

Where the  
**kurinji**  
blooms



Where the  
**kurinji**  
blooms



a biodiversity learning module



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**Text & Content:** Saneesh C.S

**Editors:** Anita Varghese, Mathew John & Philip Mulley

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## Introduction

*to nurture a lifelong love towards nature*

'Where the kurinji blooms' is a biodiversity learning module for conservation education and has been designed for adults who work with children. The module is based on the Nilgiri Biosphere Reserve (NBR) and uses the region as the learning canvas. The diversity, inter linkages and richness of the reserve has inspired this book. This learning module can only be tapped fully if the adults are guided by the following principles of learning - 1. Learning requires the active participation of the student. 2. Children learn in a variety of ways and at different degrees. 3. Learning is both an individual and a group process.

Children can be taken through the disciplines of science and humanities through the study of conservation, this is an advantage of the study of terrestrial environments. In many aspects, this biodiversity learning module will provide children a broader understanding of how sciences interrelate than if they were to be studied separately.

The educator-led activities, provided in this module, encourage children to discover animals and plants in a variety of habitats and their relationships. The module also encourages children to discuss with elders who are custodians of traditional knowledge in this biosphere reserve. Understanding maps through activities based on them has been incorporated in the activities. The rich images are all taken from the NBR and the illustrations represent life in the region.

This manual will have served its purpose if educators are inspired by it and find the information and activities relevant and useful. One does not have to be a specialized subject teacher to implement this module, only inspired and interested. We look forward to your feedback, comments and suggestions.

***'If you are thinking one year ahead, sow a seed; if you are thinking 10 years ahead, plant a tree; if you are thinking 100 years ahead, educate people'***

-Chinese proverb

Saneesh C.S.

Keystone Foundation

## Foreword

The Nilgiri Biosphere Reserve (NBR) can be said to have witnessed what some observers have termed a "Living Past". The "Living Past" of the indigenous communities, numbering not less than thirty groups in the biosphere reserve has had profound relevance to their immediate environment. The nature-culture interface that is obtained in the NBR even down to post-modern times survives with some degree of tenacity. How many of the livelihood traditions stemming from this complex 'psyche' could still help these communities in redefining their role is exciting.

This exercise provides an exploratory context in which these communities are to be placed. The several aspects of this context have been presented in this instructive work. The able team of Keystone Foundation has succeeded in producing an exemplary manual towards achieving an understanding of the environment of the NBR.

This task has been undertaken targeting the future generations of the communities whose home is the NBR. Written in cogent language, this work seeks to educate, enlighten and establish a knowledge base meant for those who are really the stakeholders of this region. Imparting a process of comprehension of the needs of the region is very well displayed in all the chapters of this work. The dynamics of environmental, social and cultural changes in the biosphere reserve have been addressed commendably by the compilers of this volume. More detailed comprehensive and wide ranging issues emanating from these sources, I am confident, would be readily responded to by the Keystone Foundation.

The potential offered by the environment of the NBR at various levels of development and interwoven with the indigenous perspectives documented here certainly showcases the living past of this hoary region. And I wish this significant publication to launch a *learning mission* in the evaluation of the uniqueness of the NBR in its human as well as ecological setting.

Rev. Philip K. Mulley

Trustee-Keystone Foundation

Native of the Nilgiris, Storyteller, Cultural Anthropologist....

## Nilgiri Biosphere Reserve (NBR): A bird's eye view

The Western Ghats, also known as the Sahyadris, is the main continuous mountain range in peninsular India. Its northern tip originates near the Tapti River and tapers towards the south, ending near Kanyakumari. Since the Ghats stretch along the coast, rising up to an average elevation of 900-1500 meters above sea level (ASL), it obstructs the monsoon winds from the south west, thereby bringing heavy rains to the western coast. The Western Ghats spread over 6 states, 51 districts and 163 taluks. It shelters 12 national parks and 44 wildlife sanctuaries. The Agasthyamalai Biosphere<sup>1</sup> Reserve and the Nilgiri Biosphere Reserve are crucial habitats for biodiversity<sup>2</sup> within the Western Ghats.

### Nilgiri Biosphere Reserve:

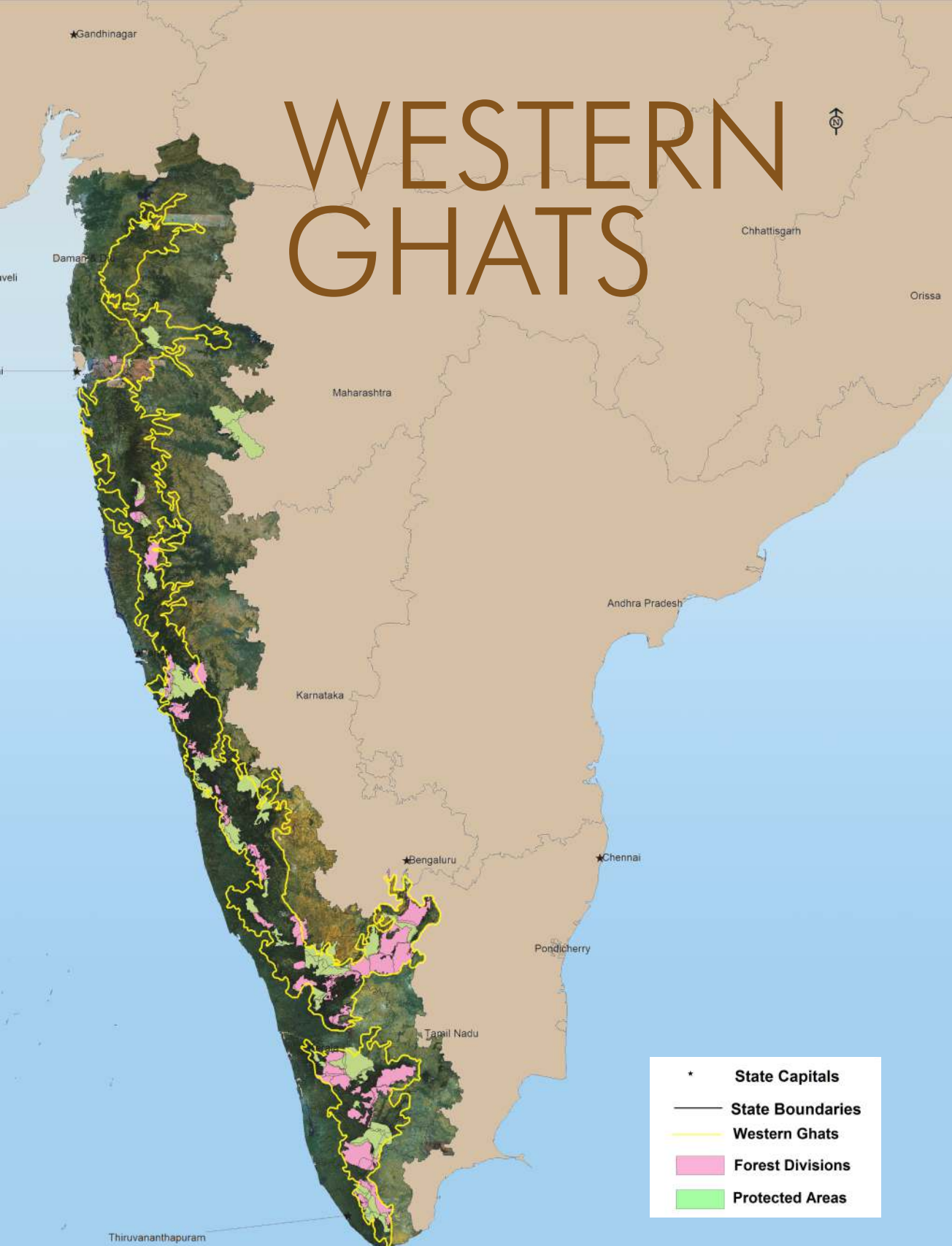
Designated in 1986 by the Man and Biosphere Program of the UNESCO, it comprises a total area of 5520.40 sq.km. and is a vast physical, ecological and cultural complex. The Nilgiris district in Tamil Nadu lends it name to this first biosphere reserve of India. The biosphere concept considers people as part of the ecosystem and recognizes the need to integrate them in conservation efforts.

The northern portion of the NBR comprises the Mysore plateau consisting of the Bandipur Tiger Reserve, Rajiv Gandhi National Park and the Mudumalai Tiger Reserve. On the western side lie the Waynad Wildlife Sanctuary, Silent Valley National Park, and forests of the Siruvani Hills and the Nilambur Valley. The southern portion of the NBR comprises the Attapadi plateau and the contiguous stretch of Coimbatore plains.

<sup>1</sup>**Biosphere** is a part of the earth and its atmosphere in which living organisms exist or which is capable of supporting life. The concept of a biosphere reserve emerged through the Man and Biosphere program, initiated through a resolution passed at the Biosphere Conference convened in Paris by UNESCO in 1968.

<sup>2</sup>**Biodiversity** is a general term used for species, habitat and genetic diversity.

**Biodiversity hotspots** are those areas that hold a high number of endemic species. The concept of biodiversity hotspots was put forward by Norman Myers in two articles in "The Environmentalist" (1988 & 1990). India is home to 3 biodiversity hotspots - Eastern Himalayas, Indo-Burma, and Western Ghats.



Source: <http://keystone-foundation.org/proceedings-of-the-save-western-ghats-meet-2010/>



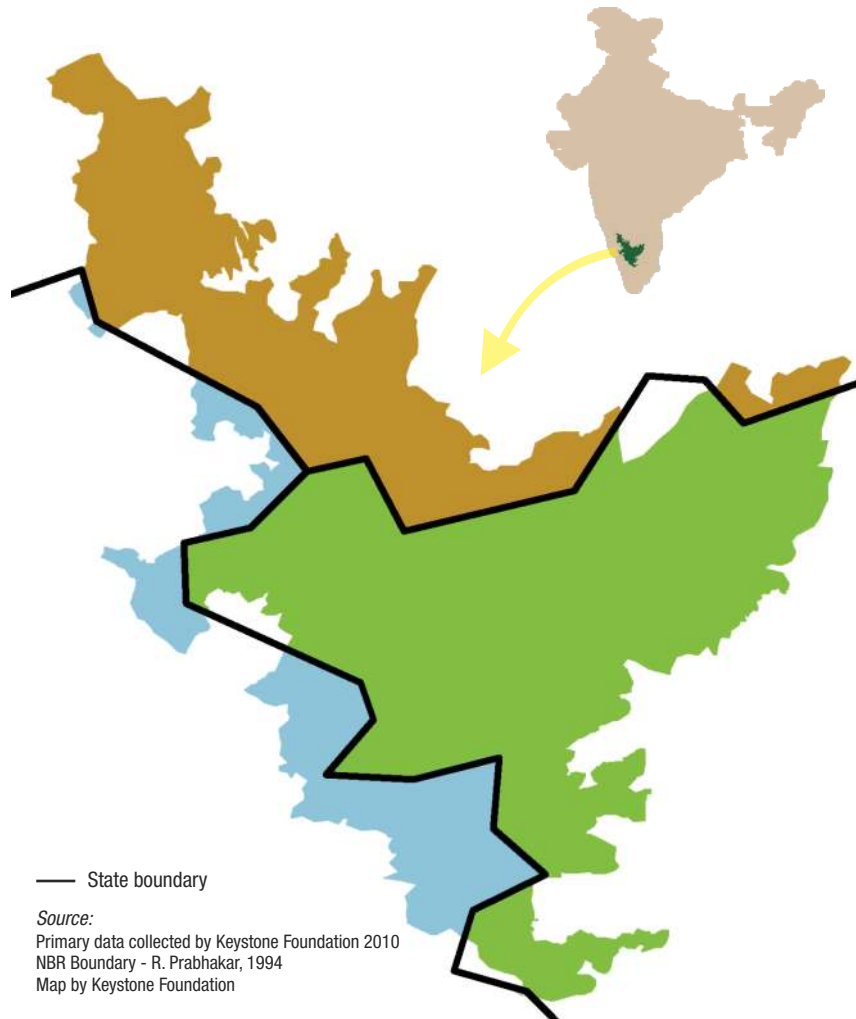
Southern slopes of NBR

**State wise distribution of the NBR:**

**TAMIL NADU**  
Nilgiris  
Coimbatore  
Erode

**KERALA**  
Palakkad  
Malappuram  
Wayanad

**KARNATAKA**  
Coorg  
Mysore



The NBR is remarkable for its endemism<sup>3</sup>- of approximately 3000 species of angiosperms (or flowering plants) known, 82 are endemic to this landscape. Amongst the 285 species of vertebrates endemic to the Western Ghats, 156 are found in the NBR.

Topographic<sup>4</sup> variation ranging from low lying valleys in the west to mountains over 2000 meters and flat elevated table land of nearly 800-1000 meters above sea level in the east has resulted in the various climatic and vegetation zones. Thus, we find in the Western Ghats, dry scrub jungles, dry and moist deciduous forests, tropical evergreen and semi evergreen forests, and montane sholas.

<sup>3</sup>Endemism: Endemism is the ecological state of being naturally unique to a particular geographic location, such as a specific island, habitat type, nation or other defined zone. Physical, climatic and biological factors can contribute to endemism. For example, the plant *Cycas circinalis*, and bird, Malabar Grey Hornbill are endemic to Western Ghats, meaning that they are exclusively found in the Western Ghats.



<sup>4</sup>Topography is the study and description of the earth's surface and features

**Blue Mountains:**

The word 'Nilgiris' is derived from two Sanskrit words; *nilam* (blue) and *giri* (a mountain). Its origin is at once apparent to those who have, at a distance, viewed the mountain, rising cool and tranquil, enveloped in the peculiar blue haze which usually shrouds them.

Presence of isoprene<sup>5</sup> in the atmosphere and the tiny molecules of oxygen and nitrogen, water and dust which interact with light and this interaction scatters blue light in all directions. Thus, the sky looks blue when we are standing far from a mountain.

The origin of the name 'Nilgiris' has also been attributed to the vast stretches of blue occasionally seen on the slopes, as a result of the masses of purple coloured *kurinji* flowers on these mountains.

<sup>5</sup>Isoprene is a colourless liquid, produced and emitted by many species of trees into the atmosphere (major producers are oaks, poplars, eucalyptus and some legumes).



