is received during the south-west monsoon (Iype *et al.*, 1991).

## **Temperature**

The mean annual temperature varies from 25.4<sup>0</sup>C to 31<sup>0</sup>C in the central parts of Kerala. However, a major portion of the midland records temperature under 27.5<sup>0</sup>C. The diurnal variations are not high (5-7<sup>0</sup>C) except in the highland zones where the difference goes up to 15<sup>0</sup>C. March, April and May are the summer months during which the mean annual temperature varies between 29<sup>0</sup> -31<sup>0</sup>C. Due to high rainfall during the south- west monsoon, the temperature comes down during July-August and starts increasing from October onwards (Iype *et al.*, 1991).