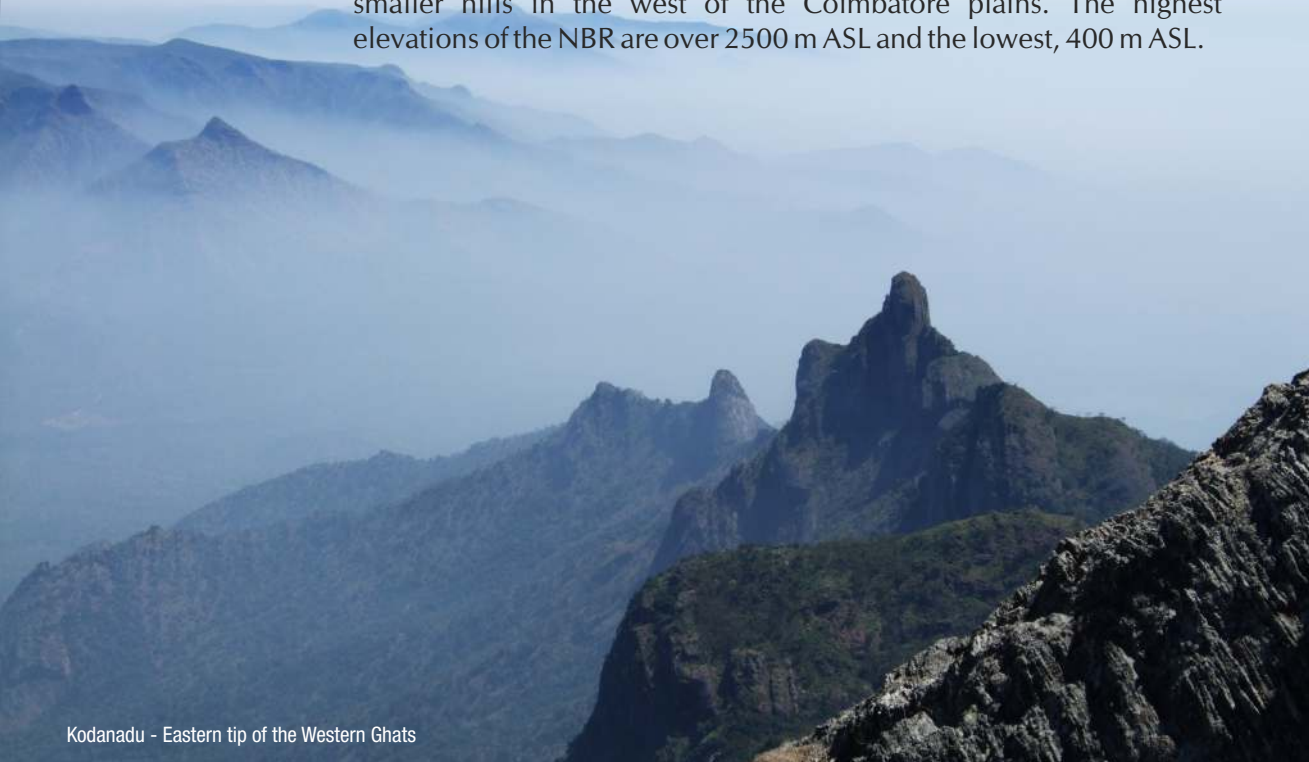
*Strobilanthes kunthiana* - Photo: TNA Perumal



Silent Valley - Photo: P.A. Vinyan

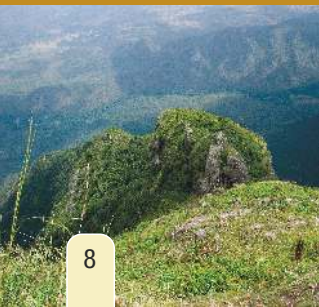
## Mountains and Valleys

The NBR is an interesting geographical landscape, which comprises a number of mountains<sup>1</sup>, peaks and valleys<sup>2</sup>. Encompassing high hills<sup>3</sup>, wide plateaus<sup>4</sup> and undulating features, NBR includes the towering Nilgiri Mountains<sup>5</sup> that extend into the north and south with a number of off-shoot ranges. The southwest slopes are steep, while on the eastern side, the slopes are relatively gentle. The northern parts of the Reserve extend into the Mysore plateau and the southern tail forms relatively smaller hills in the west of the Coimbatore plains. The highest elevations of the NBR are over 2500 m ASL and the lowest, 400 m ASL.



Kodanadu - Eastern tip of the Western Ghats

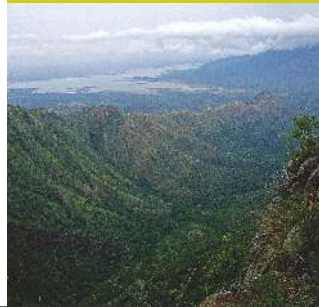
<sup>1</sup>**Mountains** are a large landform that stretch above the surrounding land in a limited area usually in the form of a peak. A mountain is generally steeper than a hill.



<sup>2</sup>**Valley** is a long depression in the surface of the land that usually contains a river.

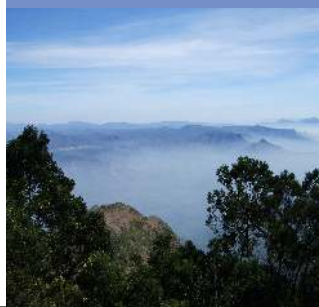


<sup>3</sup>**Hills** are generally somewhat lower and less steep than a mountain (The distinction between a hill and a mountain is unclear and largely subjective).



<sup>4</sup>**Plateau** is a relatively flat highland.

<sup>5</sup>**Nilgiri Mountains** extend in north-west-east direction along the south-western coast of India. Most of these ranges fall in Tamil Nadu, while the south-eastern slopes are part of Kerala



### Peaks:

**Rangasami Peak** is a conical peak at 1784 m ASL and is located 22 kms north-east of Kotagiri in Tamil Nadu. This is the most sacred hill to the local people of the NBR. According to legend, Lord Rangaswamy, who used to live at Karamadai in Coimbatore district, quarrelled with his wife and came here to live alone here. To the north-west of Rangaswamy Peak lies the Rangaswamy Pillar, which is an extraordinary isolated rocky pillar rising in solitary grandeur to a height of about 121 m and has sheer sides, which are difficult to climb.

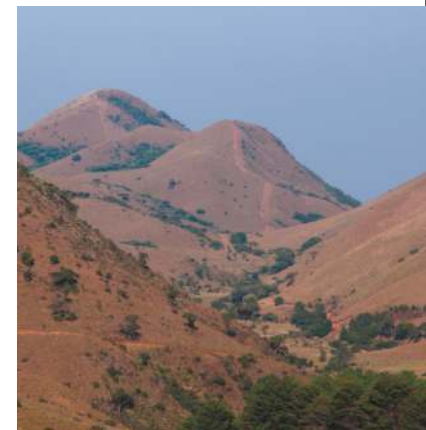


**Anginda Peak** is the highest peak of the Silent Valley region of NBR in Kerala and is situated on the northeastern corner. Anginda peak is at 2146 m ASL. The main river system is the Kunthipuzha and its tributaries, a large part of which flows through the forests.



**Nilgiri Peak** is located in the Mukurthi National Park at 2476 m ASL. This peak is the abode of the ancestral spirits of the people of the Cholanaicken tribe. Even though they are expert honey hunters, they leave the honey combs on these cliffs intact. Western slopes of these peaks, owing to their exposure to the full strength of the south-west monsoon, are thickly covered with evergreen forests. Major tributaries of the Chaliar river such as Thalipuzha, Korampuzha etc. originate from these hills.

**Doddabetta Peak** is the highest peak of the Nilgiri district at 2637m ASL and is 4 kms south-east from Ooty town in Tamil Nadu. Doddabetta (Big Mountain), is one of the major tourist attractions of the Nilgiris. The Doddabetta range which runs across the Nilgiri district plays a major role in the climate of the district; it forms a barrier against the north-east monsoon. Several streams originate from the swamps dotting the slopes of Doddabetta range.



**Gopalswamibetta Peak** is the highest peak in the Bandipur Tiger Reserve at 1451m ASL and is about 10 kms west of the national highway 67 to Mysore - Ooty.

**Mukurthi Peak** is perhaps the best known peak on the Nilgiris, at 2556m ASL. It is very noticeable owing to its curious shape, which is that of an acute-angled triangle with one side almost vertical. The peak is 27 kilometers from Udagamandalam. It is said that even in the Alps, there are no really sheer precipices of this altitude and the drop is probably nearer 1500 feet. On a clear day one can see as far as the western sea from the top. The peak is sacred to the Todas.





<sup>6</sup>Altitude is elevation especially above sea level or above the earth's surface.

### Interesting Facts:

Temperature drops with altitude<sup>6</sup>-sunlight passes easily through the clean air and heats the ground, the atmosphere then gets heated from the ground, and the atmosphere nearer to the ground becomes warmer. As warm air rises from the ground, it expands and cools. The result is colder air at higher altitudes than at the lower altitudes.

### Valleys:

Valleys have been an important place for people because of their presence close to water, good soils and food such as fish. The valleys themselves are also helpful in that valley walls often blocked winds. Once a mountain is formed it faces many onslaughts from weather. Rivers flowing through mountains carve out steep, narrow valleys that become broader and gentler as the river and its tributaries wear away the rock over time. Usually in the Nilgiris, the base of one hill is so close to that of another, that the space between them more often resembles a narrow ravine or hollow (a small valley between mountains), than a true valley.

Within the NBR human settlements, deforestation and other man-made changes have totally converted all the valleys for agriculture, mainly vegetables and tea.

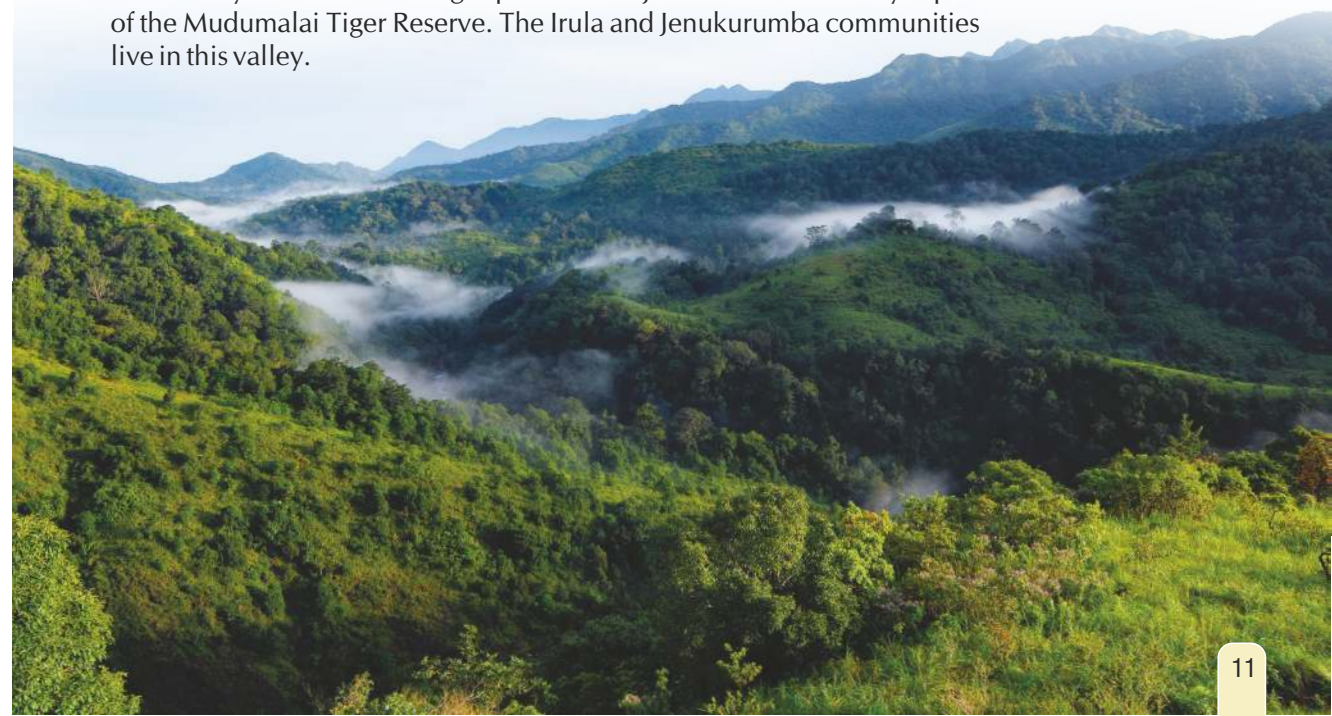
**Nilambur Valley**, also known as the New Amarambalam valley on the south western slopes of the NBR, has fairly evergreen undisturbed forests. It is an Important Bird Area (IBA) declared by Bird Life International (2009) and also harbours threatened and endemic mammals such as the Nilgiri Tahr. The lower western slopes of the valley are cleared periodically to cultivate teak trees. Streams from the natural forests of the valley feed the Karimpuzha river, one of the major tributaries of the Chaliar river. The Nilambur valley is home to the hunting-gathering indigenous community called the Cholanaicker.

**Silent Valley** is on the southern slopes of the NBR and is separated from the eastern and northern high altitude plateaus of the Nilgiri mountains by high continuous peaks. The valley gradually slopes southward down to the Palakkad plains. This valley is famous for its undisturbed tracts of montane rain forests and tropical moist evergreen forests of India. The Kuntipuzha river runs up to a 15 km length through the park from north to south, through this valley. There are several indigenous communities who live around Silent Valley such as the Mudugas, Kurumbas and Irulas.

**Ketty Valley** is a major valley along the Ooty - Coonoor highway. However, due to the extensive development of the valley in the recent years, the wild flora and fauna have declined. Agriculture and rearing livestock constitute the major activity in this valley. Nilgiri Mountain Railway (NMR), recently declared as a national heritage site by UNESCO, crosses a large extent of this valley which is home to many Badaga habitations who farm the valley intensively.

**Moyar Valley** divides the Eastern Ghats from the Western Ghats at the north eastern point of the Nilgiri mountains at the Gajalhatti pass. The Moyar river flows through the valley. Cactus plants (*Opuntia sp.*) are common here with a variety of adaptations that enable them to survive in hot and dry environments. Sigur plateau is adjacent to it. The valley is part of the Mudumalai Tiger Reserve. The Irula and Jenukurumba communities live in this valley.

<sup>7</sup>Ridge is a long narrow range of hills.

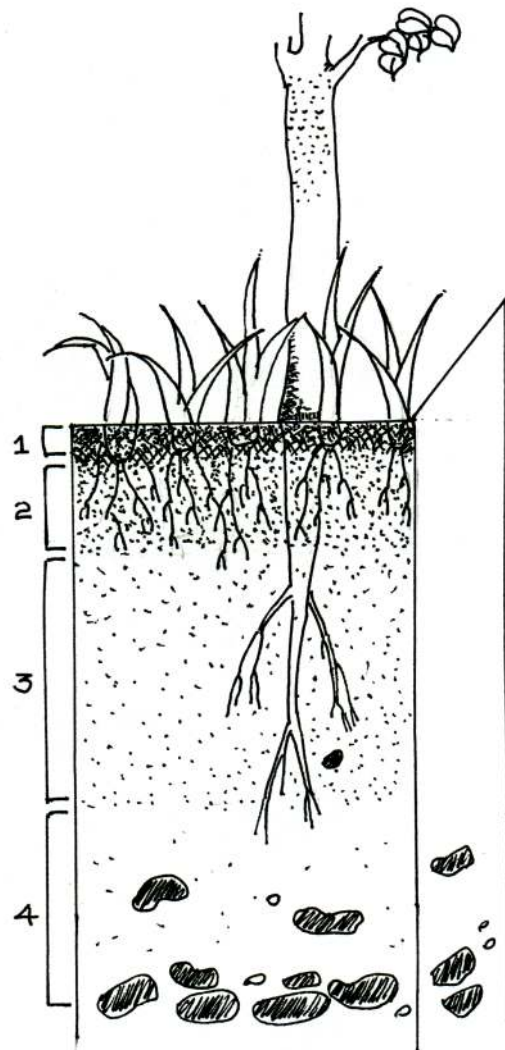




## Soils:

Rivers and mountains formed the Nilgiris many millennia ago. But one crucial ingredient to sustaining life on this biosphere is soil. Topsoil which is 15 to 25 centimeters (6 to 10 inches) of the earth's surface in which nearly all plants grow—is a complex mixture of weathered mineral materials from rocks, partially decomposed organic matter, and a large number of living organisms.

With proper management, topsoil can be kept fertile and productive, indefinitely. Unfortunately, many agricultural techniques lead to the removal of trees and shrubs. The canopy of trees create shade and retain moisture thereby protecting the soil, whereas the roots of shrubs and other plants bind the soil and keep it in place. The removal of such plants result in soil erosion by wind and water. Therefore by conserving trees, shrubs and other vegetation in its natural state, we also conserve soil and water.



### Soils Layer

- 1) Organic matter: Litter layer of plant residues in relatively undecomposed form.
- 2) Surface soil: Layer of mineral soil with most organic matter accumulation and soil life.
- 3) Subsoil: This layer accumulates iron, clay, aluminum and organic compounds
- 4) Parent rock: Layer of large unbroken rocks. This layer may accumulate the more soluble compounds.

Soils are classified based on various properties such as texture, structure, organic matter and moisture. There are six main types of soil in the NBR.



**Alluvial Soil** – This type of soil is deposited by water flowing over flood plains or in river beds. The fine-grained and fertile soils mostly contain a fair amount of potash, phosphoric acid and nitrogen which are ideal for the growth of vegetable and cereal crops.



**Sandy Soil** – This soil consists mostly of sand, and hence is called sandy soil. The most common constituent of sandy soil is silica. The composition of sand is highly variable, depending on the local rock sources and conditions. This is less fertile compared to alluvial soil. Sandy soils are ideal for crops such as watermelons and peanuts, and their excellent drainage characteristics make them suitable for intensive dairy farming.



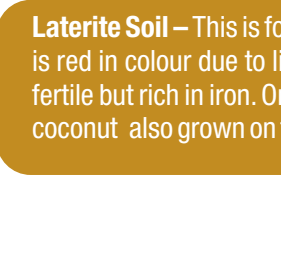
**Mountain Soil** – This soil consists mostly of gravel and stone, and is formed by the deposition of organic matter from the forest. Though this soil is rich in humus, it is poor in potash and lime. Fertility is less compared to alluvial soil. This soil is good for crops like tea, coffee and spices.



**Black Soil** - This is also called Regur Soil (a rich black soil of India). This soil is made by volcanic lava and contains many minerals. This type of soil is rich in iron, lime, calcium, magnesium and alumina. It is poor in phosphorus and organic matters but it is good for the cultivation of cotton, rice and sugar cane.



**Red Soil** - This soil is red because this generally forms from sedimentary rock and contains more sand and less clay. It is low in nutrients, humus and difficult to cultivate. But people cultivate ragi and other millet, potato, rice and sugarcane in this soil.



**Laterite Soil** – This is formed by the process of leaching during heavy rainfall. It is red in colour due to little clay and much gravel of red sand-stones. It is less fertile but rich in iron. Only grass grows on it in abundance but rubber trees and coconut also grown on this type of soil.



## Water

### NBR – A watershed

The NBR being a mountain region has a number of watersheds<sup>1</sup> and wetlands in the upper areas which are very important for both upland and downstream communities. While some springs also exist on the slopes, most of the perennial water bodies originate from the upper areas. Everyone in the region of a watershed is part of the community - animals, birds, plants, insects, fish, and people. The activities of these communities influence the watershed; any change in the smaller watersheds can also affect the larger watershed and can change the landscape itself.

River conservation strives to maintain two things: the quantity of water and the quality of the rivers and of everything else that forms part of the river system. There is a need to preserve watersheds and prevent their destruction due to unplanned urban development, construction and indiscriminate cultivation.

<sup>1</sup>**Watershed** is the entire geographical area drained by a river and its tributaries.



Karimpuzha river at south Nilambur

**Pykara River** originates in the Mukurthi peak and passes through a hilly tract, generally keeping to the north and turns to the west after reaching the Nilgiri plateau's edge. There are a number of falls formed by this river, and the last two falls of 55 meters and 61 meters respectively, are known as Pykara falls. After reaching Wayanad, this river turns westward and has a fall near Theppakadu, off the Gudalur-Mysore road. From here, this river is known as the Moyar River and continues its journey towards the east, where it joins the Bhavani River at Denaickankottai. Finally this river ends at the Bhavanisagar dam<sup>2</sup>. Pykara is the largest river in the Nilgiris District. It is of sacred value to the Toda community.

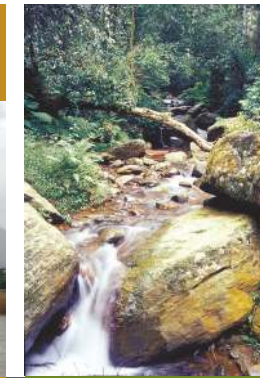
**Sigur River** springs up from the Udthagamandalam slopes. Two streams the Malkod from Pykara Hill and the Billikallu halla<sup>3</sup> from Billikal betta join to form this river. After a point it is joined by Sandy Nallah<sup>3</sup> stream, flowing towards Kalhatti, which is about 9 kms north-west of Udthagamandalam. Here it drops 52 m and forms a beautiful waterfall (Kalhatti water falls), after which it flows along the Sigur Ghat and finally joins the Moyar River.

**Bhavani River** rises in the Upper Nilgiri plateau, drains the Attapadi valley in Kerala, collects the waters of the Kundah river and flowing past Mettupalayam joins Moyar river at Bhavanisagar. Further on it reaches Cauveri river at Bhavani town after a 217 km flow. About 90% of the river's water is used for agriculture. Pesticides from the tea estates of the



Drainage of Bhavani river

<sup>2</sup>**Dam**- a barrier constructed to contain the flow of water.



<sup>3</sup>**Halla/ Nallah** is used to refer to streams, in local parlance

<sup>4</sup>**Tributary** is a branch of stream that flows into the main stream or river.



Nilgiris District seep into the Bhavani. It is estimated that tea estates and coffee pulp houses add about 1.5 million litres per day (MLD) of effluents to the river every day.

**Pandiar River** originates in the grasslands on the northern slopes of the Mukurthi National Park and joins with the Punnapuzha river, a tributary of Karimpuzha. This is one of the last free flowing rivers of South India which has not been dammed.

**Karimpuzha River** originates from the western slopes of the NBR, near the Mukurthi Peak. Cherupuzha river, which joins the Karimpuzha near Karulai, originates from the forests to the north-west of Upper Bhavani reservoir. This river is the largest tributary<sup>4</sup> of the Chaliyar (Beyppore river). The Karimpuzha joins the Chaliyar at Chaliyar mukku, near Nilambur town in Kerala and flows west to join the Arabian Sea. This river is famous for its freshwater fish species diversity. Important endemic fish, such as the *Tor malabaricus* and *Glyptothorax annandalei* have been described from this river.

**Siruvani River** originates from the Siruvani Hills and is one of the tributaries of the Bhavani. The Siruvani waterfalls and the dam named after it are located 37 kms to the west of Coimbatore. Water from the Siruvani river is renowned for its taste and mineral properties and is one of the main water sources for Coimbatore city.



Drainage of Chaliyar river



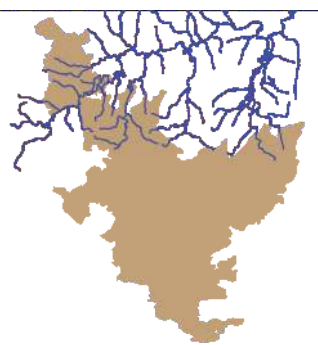
Pillur reservoir



Siruvani river

**Coonor River** originates from the south eastern slopes of Doddabetta range and collecting waters from streams in and around Wellington, flows through Coonor ghats to feed the Bhavani river at Nellithorai near Mettupalayam. The Kallar river collecting waters from the Catherine Falls (76m) below Kotagiri on its westward flow meets at the same confluence.

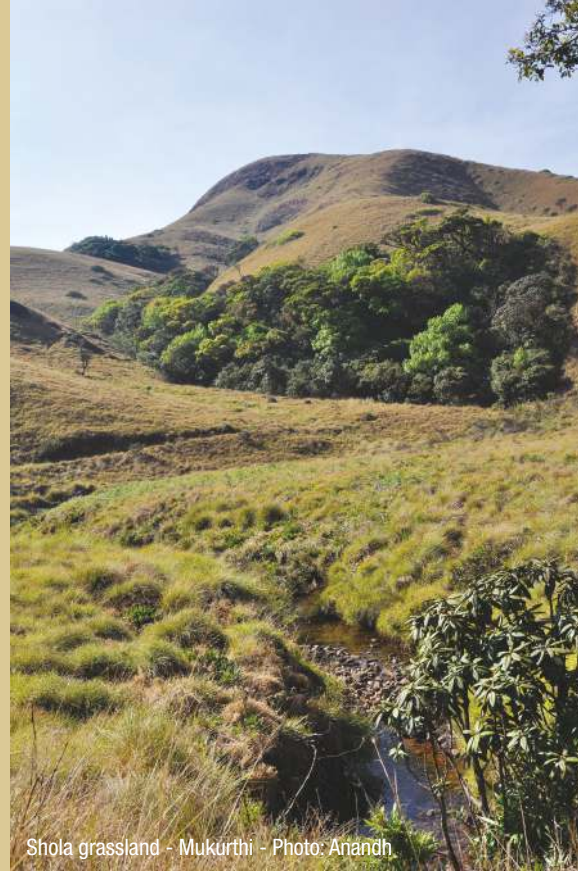
**Kabini River** is a confluence of the Panamaram river (originating from Lakkidi Hills, Kerala) and Mananthavady river (originating from Tondarmudi hills, Kerala). After flowing through Mananthavady town, the Mananthavady river joins the Panamaram river near Payyampally. Two kilometers from Payyampally, the Kabani River forms an island called Kuruva Island, spreading over 950 acres containing diverse and unique flora and fauna. Downstream from the island, another tributary of the Kabini River, called the Kalindi, joins it. The Kabani flows through Kerala only for a stretch of 8 kms and turns eastward to join the Cauvery river at Tirumakudal in Narasipur, Karnataka. The Cauvery finally empties into the Bay of Bengal.



Drainage of Kabini river

## How do rivers form?

All the rivers in the NBR start their journey from mountain sholas, grasslands or wetlands. Fairly good rainfall in the region accounts for the countless small brooks which run for some distance but get absorbed by the top soil of the slopes, before they gain enough strength to flow further. These brooks become rivers and provide our drinking water, nourish our agriculture, and support many endangered species. While each river is unique, all rivers are part of larger systems, and have common characteristics that enable us to understand how they function and how to protect them.



Shola grassland - Mukurthi - Photo: Anandh

Shola forest - Photo: Anandh



## Watersheds

A watershed receives water from rain and in turn discharges in to streams, wetlands, ponds, and lakes. Streams form from small watersheds of their own, and also form part of the larger watershed region of the river they drain into. Large watersheds are sometimes referred to as river basins. Some amount of the rain water returns to the atmosphere by evaporation from the leaves of plants. The remaining rain water eventually makes its way to drainage systems such as rivers and streams. E.g. Mainala water shed between south east Doddabetta slopes and Coonoor.

## Do you know rivers also become older?

These are some of the terms that limnologists (scientists who study fresh water) use...

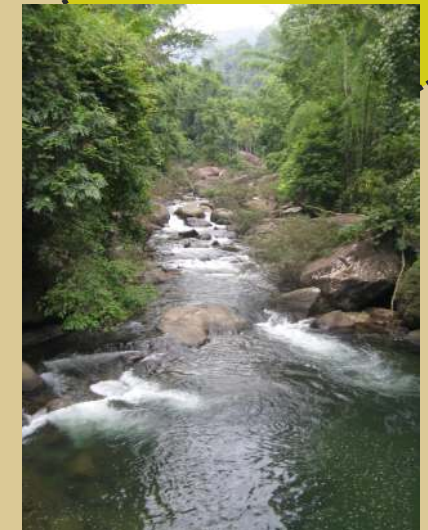
### Youthful River

A river with a steep gradient that has very few tributaries and flows quickly. Its channels erode deeper rather than wider.



### Mature River

A river with a gradient that is less steep than those of youthful rivers and flows more slowly. A mature river is fed by many tributaries and has more discharge than a youthful river. Its channels erode wider rather than deeper.



### Old River

A river with a low gradient and low erosive energy. Old rivers are characterised by flood plains.



## Lakes



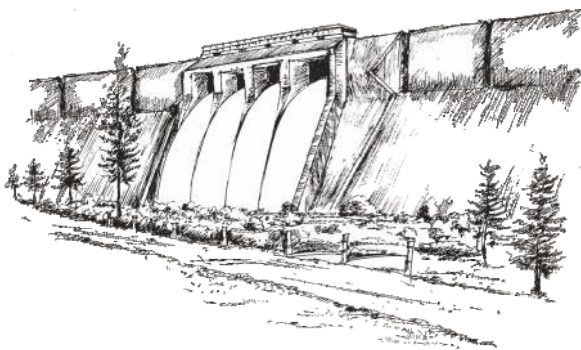
Lake close to Chembra peak, Waynad

Lakes are generally known as a body of (usually fresh) water surrounded by land. The streams of the Nilgiri district in many places exhaust themselves by forming quiet pools or lakes, whenever they do not gain enough strength to search for lower country to flow towards. The Mukurthi Lake, west of Udthagamandalam is enriched by the Mukurthi river and streams of the Parson's Valley. Pookot Lake in Waynad District, Kerala is a natural fresh water lake, surrounded by evergreen forests.

## Dams

Rivers in the NBR are dammed at many places to generate electricity and to supply water for drinking and irrigation. Reservoirs held behind dams affect many ecological aspects of a river. Dams do not allow fish to move up stream to their natural breeding grounds, causing failure of breeding cycles or blocking of migration paths. A large dam can cause the loss of entire ecospheres, submerging forests and destroying endangered and undiscovered species in the area. Dams also replace the original habitat by a new inland lake. Large reservoirs formed behind dams have been associated with earthquakes<sup>6</sup>, due to changes in water load and/or the height of the water table.

The Kundah and Pykara hydro-electric projects in the Nilgiris generate approximately 40% of the electricity needs of the state of Tamil Nadu.



## The NBR has a series of dams and some of them are mentioned below:

**Bhavani Sagar Dam** is constructed across the Bhavani river. It is also called the Lower Bhavani Dam, and is situated between Sathyamangalam and Mettupalayam in Tamil Nadu.

**Siruvani Dam** is constructed across the Siruvani river to meet the drinking water requirements of Coimbatore city. The dam is situated to the west of Coimbatore at a distance of about 45 kms, and north of Palakkad Gap in Kerala.

**Pillur Dam** is constructed across the Bhavani river to generate electricity and after generating power, flows into Bhavani river. This dam is situated 79 kms to the north-west of Coimbatore and supplies drinking water to the city.

**Banasura Sagar Dam** is built across Karamanathodu river, a tributary of the Kabini river. The dam supports the Kakkayam hydroelectricity<sup>7</sup> power project. It is a large earthen dam and the second largest in Asia. This dam is located 21 kms from Kalpetta in Kerala.



<sup>6</sup>**Earthquake** is the shaking and vibration at the surface of the earth resulting from underground movement along a crack in the earth's crust.

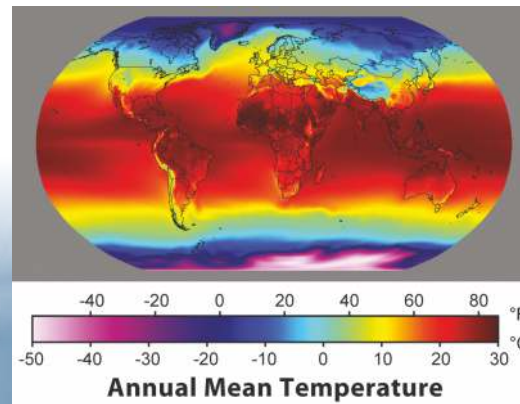
<sup>7</sup>**Hydroelectricity** refers to electricity produced gravitational force of falling or flowing water.



## Climate

A characteristic of all mountains areas is the vast dissimilarities between different parts of the region. Climate is one such variable. Interconnections between topography<sup>1</sup>, climate, and ecosystems make the NBR a very interesting area for scientists (especially meteorologists<sup>2</sup>).

The effects of topography on the climate of any given region are powerful. Mountains and plateaus are exposed to the cooler temperatures of higher altitudes. Mountains in the NBR play an important role in precipitation<sup>3</sup> patterns. The climate of an area determines a region's animal and plant life. Figuring out the climate of a location requires quantifying the weather<sup>4</sup> data over a period of decades, and averaging the results. Over a long period of time a region's characteristic weather is called its climate. When meteorologists report the weather conditions (temperature, humidity<sup>5</sup>, precipitation), their report covers the conditions present at a specific time and location. At the equatorial (the imaginary horizontal line across middle of the Earth) zones, the rays of the sun are more concentrated and the temperatures are higher. These high temperatures cause high evaporation<sup>6</sup>, which result in high rainfall. This is the reason why most of the rainforests are located around the equatorial zones. NBR is also located within the equatorial zone.



<sup>1</sup>Topography is a precise, detailed study of the surface features of a region.

<sup>2</sup>Meteorologists are specialists who study processes in the earth's atmosphere

<sup>3</sup>Precipitation or rain is the quantity of water falling to earth at a specific place within a specified period of time

<sup>4</sup>Weather is the state of the atmosphere in terms of temperature, wind, clouds and precipitation

<sup>5</sup>Humidity is the wetness in the atmosphere

<sup>6</sup>Evaporation is the process of a liquid becoming a vapour

### Rain:

Topographic barriers such as mountains and hills, force prevailing winds up and over their slopes. As air rises, it also cools. Cooler air is capable of holding less water vapour<sup>7</sup> than warmer air. As air cools, this water vapor is forced to condense, depositing rain on the windward<sup>8</sup> slopes. Mountains and valleys on the western slopes like Silent Valley and New Amarambalam valley of the NBR, trap monsoon clouds travelling from the Arabian Sea, whereas it might have passed unobstructed to the north-east and reached places like Sigur plateau, Pillur or Punanjanur. These eastern slopes are examples of rain shadow areas, which are on the leeward<sup>9</sup> (protected) sides where the air contains very little moisture to cause rain.

In the NBR, the summer season is from March to May; June to September is the south-west monsoon while October and November constitute the post-monsoon or the retreating north-east monsoon season. The western part of the Nilgiri hills receives its principal precipitation from the south-west monsoon, while the eastern part obtains the bulk of its rainfall from the retreating north-east monsoon. During the period December to March, skies are generally lightly clouded or mainly clear. On individual days during the winter the water temperature goes below freezing point at many places and frost<sup>10</sup> occurs. Clouding increases after March. During the period June to November, the skies are heavily clouded or overcast.

<sup>7</sup>Water vapour is the gas phase of water generated by evaporation and removed by condensation

<sup>8</sup>Windward is the direction from which the wind is coming

<sup>9</sup>Leeward is the side of a place that is sheltered from the wind

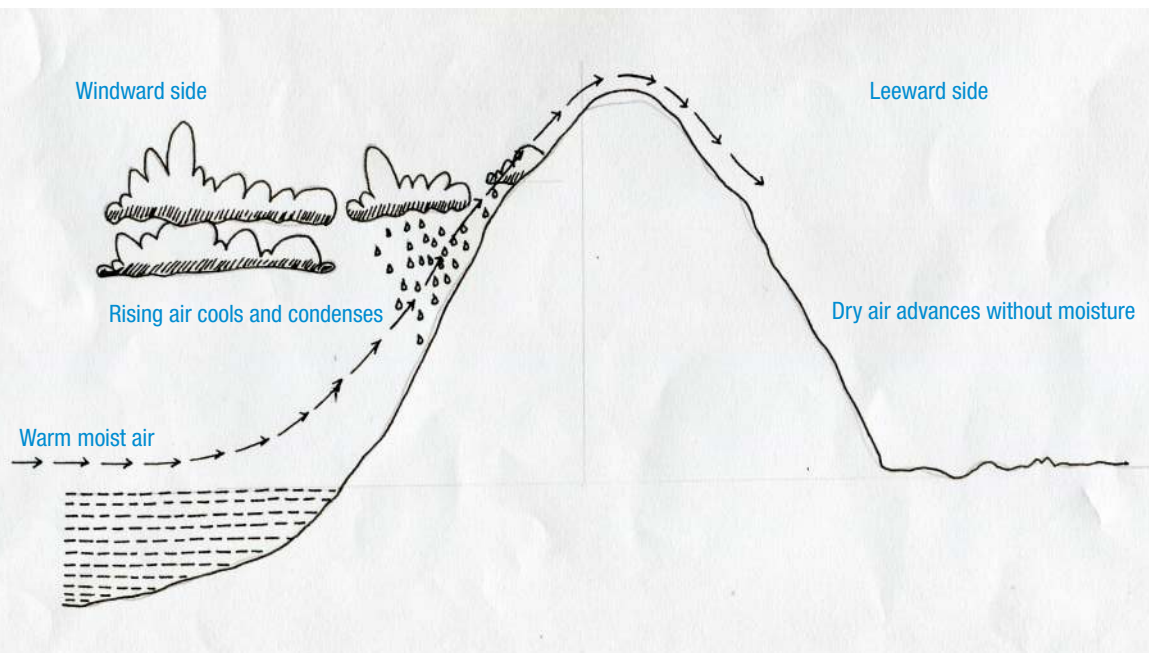
<sup>10</sup>Frost is the solid deposition of water vapour from saturated air. It is formed when solid surfaces are cooled to below the dew point of the adjacent air as well as below the freezing point of water.

**Average rainfall (mm) in 2008 from different stations of the NBR:**

Months	Windward (Nilambur)	Leeward (Sigur)
Jan	0	0
Feb	0	111
Mar	380.2	249
Apr	34.9	0
May	145.4	6.31
June	569.9	14
July	436.8	3.85
August	530	10.74
September	582.5	129
October	319.2	100.92
November	20.1	41.4
December	0	0
<b>Total</b>	<b>3019</b>	<b>666.22</b>

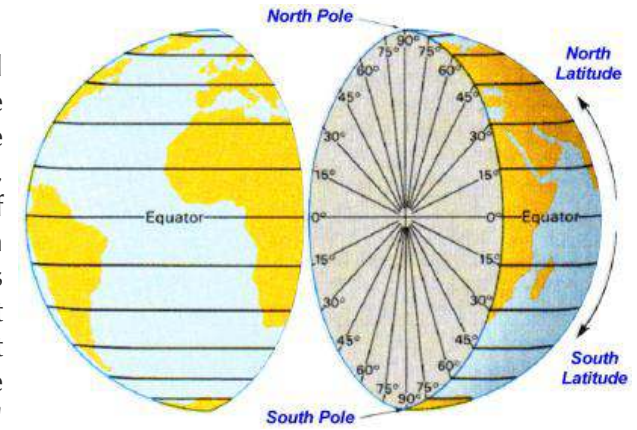


**Role of mountains in rainfall**



**Climate and Latitude :**

Lines of latitude are imaginary lines that tell how far north or south a place is from the Equator<sup>11</sup>. Zero degree is the location of the Equator. Latitude is measured in degrees, minutes, and seconds. Measurements of latitude range from equator 0° to 90° north and south from this point. Latitude is probably the single most important determining factor in climate because it determines the intensity and duration of the sun's exposure. NBR is located at 100° 45' to 120° 5' north latitude from the Equator.



Source: <http://geographyworldonline.com/tutorial/lesson1.html>

When an area is closer to the sun the days are longer and the sun's rays are stronger. And the tilted axis of the Earth also causes seasonal variation in temperature.

**Wind and Monsoon:**

Wind has a very important role in aiding plants and other immobile organisms in dispersal of seeds, spores, pollen, etc. Clouds formed with the moisture from ocean, seas or other water bodies also move with the help of the wind. Monsoon is a seasonal wind that lasts for several months within tropical regions. This wind comes from the southwest (from the Indian Ocean and Arabian Sea) bringing heavy rainfall to the NBR and other parts of India. Monsoon brings 80% of the rainfall in India. However because of the hilly terrain with its varied ridges and valleys, wind directions may differ widely at different places.



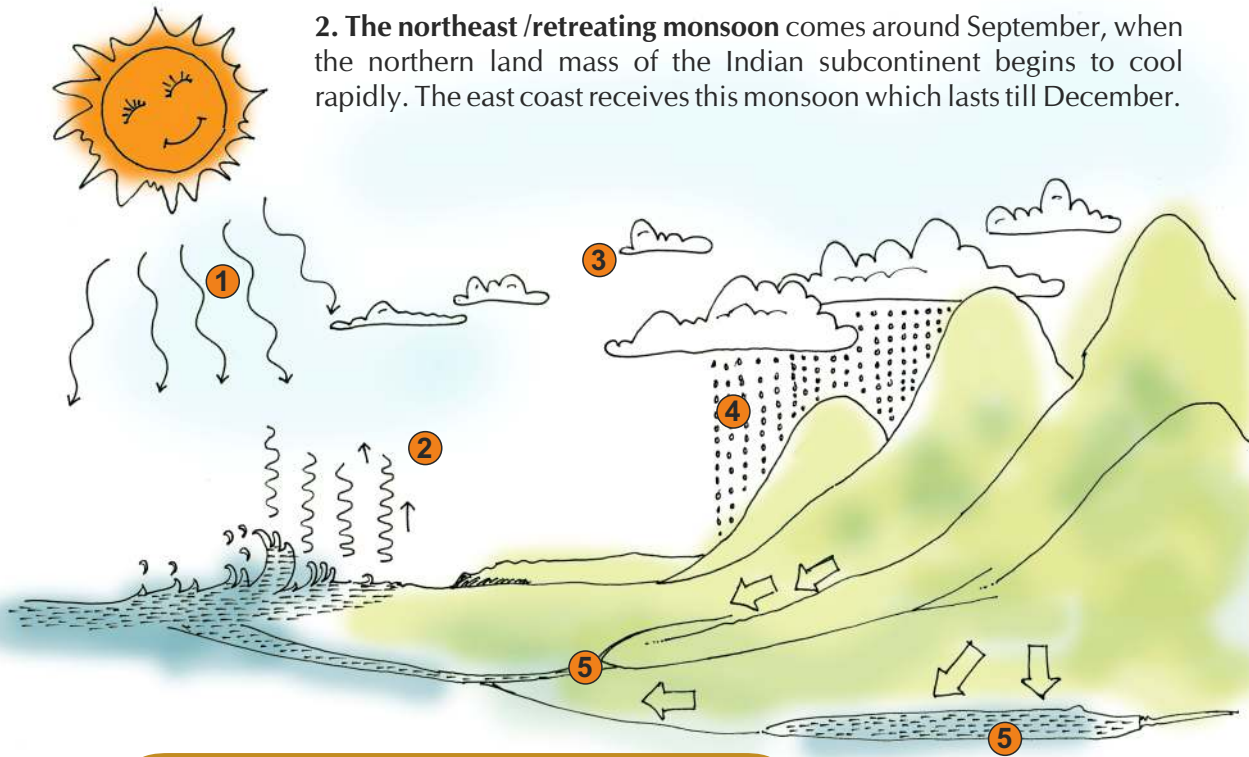
<sup>11</sup>Equator is an imaginary line around the Earth forming the great circle that is equidistant from the north and south poles

## Water cycle:

For a thousand years or more, Arab sailing vessels have relied on the south-west monsoon winds, called the 'trade winds', to sail across the Arabian Sea to India, and return with fresh cargo on the winds of the north-east monsoon. It is not surprising that the word 'monsoon' derives from the Arabic word 'mausim', meaning 'season'. The monsoons, which help balance global temperatures and sustain life on earth, affects a vast area of the globe - from Africa across Asia to the Pacific; northern China and the Himalayas to north Australia; and even Mexico and parts of Central America - directly influencing the lives of over half the world's population. In India, 50% of the arable land is irrigated solely by monsoon rains. There are two Indian monsoons-

1. **The southwest monsoon** begins around the start of June, when moisture laden winds reach the southern most point of the Indian Peninsula and fades towards the end of September. The west coast receives the bulk of this monsoon.

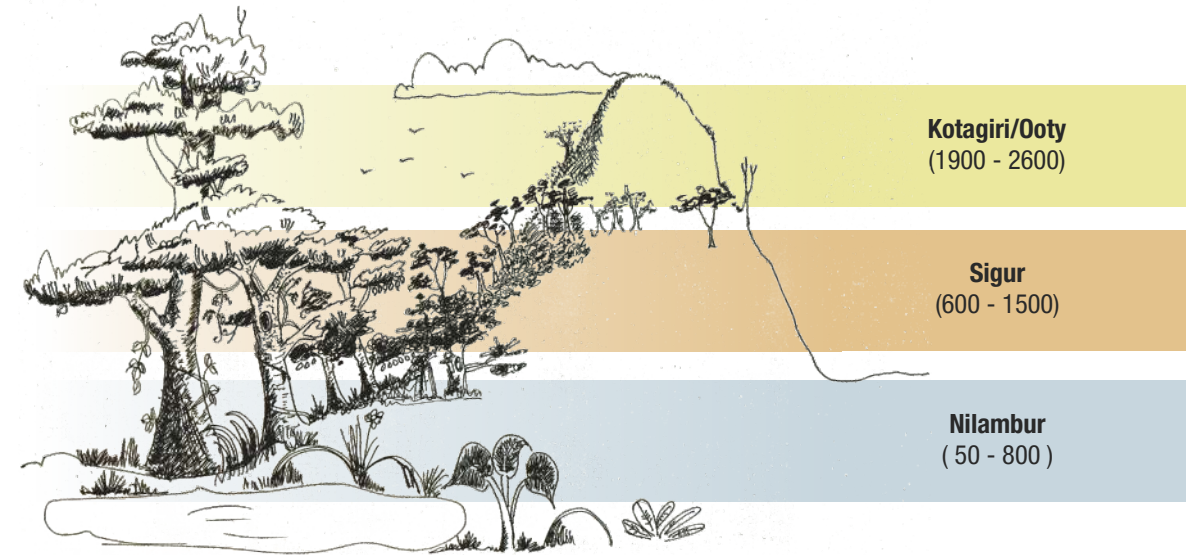
2. **The northeast /retreating monsoon** comes around September, when the northern land mass of the Indian subcontinent begins to cool rapidly. The east coast receives this monsoon which lasts till December.



### Water cycle

1. The sun heats the ocean
2. Ocean water evaporates and rises into the air
3. The water vapor cools and condenses to become droplets, which form clouds
4. If enough water condenses, the droplets become heavy enough to fall to the ground as rain
5. Some rain collects in wells, lakes and pond etc. The rest flows through rivers back into the ocean

## Altitude and plant distribution:



Plant life is influenced by altitude. Above a certain altitude, trees become smaller and scattered, growth becomes stunted or distorted and leaves are smaller, because, as the altitude increases, the amount of carbon dioxide (which is essential to the survival of all plant life) also decreases. Only grasses, a few hardy wild flowers, lichens and moss will venture beyond this point, called the 'tree line' and into the grassland region.



**Environmental Lapse Rate (ELR)** - the decrease in temperature with the increase in altitude is called the Environmental Lapse Rate (ELR) in the stationary atmosphere at a given time and location. According to the International Civil Aviation Organization, the average temperature lapse rate is of 6.49°C/1000 m ASL to 11000 m ASL.

## Why is their dew on the grass in the morning?

As we all know, it is generally warmer during the day than it is at night. During the day when it is warm, water evaporates into the air and the amount of water the air can hold depends on how warm the temperature is. At night as the temperature cools, the moisture which evaporated during the day is still in the air, but the air is no longer warm enough to be able to hold as much moisture as it could during the warmer day. As a result, the water begins to condense on the cooling ground or grass. In other words it comes out of the air forming dew. When the temperature warms up again in the morning the air can contain the water again and the dew evaporates back into the air.







*Cycas circinalis* in the semi evergreen forests of Nilambur

## Biodiversity

There are many regions with cultural and biological diversity. These places, though uniquely identifiable for their individuality can still be grouped together based on certain common physical and social linkages. This section studies the divisions of the NBR, an unquestionable store house of natural wealth, the region is an unmatched biodiversity hotspot.



### Micro regions of NBR:

Micro regions	Altitude Range (meter)	States	Indigenous Communities	Forest types
Chamarajnagar/ Sathyamangalam	1000-1200	Karnataka & Tamil Nadu	Sholiga, Irula and Badaga	Moist deciduous, Shola and Dry deciduous forests
Coonoor	500- 1400	Tamil Nadu	Kurumba and Irula	Shola, Semi-evergreen, Moist deciduous and Dry deciduous forests
Kotagiri	1800-1400	Tamil Nadu	Toda, Kota and Badaga	Shola and Grasslands
Mudumalai/Sigur	900	Tamil Nadu	Kattunaicken, Irula and Jenu Kurumba	Moist deciduous, Dry deciduous, Scrub and Riverine
Nilambur/ New Amarambalam	60- 1200	Kerala	Cholanaicken, Kattunaicken, Paniya and Aranadan	Evergreen, Semi-evergreen, Moist deciduous, Riverine forests, and Plantations
Silent valley and Attapady	658- 2383	Kerala	Kurumba and Irula	Evergreen, Shola grasslands, and Riverine forest
Waynad	650-1150	Kerala	Mullukuruma, Adiya, Kurichya, and Paniya,	Moist deciduous, Semi-evergreen forests and Plantations.
Nagarhole	800-850	Karnataka	Jenu Kurumba, and Koraga	Dry deciduous, Moist deciduous, Swamp forests, and Plantations
Bandipur	680- 1454	Karnataka	Jenu Kurumba, Betta Kurumba, Yerava and Sholiga	Dry deciduous, Moist deciduous, and Scrub forest.



### Forest types of the NBR:

The forests of the NBR are very rich in plant diversity, of about 3,200 species of flowering plants found here, 132 are endemic to the reserve. Of the 175 species of orchids found in the NBR, 8 are endemic. This plant diversity is threatened by many factors like changing land use patterns, climate changes and encroachment by exotic & invasive plants.

#### Forest type

#### Micro Region

**Shola montane**-The trees in this forest type are short (7-20 m) have small dense leaves that form a thick canopy. There are thick concentrations of mosses<sup>1</sup>, ferns<sup>2</sup> and epiphytes<sup>3</sup> in these forests. These forests are referred to as “living fossils”(home for many of the ancient species that trace back to the Gondwana land). The average rainfall is around 1000-1200 mm, and the mean temperature is not higher than 21°C.

- Chamarajnaragar/ Sathyamangalam,
- Coonoor
- Kotagiri,
- Silent Valley
- Nilambur/New Amarambalam

**Grassland**- Located above the treeline, where harsh, windy conditions exist and poor soils create dwarfed and twisted forests of montane shola and grasslands. They are home to many distinctive and endemic plants which evolved in response to the cool, wet climate and abundant tropical sunlight. These forests are located at an altitude of 1500-2000m ASL. This region experiences rainfall that varies from 800 mm – 1500 mm and mean temperature is higher than 20°C.

- Kotagiri
- Silent valley
- Chamarajnaragar/ Sathyamangalam,
- Coonoor
- Nilambur/New Amarambalam

**Evergreen**- These forests are characterized by giant trees, which can grow up to 45 m or more and are often supported by huge buttresses. Grasses are almost entirely absent from the forest floor; those that grow there have broad leaves. The annual rainfall is more than 2000 mm and the mean temperature is higher than 15°C throughout the year.

- Nilambur/New Amarambalam
- Silent valley

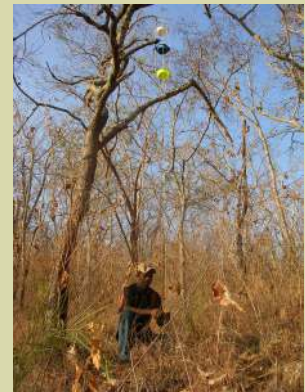
**Semi-evergreen**- These forests are moist and occur as a transition zone between the evergreen and moist deciduous forests. They could be degraded forests in the process of becoming evergreen forests or degraded forms of evergreen forests. The annual rainfall is more than 1800 mm and the mean temperature is higher than 15°C throughout the year.

- Nilambur/New Amarambalam and
- Coonoor
- Waynad
- Chamarajnaragar/ Sathyamangalam



**Dry deciduous**- In these forests during the dry season a leafless period occurs to prevent loss of moisture through leaves. Though less biologically diverse than rainforests, these dry forests are home to a diversity of wildlife. Dry forests are highly sensitive to forest fire and deforestation. The annual rainfall is around 1300 mm, and the mean temperature will be around 22°C.

- Mudumalai/Sigur,
- Coonoor
- Chamarajnaragar/ Sathyamangalam
- Nagarhole
- Bandipur



**Moist deciduous**- The trees in these forests have broad trunks and are tall. Some of the taller trees shed their leaves in the dry season. The under growth includes many evergreen shrubs and small trees with a height of 25-30 meters. Buttress trees, woody climbers and dense undergrowth are common. The annual rainfall is around 3000 mm, and the mean temperature is around 29°C.

- Mudumalai/Sigur,
- Coonoor,
- Nilambur Chamarajnaragar /Sathyamangalam
- Attapadi
- Waynad
- Nagarhole
- Bandipur



Dry thorn forests and savanna woodlands are found at the lower elevations especially in the northern part of the NBR. Riverine forests can be found along rivers and have plants that are adapted to periodic flooding.



<sup>2</sup>Moss is a leafy-stemmed flowerless and seedless non vascular plant.

<sup>3</sup>Ferns are flowerless and seedless vascular plants having true roots from a rhizome and fronds that uncurl upward.

<sup>4</sup>Epiphytes are plants that derive moisture and nutrients from the air and rain; usually growing on another plant but not parasitic on it.



Gaur



Nilgiri Tahr

Together the NBR has more than eight different forest type which shelters a large diversity of animals too. Fauna<sup>4</sup> of the NBR includes over 100 species of mammals, 350 species of birds, 60 species of reptiles<sup>5</sup>; about 39 species of fish, 31 amphibians, 330 species of butterflies and innumerable invertebrates.

<sup>4</sup>Fauna is all of the animal life of any particular region

<sup>5</sup>Reptiles are any cold-blooded animals for example tortoises, turtles, snakes, lizards, alligators, crocodiles etc

**Mammals-**

The NBR is home to 100 species of mammals such as tiger, leopard, Asian elephant, Nilgiri tahr, and Indian gaur. A mouse species, *Mus famulus*, is the only recorded endemic mammal of the NBR.



Indian gaur (*Bos gaurus*) is generally misnamed as bison. The gaur appears to be the tallest of all the oxen, with old bulls sometimes reaching as much as 6 feet at their shoulder, while the cows do not exceed 5 feet. Gaurs prefer hilly areas to plains, herd sizes range from 12 to 30. Each herd is led by an old bull. Solitary gaurs are always very old bulls, which have been driven from the herds by their younger rivals. Their food mainly consists of grass, leaves, bark of certain trees and bamboo shoots.



Sambar deer

**Human Wildlife Conflict:**

Due to indiscriminate land use and allocation of revenue/private land in the middle of forest areas, there is a high incidence of human-wildlife conflict in the NBR. This is mainly related to large mammals like elephant, deer, leopard, tiger, wild boar etc. Mega herbivores<sup>6</sup> like elephant, with a large home range and equally large food requirement has been among the most affected species.

**Some reasons for conflicts are-**

- Habitat fragmentation<sup>7</sup> caused by human activity like reservoirs for irrigation and electricity generation,
- Conversion of natural vegetation to tea, coffee, and cardamom estates and forest plantations

**Ornithology** is a branch of zoology that is concerned with the study of birds. In the NBR there are about 350 species of birds of which only one is endemic to the NBR, Nilgiri Laughingthrush (*Trochalopteron cachinnans*).



Nilgiri Laughingthrush - Photo: Sandeep

<sup>6</sup>Herbivores are animals that feed chiefly on grass and other plants

<sup>7</sup>Habitat fragmentation is the breaking up or separation of the environment in which an organisms lives

**Reptiles-**

Reptiles in general, but specifically snakes, have always fascinated and terrified us from the first light of time. Scientific study about snakes is known as Herpetology. In general, this is the branch of zoology concerned with the study of amphibians (including frogs, toads etc.) and reptiles (including snakes, lizards, turtles, tortoises and crocodilians). NBR is home to 60 species of reptiles and 7 of them are endemic to the area.



Roux's Forest Lizard  
Photo: Vinayan

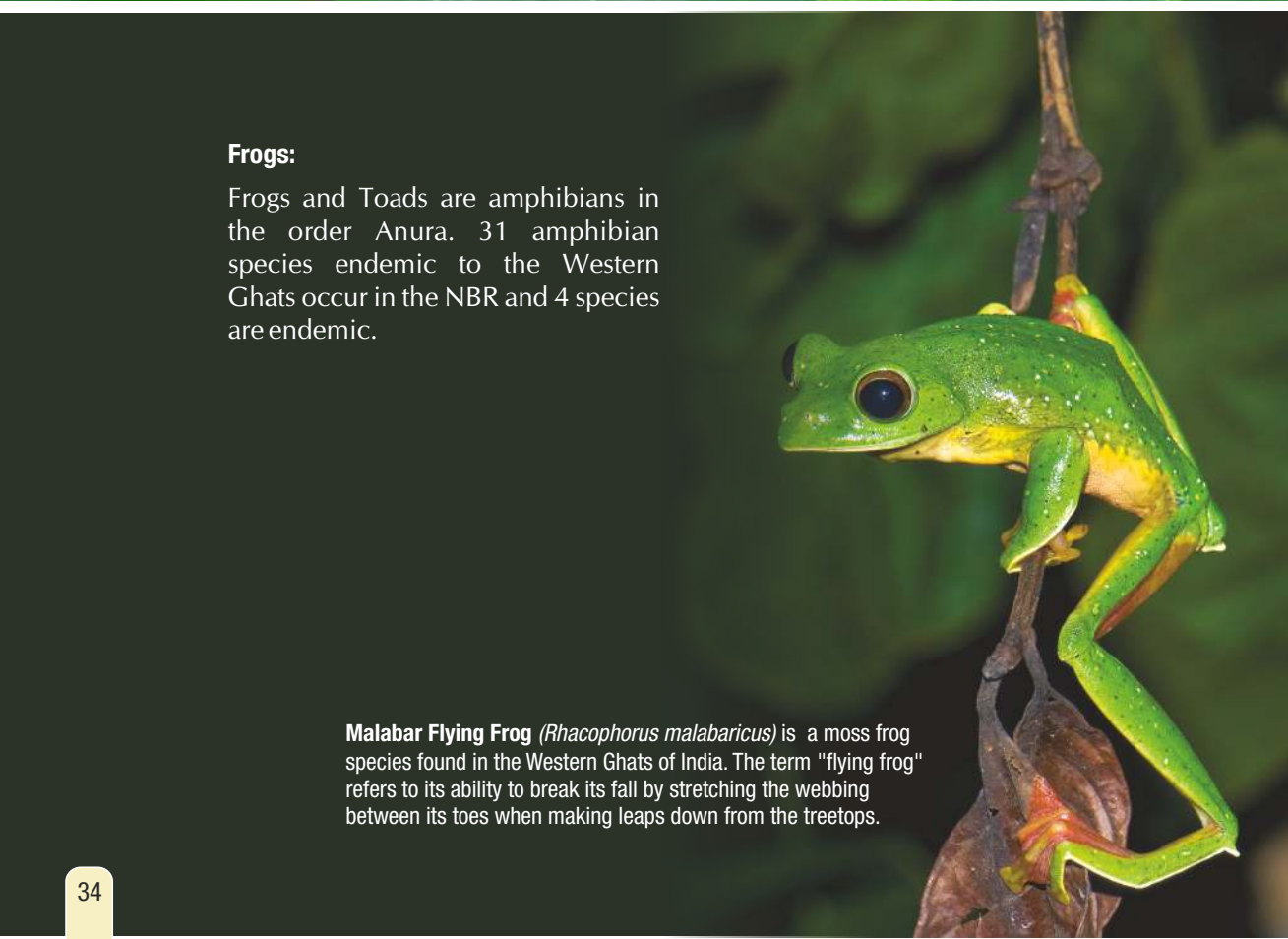


### Snakes

In India there are 265 snakes, of which only 50 species of snakes are venomous<sup>8</sup>. Most of these rarely come in contact with human beings because they live in forested areas.

<sup>8</sup>**Venom** is a toxin secreted by certain snakes and poisonous insects.

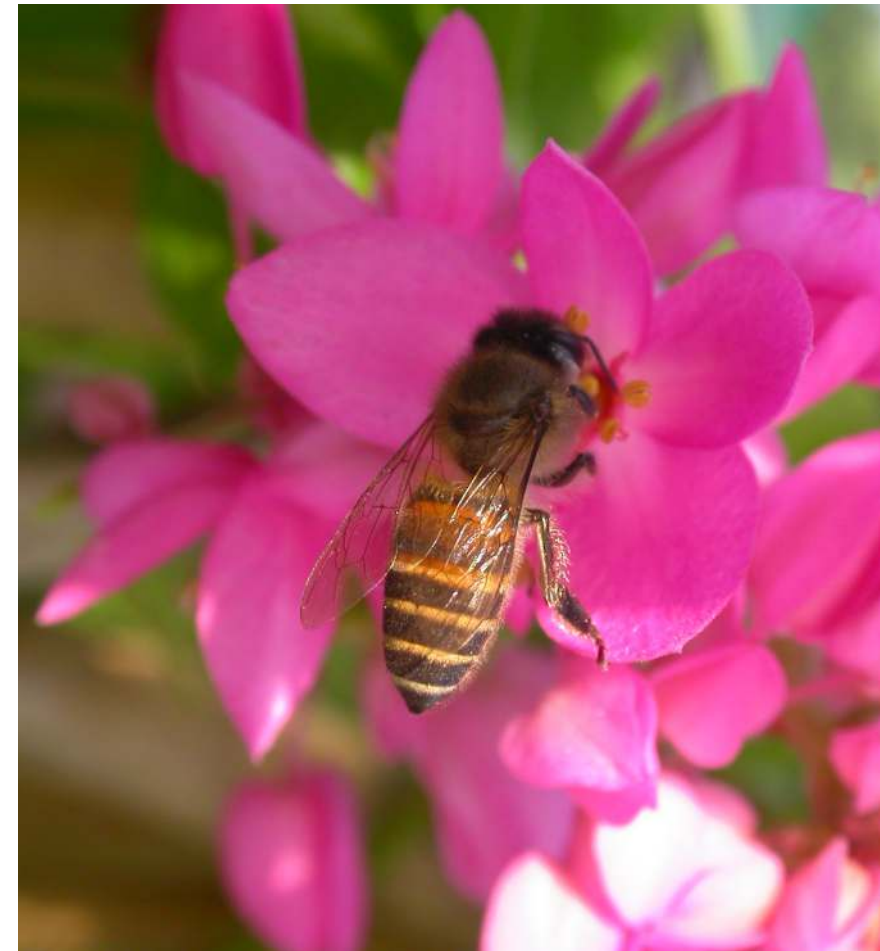
Green vine snake (*Ahaetulla nasuta*) is a common snake found across India.



### Frogs:

Frogs and Toads are amphibians in the order Anura. 31 amphibian species endemic to the Western Ghats occur in the NBR and 4 species are endemic.

**Malabar Flying Frog** (*Rhacophorus malabaricus*) is a moss frog species found in the Western Ghats of India. The term "flying frog" refers to its ability to break its fall by stretching the webbing between its toes when making leaps down from the treetops.



Asiatic honey bee

### Honey bees

Honey bees are flying insects<sup>9</sup> closely related to wasps and ants, and are known for their role in pollination<sup>10</sup>. An estimated 90% of flowering plants depend on bees.

Honey bees undergo complete metamorphosis<sup>11</sup>, where the insect changes in four stages; egg hatches to produce a larva, the larva grows and becomes a pupa and emerge as adults. Butterflies are the other well-known insects that undergo complete metamorphosis.

Bees are adapted to feeding on nectar and pollen, the former primarily as an energy source and the latter primarily for protein and other nutrients. Bees visit the flowers of plants and collect nectar to make honey. While the bee is collecting nectar, the pollen from the plant sticks to its body. Bees fly from one flower to the next, transferring pollen and helping plants reproduce! Thus plants help bees, and bees help plants.

Bees are vital insects that need to be preserved. Without them, plants would not be able to reproduce and there would be no food.

### Honey bees in the NBR

- Apis cerana* Asiatic honey bee
- Apis florea* Dwarf honey bee
- Apis dorsata* Giant honey bee
- Trigona spp.* Stingless bee

<sup>9</sup>**Insects** are a class of living creatures within the arthropods that have a three-part body (head, thorax, and abdomen), three pairs of jointed legs, compound eyes and two antennae

<sup>10</sup>**Pollination** is the transfer of pollen from the anther to the stigma of a plant

<sup>11</sup>**Metamorphosis** is the marked and rapid transformation of a larva into an adult that occurs in some animals

## Indigenous People

The NBR, in addition to being rich in biodiversity, is also home to a significant population of indigenous communities, who are referred to locally as adivasis and as per government records, 'scheduled tribes'. Hence the NBR is rightly called a bio-cultural reserve. These communities are more or less completely dependent on the natural resources available within the region, and they comprise small populations who live in geographical concentrations, often distinct from one another.

Besides indigenous people there are many other communities who have made the NBR their home. We estimate the total population of the indigenous people to be 2,00,000 and of 30 distinct groups.



Kurumba houses at Thanayakandi



Kurumba elder

### Aalu Kurumba & Jenu Kurumba:

Mostly residing in the southern and eastern belt of the Nilgiris district, an Aalu Kurumba village (called *motta* or *kombai*) usually consists of five to six huts which are constructed using bamboo, secured with mud and supported by a tiled roof. However there are very few such villages in the NBR now and most people have been settled in 'line houses'. The design and layout of these houses are decided by the government. Their settlement size varies from 3-60 households. Today these people are settled in villages adjacent to forests, making their living partly by working on their own land or collecting forest produce (explained in Chapter 7).

The forest gathering patterns of most adivasi are specialized and the Kurumba are famous for their skills in collecting the honey from Rock Bee (*Apis dorsata*) which nests on high cliffs. Some members of this community undertake seasonal agriculture, while others depend on wage labor.



Jenu Kurumba family



Toda family

## Toda

The Toda people mostly live in the grassland shola neighbourhoods of the upper Nilgiri plateau<sup>1</sup> in the NBR. They live in small hamlets<sup>2</sup> called mund, and a traditional mund consists of three to seven small thatched houses. Their houses are constructed in the shape of half-barrels and are located on the slopes of the pasture. Thick bamboo/canes are arched to give the hut its basic arched-shape. Each hut has only a low door through which one enters. This unusually small entrance is a means of protection against wild animals and harsh winds. The front portion of the hut is decorated with the Toda art in the form of murals<sup>3</sup> carved on rock. Toda people are a pastoral<sup>4</sup> community and traditionally trade in dairy products.

## Kota

Kota people mostly live in the north-eastern hills of the NBR. Their villages are called *Kokkal* and the village size varies from 40 -100 houses. This community is composed of the artisanal adivasis of the Nilgiris who are skilled blacksmiths, silversmiths and carpenters. For their livelihood, Kotas traditionally produced crops of grain, millet, garlic, mustard etc., in addition to bartering artisanal services to other people in the Nilgiris. *Ainor*, *Amnor* and *Kamtraaya* are the principal deities of the Kota. The *Kamtraaya* is considered to be the creator of the universe.



Kota priest



Kota elders

<sup>1</sup>Hamlet is a community of people smaller than a village

<sup>3</sup>Mural is a painting that is applied to a wall surface

<sup>4</sup>Pastoral relates to shepherds or herdsman who raise sheep or cattle



Kattunaicken with his fishing basket

## Kattunaicken

Kattunaicken live in the northern, northwestern and western foothills of the Nilgiri region and southwestern Wayanad. The settlement sizes are very small, with an average of 5-8 houses. They live in nuclear families and the couple lives with the husband's family. The Kattunaicken get their name from the words *kattu* (forest) & *naicken* (leader/chief). They are amongst the most important honey-collecting communities in the NBR. Their primary occupation is hunting and gathering, especially honey. They grow ginger, coffee, pepper and yam around their houses, but are generally not cultivators and some of them also work for wages and in estates. The Kattunaicken are experts in basketry. Kattunaicken worship *Maladeivam* and their ancestors.



## Irula

Irula live in the relatively low altitude regions of the southern and eastern slopes of the Nilgiris and northern and eastern slopes of the Coimbatore Hills. They also live in the northern slopes of Nilgiris (Sigur plateau). An average Irula settlement consists of about 30 households. They are among the larger adivasi groups in NBR. They practice hunting, food-gathering and agriculture, and make a living by selling agricultural and forest produce. They collect honey from rocks and trees. They prefer not to collect the honey from the cliffs. They also rear livestock like chicken and goats. Most Irulas in the Attappady and Silent Valley region of NBR still follow the old slash-and-burn method of cultivation in their own lands and grow millets and vegetables. Irulas worship Vishnu, especially at Rangaswamy peak.



Irula children



Sholiga Priest

**Sholiga:**

This community mainly live in the north-east region of the NBR, in Karnataka, along the border between Bandipur, Theppakadu and Biligirirangan Betta. A Soliga settlement is known as *podu*. In each *podu* there are few clusters of houses and each house is called *mane*. The Sholigas collect forest produce such as honey, gooseberry, phoenix grass, and lichen. Earlier they used to practice shifting cultivation and kept on moving from one land to another in a gap of 3-4 years, principally for growing ragi which is their staple diet. The Sholiga worships several gods and deities- such as the family deities

known as *Mane Devaru*. Shiva, Rangaswamy (an incarnation of Vishnu) Jadeswamy, Parvati, Manteswami, Durga, Chamundeswari, Mariamma, Masanamma, Chikkasampigeshwara, Siddhapaji, Muruga, Kyatedevaru, Karayyaswamy, and Tolasamma are also worshipped by them.



**Cholanaicker:**

Cholanaicker live in the New Amarambalam Valley in Nilambur, Kerala in the western part of the NBR. They are grouped under various clans called *ala*. They are among the most primitive indigenous communities, and are still in the pre-agriculture stage of development. They live in temporary shelters alongside rivers and shift to caves in the monsoons. Their lives are closely linked to the semi-evergreen forests where they live and they collect forest produce for sale. The population of this community is less than 200. Their worship sites are inside the forest, where they keep terracotta images of elephants, dogs, lamps, and human figures. They also practise ancestor worship. The idols are kept in baskets inside the caves or in shelters.



Cholanaicker

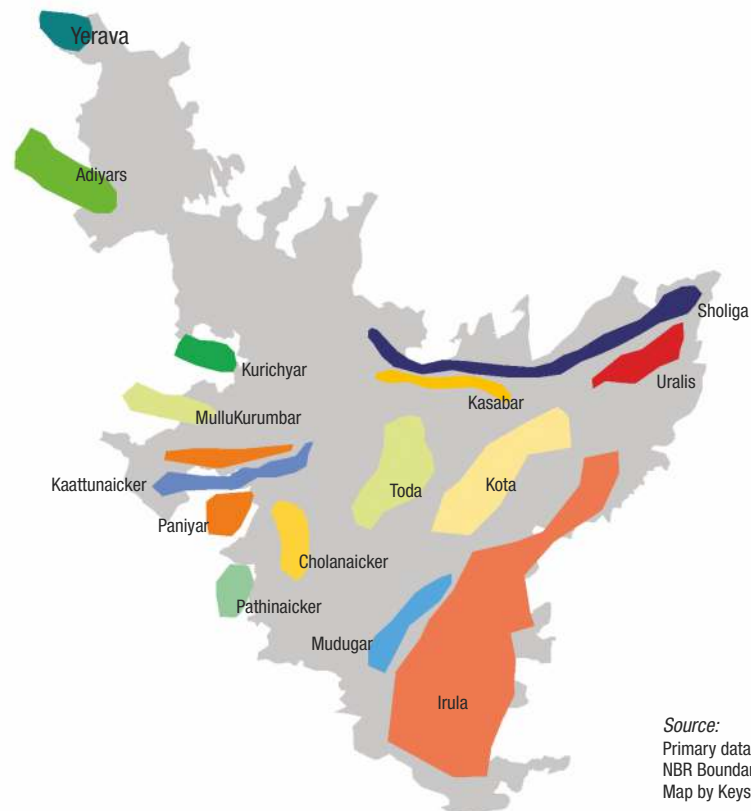


Badaga festival

**Badagas:**

Badagas constitute the largest single ethno-linguistic entity in the Nilgiri district of the NBR. Traditionally buffalo-herders, they also practiced subsistence agriculture. Since British times they turned out to be vegetable farmers. Presently they are small tea growers.

**Location of indigenous communities in the NBR**



Source:  
Primary data collected by Keystone Foundation 2010  
NBR Boundary - R. Prabhakar, 1994  
Map by Keystone Foundation



Koppe - Irula ancestor memorial place

### Sacred groves and indigenous communities:

Sacred groves comprise patches of forests or natural vegetation – from a few trees to forests of several acres – that are usually dedicated to local hereditary deities (Example – *Kumbhadevar*, *Malingasami*, *Panchapandavar* and *Dodda Deva*- Kurumba and *Konnos* - Toda). Banagudi shola is one such sacred grove which is revered and protected by the Kurumba communities. The degree of sanctity of the sacred forests varies from one grove to another. In some forests even the dry foliage and fallen fruits are not touched. People believe that any kind of disturbance will offend the local deity, causing diseases, natural calamities, or failure of crops. Rituals and rules pertaining to sacred groves vary across such groves. It is believed that sacred groves are relics of the natural vegetation and are characteristic of the area. The sacred grove of Banagudi contains evergreen forests. However the land use around these areas has changed drastically over the past 30 years and this has begun affecting the species of these groves.



### Dolmens:

These are the memorial stone shelters. The dolmens or stone tables of upright stones with a cap stone resting on them are believed by Kurumbas and Irulas to have been built by their ancestors. The inner side of some of the dolmen stones are roughly sculptured representations and reflect the civilization of the period.



Kurumba Dolmens

### Cave paintings:

Pre historic cave paintings have been discovered in the NBR. The paintings near the Kurumba village of Vellari Combai, Kotagiri and the Irula village of Gharkiyur are believed to be several thousand years old.

Rock paintings





# Non-Timber Forest Produce (NTFP)



Since time immemorial, humans have harvested Non-Timber Forest Produce (NTFP) for subsistence use and trade. NTFP produce may be used directly, as food, fiber, medicine, construction materials or processed further to yield oils, cosmetic products, perfumes, poisons, toys and chemicals or make musical instruments. These products may be traded for money or bartered for other goods. The role of forest products in local livelihoods is vital. Everybody in an indigenous village collects NTFP and some are specialists in collecting a particular produce. e.g. honey hunters, traditional healers, and artisans. The plant parts used are diverse and include flowers and seeds, leaves, gums and resins, barks, roots and tubers and in some cases the whole plant itself. From the forests of the NBR, more than 50 varieties of NTFPs are harvested for various uses.

Young NTFP harvester with *Phoenix* leaves



One plant many NTFPs



Leaves as NTFP



Fruits as NTFP



Resin as NTFP



Bark as NTFP



Whole plant as NTFP



Root / Tuber as NTFP



### Flower and Seeds:

An adult plant produces flowers which need to be pollinated to produce fruits with seeds. Only some seeds germinate when they are dispersed and make it to the saplings stage. Flowers and seeds are harvested to make dyes, medicine, jewellery, food etc. Fruits of *Phyllanthus emblica (nelli)* *Terminalia chebula (kadukka)*, *Garcinia gummigutta (kudampuli)* etc., and seeds of *Hydnocarpus sp. (Neerutti/marrotty)* and *Madhuca indica (illupai)* are harvested in the NBR.



### Bark:

The bark functions like a protective skin of the plant, surrounding the tissues that transport water and food. The bark also protects the plant from fire, fungal, and insect attacks. Bark and bark extracts are used for a range of products including herbal medicines, spices, and paper. Bark of *Cassia sp.*, *Cinammonum sp.* etc. are commonly used across NBR.



### Leaf:

Leaves allow plants to obtain energy from the sun through photosynthesis. This energy is used for growth and reproduction. Leaves are harvested as NTFP for a variety of uses. Leaves of *Phoenix humilis* is used to make brooms, mats etc.



### Roots and Tubers:

Root helps the plant to acquire water and nutrients from the soil and anchor of the plant body to the ground. Tubers help some plants to store food and nutrients. Roots and tubers are the ground parts of the plants and are frequently used for food, medicine, fiber, and dyes. *Dioscorea sp.*, *Hemidesmus indicus (Nannari)*, *Asparagus racemosus (Shatavari)* etc. are some commonly harvested roots/tubers.



### Gums and Resins:

Gums and resins are plant secretions which are abundant in many trees. Trees produce resins which are exuded when an injury is caused to the plant to seal up wounds and prevent their evaporation. It also helps protect against attack of insect and fungi, and prevent injury through decay. Traditionally they have been used for caulking boats, processing food, decoration of furniture, and for medicinal purposes. *Canarium strictum (panthamaram/dhoopa maram)* and *Boswellia serrate (sambrani)* etc. are examples of resin producing trees.



### Whole plant:

The role of a plant is wide in the ecosystem. Plants are the primary producers of food. They produce food by converting energy from sunlight to chemical energy (Photosynthesis) and storing as sugar. Whole plant harvest refers to the practice of uprooting the entire plant. Plants like *Sida spp.(kurumthotty)*, *Cycas circinalis (entha)*, *Cyclea peltata (paada kizhangu)* are some of the plants collected entirely.





*Apis dorsata* combs

## Honey

In the Chapter on biodiversity we saw the different types of honey bees found in the NBR and their importance in the ecology. Honey bees produce honey, and combine it with pollen to feed its brood. Honey is also the food that bees consume before they make their long migration. In cold weather or when fresh food sources are scarce, bees use their stored honey as their source of energy.

Honey is probably one of the oldest forms of sugars known to human beings. As a NTFP, honey has a long history. Experts say that human beings started hunting for honey at least 10,000 years ago.

## Interesting facts

NTFPs play an important role in the sustainable management of the forests.

NTFPs play an important role in the local economy of an area by meeting needs of people with regard to food supplements, medicine, raw materials for construction, for making tools etc. Some of the products have significant social and cultural significance.

*Apis dorsata* is an economically important bee species in the NBR due to the large quantities of honey produced. It is also the largest social bee present in the NBR and requires cliffs and tall trees for colony building. 70% of the honey harvested in India is from these bees.

Some plants like *Cycas circinalis* have become endangered and threatened due to over-harvesting or unregulated harvests. All parts of this tree are harvested for various uses. Its leaves are used to decorate temples and homes on special occasions; seeds as a source of food; pith<sup>9</sup> to prepare medicine; cone to repel insects on fields and for other unknown reasons; tender leaves to prepare curry and for medicine.

There are sustainable ways through which we can extract forest produces and reduce the adverse impacts on the plants. However, on the whole, a livelihood based on NTFP is considered sustainable because:-

1. In most cases only plant parts are harvested.
2. Plants can regenerate faster and in larger numbers than animals.
3. Plants and their parts are available through the year.
4. Knowledge about NTFPs is high amongst indigenous people.



*Apis florea* comb

## Food



At some time in the distant past, 8,000 to 10,000 years ago, scholars believe that humans discovered seeds from certain wild grasses could be collected, planted and harvested. Agriculture marked the transition of humans from hunting and gathering their food to domesticating plants for food. Some scientists and historians call this period of time, the “agricultural revolution.” Shifting from a hunter-gatherer society to an agrarian society led to increasingly larger-scale agricultural production that involved selecting certain crops for domestication. Grains and cereals have been a staple in the diets of people living in the NBR for centuries. These seeds contain protein, calcium, phosphorus, and the essential amino acids.

Irula farmers with millet harvest



### Cash Crops:

Cash crops are grown for profit rather than consumption by a family. In earlier times cash crops were usually only a small (but vital) part of a farm's total yield. Large cash crop farms are monoculture<sup>1</sup> plantations, such as tea, cashew and rubber. In the Nilgiris approximately 30,000 ha. of land is under tea cultivation. Cash crops like coffee, banana, pepper, cardamom, coconut, areca, beans, ginger, nutmeg, cocoa, and potato are grown as mixed crops in the NBR.

<sup>1</sup>**Monoculture** is the cultivation of a single crop.



### Subsistence Crops:

Subsistence agriculture is a mode of farming where the farmers focus on growing enough food to feed the family. The typical subsistence farm has a range of crops and animals needed by the family for consumption. Farmers across the NBR use their small land holding to produce enough for their own consumption, while the remaining produce is sold. Paddy, millet, potato, vegetables, yams etc. are some of the crops in subsistence agriculture.

### Seasonal crops:

This type of agriculture makes farming more realistic by adjusting the growth durations and growing seasons such that crops are grown on an annual basis (i.e. sow seeds in monsoon, harvest in summer). Tapioca, paddy, potato, banana, millet, maize, carrot, beans and ginger are some of the seasonal crops in the NBR.



**Mixed crops (also known as multiple cropping/ inter-cropping or co-cultivation):**

When two or more crops are grown simultaneously on the same piece of land the method is called mixed crops. This type of cropping leads to an improvement in the fertility of the soil. Mixed cropping is an insurance against crop failure due to abnormal weather conditions. In the NBR coffee, pepper, jack and cardamom are grown together in small and medium sized farms.



**Wild Foods of the NBR:**

The NBR is home to several hunting gathering communities as mentioned in earlier chapters who are endowed with a deep knowledge about the use of wild plants, and animals for food purposes. Most of them depend on forest resources for their livelihood and take edible forms of flowers, roots, fibres, tubers, rhizome, leaves etc. for food. Many wild edible plants are nutritionally rich and can supplement nutritional requirements, especially vitamins and micro nutrients. They are also able to fill a variety of food gaps at various seasons. Wild foods rarely come to the markets of the NBR.

**Permanent crops:**

Permanent crops are plants which last for many seasons, rather than being replanted after each harvest. Permanent crops can be found in cash crop, subsistence crop and mixed crop farms. Permanent crops can be seen across the NBR. This practice exists among small farmers to large planters. Tea, coffee, coconut, jack, areca, rubber, mango, nutmeg, pepper, coco etc. are some of the examples of permanent crops.



**Rainforest and agriculture:**

Throughout the world's rainforests the greatest losses have been due to the clearing of land for agriculture, in particular for 'cash crops' grown in large plantations. As a result of the huge rise in worldwide demand, large areas of forest have been cleared in recent years to plant coffee trees and oil palm. The thick forests of the Nilgiris were destroyed by the end of 19th century and brought under tea and coffee plantations. Tree plantations of Eucalyptus and Acacia were promoted to meet the needs of industry and the colonial army.



**The contributions wild foods make food security can be characterized in three main ways-**

- (i) Providing a supplementary source of food,
- (ii) As seasonal foods in the diet, and
- (iii) As emergency food supplies during periods when others are unavailable.

## Give and take- An old market scene!

This activity will help students learn more about lesson 6

**Objective:** To introduce the concept of barter system and community living.

**Materials needed:** Paper, Scissors



### Instructions:

- Divide into two groups
- (1) One group is willing to barter cereals, vegetables, fruits, poultry, milk and milk products fish, etc.
- (2) Second group can barter agricultural tools, sandals, soap, cloth and crafts (pottery, baskets, bamboo mats, ropes, etc.)
- Write down the list of things in your group and announce the things you have in your group to the opposite group.
- What do you want to exchange and get from the opposite group?
- How much of your products would you give to get something you want? For example, how much rice or milk would you give to the person who is giving you an agricultural tool?

# Where the kurinji blooms

a biodiversity learning module

ACTIVITIES

This activity will help students learn more about lesson 2

# Who's the tallest of them all?

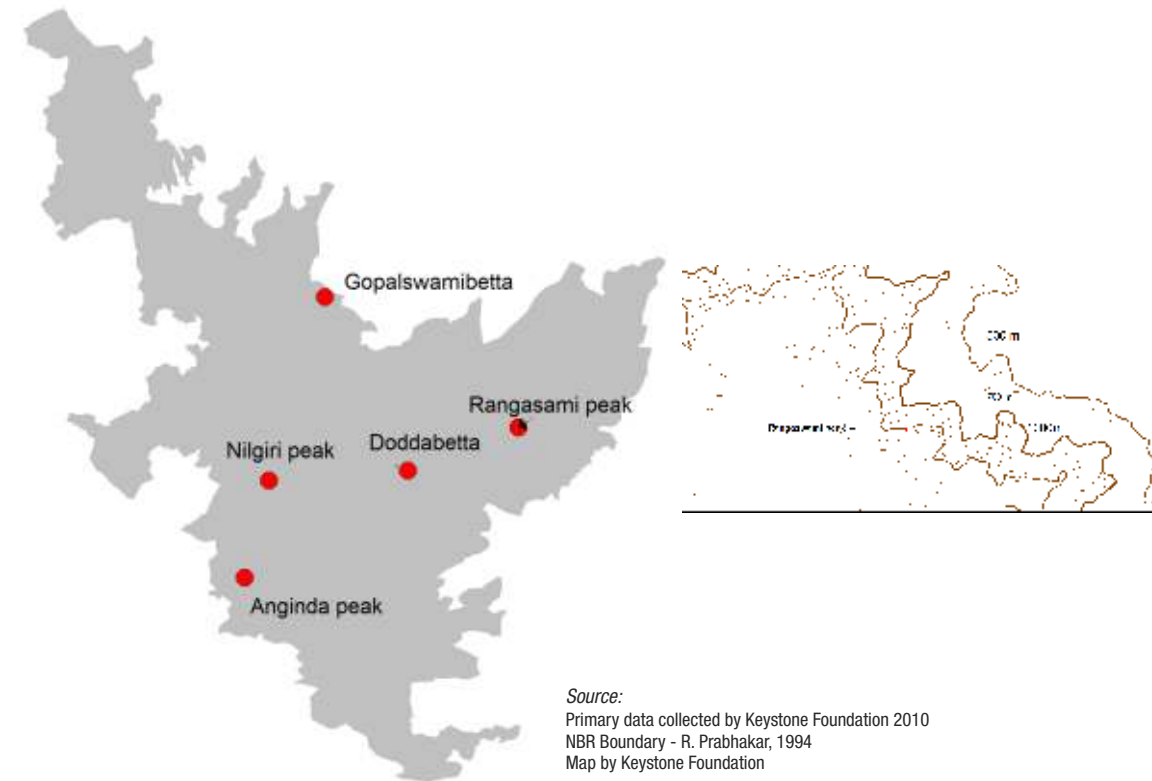
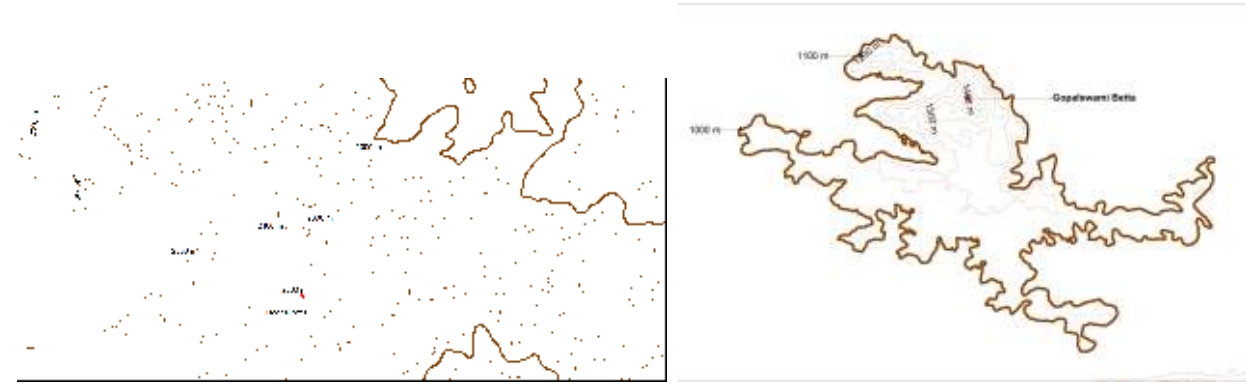
**Objective:** Using this activity children will learn about the different peaks of NBR as well as their heights in relation to one another. The children also learn math/geometry and geography while doing art and craft – older children can make 3-D models of the peaks by cutting paper in a conical shape.

**Materials needed:** scissors, chart paper, ribbon and map from manual – preferably a pull out.

## Instructions:

- Divide your students into as many groups as the number of peaks you want to discuss.
- Provide them with a measuring tape and a different coloured ribbon for each team.
- Explain to them how each peak is at a different height and has different contours and they should study the pictures of the mountain.
- Assign one peak to each group.
- Remind them that what they are making is a visual representation of a much larger area of land. For studying maps and to make them useful maps have to be small enough to be handled by an individual. The peaks need to be scaled down so that they fit on the available map of NBR provided.
- Tell your students that when scaling down the peak, every part of the map would have been scaled down by the same amount to keep proportions correct. This can be done using the fractional method.

*Fractions are simple representations of the ratio between what ( is shown on the map and the real world.)*



Source:  
Primary data collected by Keystone Foundation 2010  
NBR Boundary - R. Prabhakar, 1994  
Map by Keystone Foundation



This activity will help students learn more about lesson 2

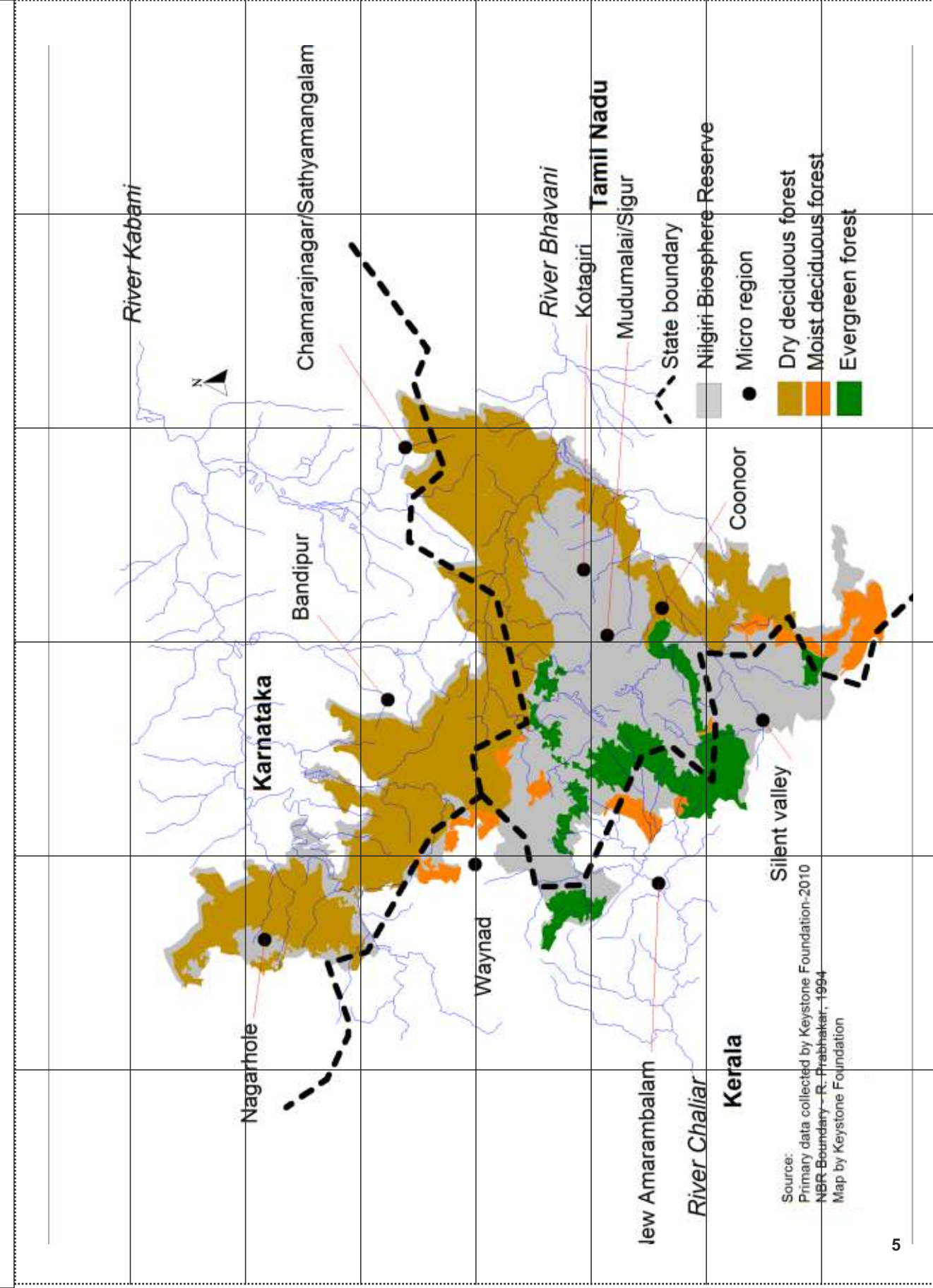
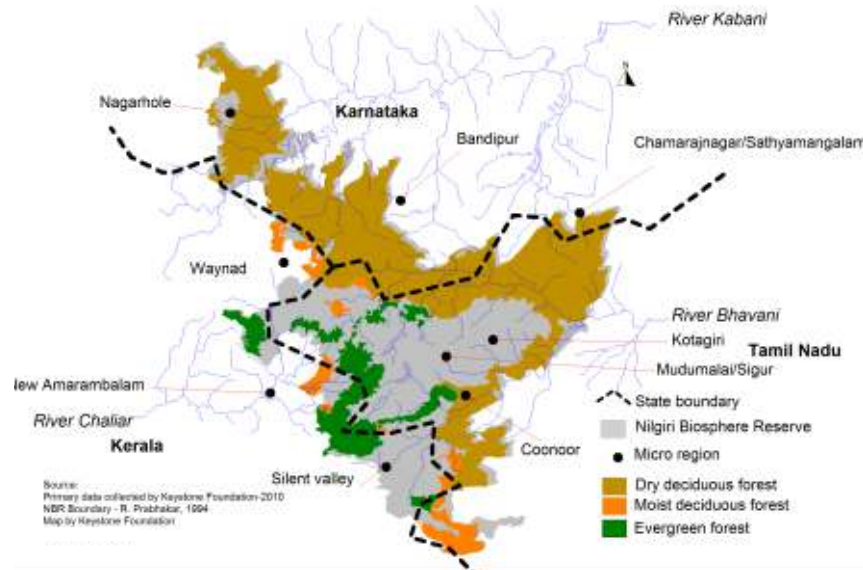
# Piece by Piece

**Objective:** To understand the map of the NBR this activity in the form of a Jigsaw puzzle teaches where the NBR's important valleys, mountains and rivers are.

**Materials needed:** Pieces of the Jigsaw from the manual photocopied and cut out for each group.

## Instructions:

- Photocopy and cut out the pieces of the jigsaw and tell your children to use the clues to piece the map back together again.
- Divide your class into groups and give each a set of jigsaw pieces.



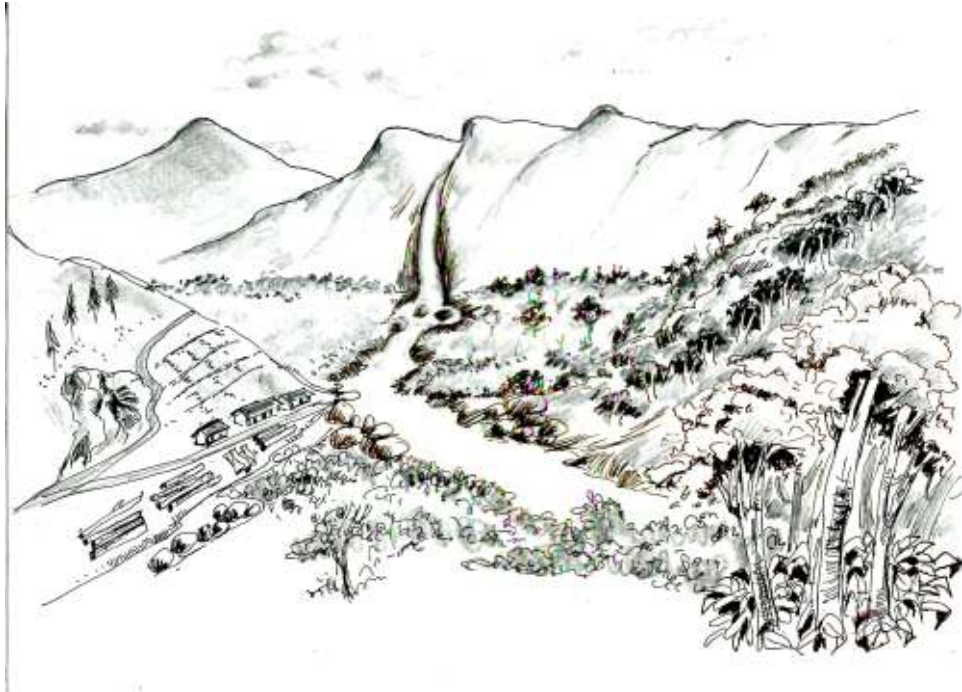


# Green or no Green!

This activity will help students learn more about lesson 2

**Objective:** This activity allows the kids to play with their hands while learning the dynamics of soil erosion and the importance of green cover.

**Materials needed:** two rock pieces ( preferably round), wet mud, green cloth



## Instructions:

- Keep the rocks at a distance of 1 feet and cover both the rocks with wet mud so as to make a valley between the two.
- Drape one mountain with green muslin cloth(assume this is the forest cover) and leave the other bare.
- Pour water on both and observe the differences in the erosion.

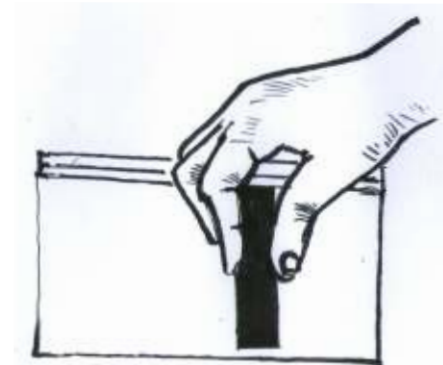
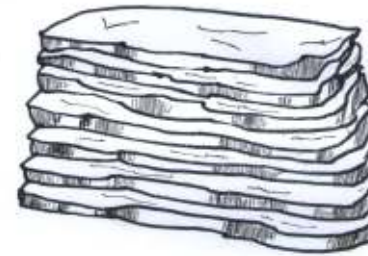
**Discussion questions:** – Discuss the state of the water coming from either run off – which of them has more sediments/mud? What will happen if the soil is gone?

# Soil Stories

This activity will help students the lesson 2

**Objective:** Did you know that even soils have a story to tell? Archeologists and geologists are people who study soil and can read what the soil has to say and through this discover the world's secrets hidden for centuries. In this game children uncover the secrets of the soil.

**Materials needed:** An open ground where the profile of the soil is visible, such as a road edge or a pit.



## Instructions:

- Have your students observe the wall of the soil profile and mark with tags or twigs where the soil colour or consistency changes.
- See if you can identify the layers of soil.

This activity will help students learn more about lesson 3

# Reading the River

**Objective:** Each team makes their own river using coordinates plotted on graph paper. Then each team overlays the river it has drawn on the NBR master map.

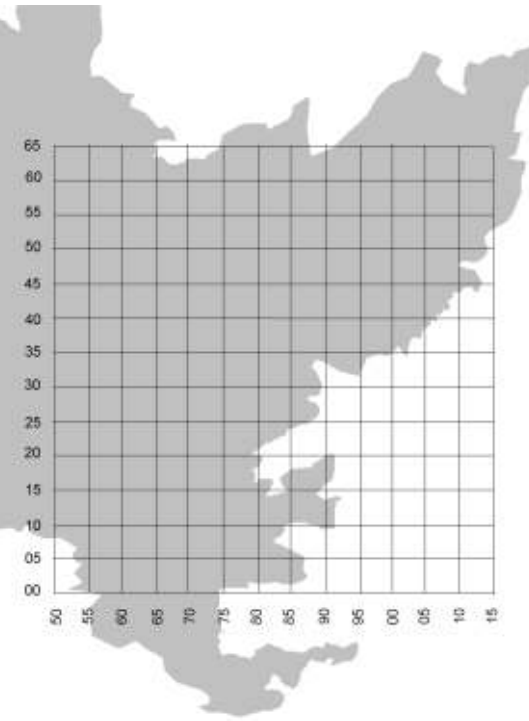
**Materials needed:** Transparent sheets, permanent markers, tapes or pins, master map of NBR, graph paper

**Instructions:**

- Divide your students into 4 groups and instruct them to follow the coordinates presented in the table. Have each group plot the coordinates on the graph using the Latitude / X axis and Longitude / Y axis as guides.
- Explain to them that each coordinate corresponds to a point on the course of the river.
- Once they have plotted all the points have them join the dots free hand to draw the curvature of the river.
- Ask them to transfer the completed river onto the transparent sheet.
- Then have each group compare their river map of NBR to see which river they have drawn and where it flows.

**Discuss:** On the master map, identify the longest river in the NBR and the river that has the largest catchment. Pick a river, determine its direction of flow and count the number of tributaries to it. Identify the forest type in which the river's tributaries originate.

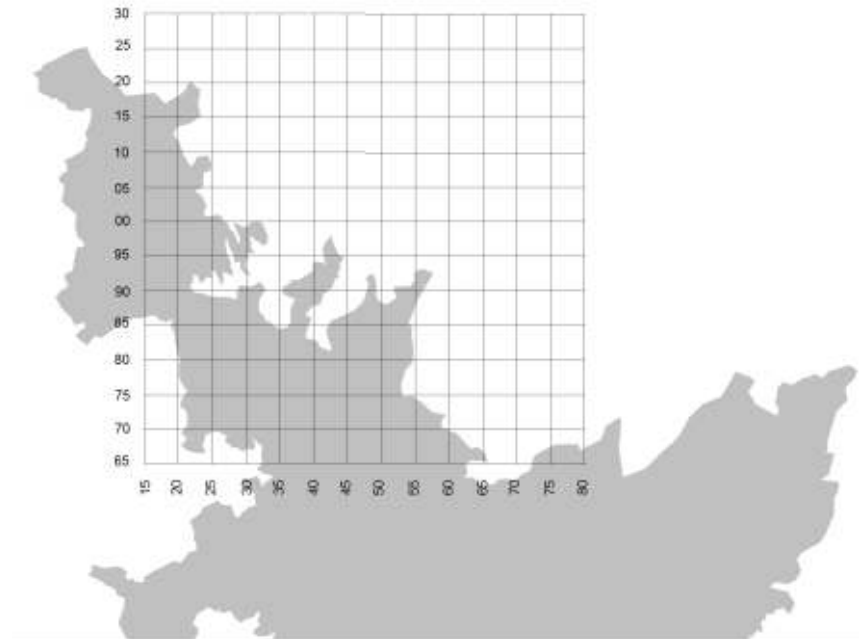
Kabani river			
Lat	Long	Lat	Long
<b>Main river</b>		<b>Tributary 1</b>	
86	18	73	27
89	20	69	39
87	20	72	42
87	21	74	41
88	20	77	42
91	20	79	42
90	22	81	41
92	23	82	42
97	33	92	44
96	35	97	44
98	36	98	46
99	39	98	49
12.00	36	00	50
01	38	08	51
99	41	<b>Tributary 2</b>	
07	37	69	58
07	39	75	69
09	39	67	84
09	41	72	75
11	45	75	69
09	47	79	68
09	52	89	70
09	56	78	76
11	57	89	70
12	64	94	70
14	66	97	69
11	69	98	70
14	72	06	73
13	74	08	70
14	76	11	71
17	80	10	68
23	83	11	69
		<b>Tributary 3</b>	
28	55		
23	62		
19	63		
19	69		
28	70		
19	69		
14	72		
		<b>Tributary 4</b>	
29	32		
18	36		
17	39		
30	42		
25	38		
24	39		
17	39		



Lat= Latitude  
Long=longitude

Source:  
Primary data collected by Keystone Foundation 2010  
NBR Boundary - R. Prabhakar, 1994  
Map by Keystone Foundation

Bhavaani river			
Lat	Long	Lat	Long
<b>Main river</b>		<b>Tributary 1</b>	
07	50	25	58
06	53	23	59
06	55	20	58
06	56	19	59
08	58	17	58
10	59	14	61
11	61	15	63
12	63	<b>Tributary 2</b>	
14	65	00	61
16	68	00	63
15	69	02	63
18	71	08	66
22	77	09	65
25	80	11	66
27	86	12	67
28	88	11	68
30	90	12	68
32	94	15	69
32	96	<b>Tributary3</b>	
33	97	15	78
31	00	16	
81	33	01	
18	83		
35	01	21	87
38	03	23	88
40	04	26	88
46	11		
48	11		
48	14		



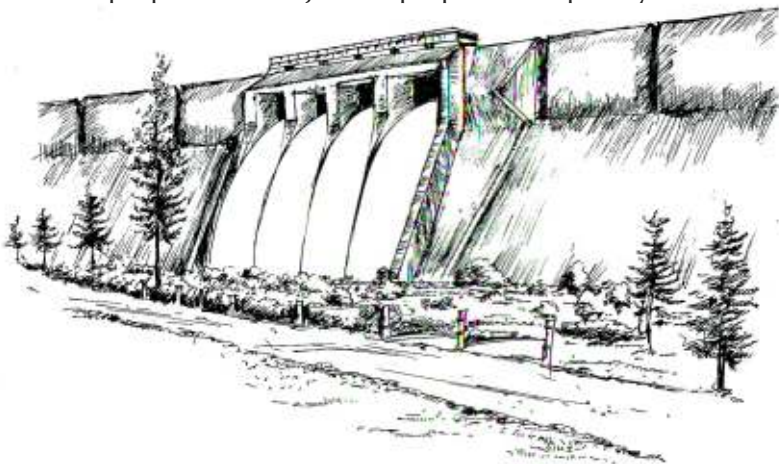
# Dam Debate

**Objective:** This activity has a twofold objective - 1. Inform children about the ill effects of dams, 2. To show children how interest groups and individual opinions can change or shape decision making.

**Materials needed:** Role playing cards \*

## Instructions:

- Begin the lesson with a discussion on whether they know what a debate is? Explain to the children that when any decision is to be made, there are often many different opinions and everyone has an idea of what should or should not be done.
- Divide the class into three groups. One group belongs to the village located at the top of the hill called Pillur, while the other group lives in the valley called Mettupalayam. Each village has almost the same number of people but their lifestyles are quite different given their surroundings. One group of 5 students will constitute an independent council to hear arguments from both sides and decide on a course of action either via vote or by giving a speech.
- To solve their water problems the council of Pillur wants to construct a dam. This will provide them with much needed irrigation water as well as unlimited supply of electricity. But damming the river will restrict the flow to Mettupalayam in the valley and to gain access to water that was previously plenty and free they may now have to pay Pillur.
- Have each group read their roles and then give them 30 minutes to come up with their arguments to present to the independent council. Tell the independent council that they must listen to both sides and then take a decision in favour of the proposal or to modify the proposal or to reject the proposal completely.



**\*Role 1:** You are the Company that is going to make the Dam. This project is one of the largest that your company would ever get and it would be a huge profit for you. You would hire local people to work on the construction of the dam there by giving work and also getting work done at low cost.

**\*Role 2:** You are from the office of the Panchayath president of Pillur. Elections are around the corner and you know that if you can provide your people with easy access to water you could win the elections with a vast majority. The Dam building company has also promised to give you a generous donation if they are given the contract to build.

**\*Role 3:** You will be displaced and your forests and agricultural land will be submerged if the dam comes up in. You argue for the animal and fish wildlife resources as well as the ecosystem services that forests offer (such as fresh air, water and food supplies, pollinators and pest control agents for your farms, etc.).



This activity will help students learn more about lesson 4

# Ask the Elders

**Objective:** Through interviewing older friends and relatives children can learn about recent changes to weather patterns. Learning to ask relevant questions, extend and follow up ideas, collect and record evidence, historical enquiry will grow.

**Materials needed:** Note book, pen, and a list of key questions to ask

**Suggested key questions that you can ask an elder about climate changes:**

1. Has the climate changed a lot since you were a child?
2. If yes in what way?
3. How has this affected your life and work?
4. Is there any way of knowing ahead that it is going to rain today / it will be a very hot day today?
5. Are there some animals or plants in the forest that tell us that it will rain or it will be sunny?

# How am I related to you?

This activity will help students learn more about lesson 5

**Objective:** To help students explore the relationship between plants and animals, and to build friendship with non-human entities

**Materials needed:** Note Book



**Instructions:**

- Name your friends.
- Who are the plants and animals that you come across everyday?
- Who is your best friend among them?
- Mention their characteristic features?
- Have you noticed any changes in their lives?

# Feathers!

This activity will help students learn more about lesson 5

**Objective:** Initiating your class into watching animals with feathers and through that an appreciation for nature.

**Materials needed:** Binoculars, note books, bird books, checklist

**Instructions:**

Bird watching with your kids can be great fun. Tell your students that to enjoy bird watching one must follow a few simple rules:

- Wearing sober clothes so as not to scare the birds away, avoid reds and whites.
- Binoculars if available
- Bird books for identification
- A field book to take notes of observation
- Being silent and patient
- A checklist can also be made to make it easier for the kids.



**For example**

Bird Name	Scientific Name/ Description	Location/ Date	Time	Behaviour
Babbler				
Sparrow				
Barbet				
Mynah				
Parakeet				
Nilgiri Thrush				
Hornbill				

This activity will help students learn more about lesson 5

## Who is singing?

**Objective:** To lead children from hearing to listening and sharpen their perception to the sounds around them.

**Materials needed:** Binoculars, note books, bird books, checklist

**Instructions:**

- Take the children for a visit by telling them beforehand that you are going to play a game.
- Once they are out to a place with more natural sounds or less rural noises, ask them to focus their attention on the sounds and ask them to recall some of the sounds with they are familiar – birds, frogs, crickets and cicadas.
- Return to the school premises and each student imitate the sound/ song they enjoyed most.



This activity will help students learn more about lesson 5

## Treasure hunt

**Objective:** This is a simple way to get children to explore nature.

**Materials needed:** Treasure hunt list

**Instructions:**

- Remind the children that they can only pick up items which they can put back in the wild and they must not disturb or damage their surroundings in any way.
- Depending on the location give them a time limit in which to collect all the objects on their list.
- After they have come back have the children discuss how each object is a vital part of nature and how littering harms the environment.

- |                                       |   |
|---------------------------------------|---|
| 1. A feather                          | 9. A twig that is as thin as their finger |
| 2. A seed                             | 10. Something red                         |
| 3. A stripped leaf                    | 11. Something green                       |
| 4. A spotted leaf                     | 12. Something soft                        |
| 5. A thorn                            | 13. An object that can make a noise       |
| 6. A round stone                      | 14. Some soil                             |
| 7. A unique stone                     | 15. Something that is fluid               |
| 8. 3 things that Humans have littered |   |

## Can you use this object?

**Objective:** To find out the uses of instruments shown in the table?

This activity will help students learn more about lesson 6 & 7

**Instructions:**

- Observe each object in the table above, write down what it is?
- Do you know which community uses/makes this?
- Do you know what this is used for?
- What has replaced each of these objects in the modern world?
- Discuss the energy consumption of the traditional object and the modern equipment?

## References:

Ali, S. and Ripley, S.D., 1983. Handbook of the birds of India and Pakistan (compact edition), Oxford University Press, New Delhi.

Daniels, R.J.R. 1992. The Nilgiri Biosphere Reserve and its role in conserving India's biodiversity. Current Science-Vol. 64, 706-708. Bangalore

Daniels, R.J.R. 1996. The Nilgiri Biosphere Reserve: A review of conservation status with recommendations for a holistic approach to management, UNESCO (South-South Cooperation Programme), Paris (France)

Prabhakar, R; Resource Use 1994. Culture and Ecological Change: A Case Study of the Nilgiri hills of Southern India, (Ph. D Thesis), Indian Institute of Science, Bangalore

Eagan, J.S.C. 1916. The Nilgiri guide and directory. S.P.C.K Press, Madras.

Grimmett, R., Inskipp, C. Inskipp, T. 2002. Pocket guide to the birds of the Indian Sub-continent. Christopher Helm Publishers Ltd.

Hockings, P. (ed.) 1989. Blue Mountains – the ethnography and biogeography of a South Indian region, Oxford University Press, New Delhi.

Keystone Foundation, 2006. Forest Plants of the Nilgiri Biosphere Reserve- Eastern-An Illustrated Field Guide. Keystone Foundation, Kotagiri

Keystone, 2007. Honey Trails in the Blue Mountains. Keystone Foundation, Kotagiri

Keystone, 2008 - Forest Plants of the Nilgiri Biosphere Reserve- Northern-A Pictorial Field Guide. Keystone Foundation. Kotagiri

Keystone, 2009- Non-Timber Forest Products, Protocols for Harvest -Resource Pack for Practitioners. Keystone Foundation, Kotagiri.

Lengerke, Hans J von and Blasco, F. 1989. The Nilgiri Environment in: Blue Mountains: the Ethnography and Biogeography of a South Indian Region (ed) Paul Hockings, Oxford University Press, New Delhi.

Manoharan, T.M., Biju, S.D., Nayar, T.S., Easa, P.S., (ed.) 1999. Silent Valley-Whispers of Reason, Kerala Forest Department, Thiruvananthapuram.

Nair, S.C. 1988. Long term conservation potential of natural forests in the southern western ghats of Kerala – Report submitted to the Man and Biosphere Committee, Department of Environment, GOI, New Delhi.

The Nilgiris District Gazetteer, Tamil Nadu state, 1995

Molur, P., 2009. Under the canopy – A window to wildlife education in North East India. Dusty Foot Productions. New Delhi

Trivedi, P. 2009. Environmental education in the Himalaya: Teacher's activity guide. Nature Conservation Foundation and Snow Leopard Trust.