ECO SYSTEM OF WESTERN GHATS

GREEN P.S.BOSE

Thanks to Cocoon Initiative and the Dasra

General movement for Rural Education and Environment - GREEN

ECO SYSTEM OF WESTERN GHATS

The background and reality

FORWORD:

The future destination of most human being is marked by the learning and experience since childhood and the environment he/she is grown. Similar life situation happened in my life. I am very happy to introduce myself. I am P.S. Subhash Bose, the Founder of GREEN Society. My native village is Erasanaikkanur, located at the foot hills of Western Ghats in Chinnamanur. I was born on 07 July 1971 in a farmer family. I completed my elementary school education at R. C. School, High School education at Government Higher Secondary School in my native village. I completed bachelor's degree in Rural Educator at Gandhigrame Deemed University, Dindigul and Completed my master's degree in Maadurai Kamarajar University. I got married in the year 1998. My wife is Mrs. Pushpa Lilly and I have two daughters namely Ms. Abila, B.Sc., (Agriculture), M.A., (Socilogy) and Ms. Anila, B.Sc., (Horticulture) at Tamil Nadu Agricultural University.

My school days always are fresh in my mind. I look at the Western Ghats Hills from my childhood and I enjoyed the nature. I had my inclination in traditional agriculture system and worked in my agricultural field hearing the sound of birds and watching animals.

But after my education, the present condition of Western Ghats alarmed me the negative changes at environmental conservation. There are many illegal activities commonly ongoing such as forest invasion, cutting of trees, preparing illicit liquor in the forest area, preparing coal and frequent forest fire incidents.

As a result, wild animals either migrated or started entering into villages, a complete change in flora and fauna. The other side many farmers turned down from sustainable traditional agricultural system and started modern cultivation using chemicals and pesticides. The situation started changing many farmers that they could not get profit from their farming and cultivation. They started borrowing money for their further investment in the land. But they are unable to withstand and started migrating to Kerala for their survival. The natural and bio diversity system at Western Ghats start degrading. Regular monsoon and rainfall failed. People started encroaching water sources such as canals, small rivers and ponds.

I witnessed all these above factors. I am very aware the pleasant living condition of the people and the richness of Western Ghats ever contributing for the people living in the foot hills. Constant questions are going on in my mind. Why the harmony is lost? Why still people are still not aware of the exploitation going on in their midst? How to bring back the previous ecological condition in agriculture and Western Ghats? Who will take the lead and responsibility? All these questions raised in my mind.

I got the answer. Why should I blame others. Why can't I take the initiative to change the situation. I discussed the same with my friends. I became aware the similar concerns with my youth team. We, 21 youth members came under a banner. We started conducting awareness programmes and street theater in the villages. We motivated the people to take the responsibility to preserve the nature in Western Ghats, Stop Forest invasion for any illegal activities, preserve our forest area and agricultural land, turn to our traditional system, stop using chemical fertilizers and pesticides.

However, we started facing threats and challenges from industries, forest mafias and people who exploited the forest resources. We realized to continue our community level intervention through networking activities to increase our strength. We joined with "Samathuva Samuthaya Iyakkam". In the meantime, I joined with Mr. Nammalvar, the leading Environment Activist and Iyarkai Velan Inayam. I have taken training under him on natural and organic farming and techniques through field visit, street theatre activities, seminars and workshops. Though we got challenges, we also received support from elder farmers, school and college students, youth group members, fans associations.

Now I strongly felt the need to continue our community-based interventions. I made my commitment stronger. And as a result, we registered "General Movement for Rural Education and Environment – GREEN" since Jan 1989. Now we continue the environmental conservation activities in Western Ghats. We hope to reach us destination with the community support and their active participation.

"Tracing the movement of endangered wildlife in rain forests. Varusanadu and Vellimalai Hill Forest"

In this situation, I had the opportunity to visit major places of Western Ghats through journey, field visit and interaction with the indigenous communities. My experience motivated to prepare this document based on the background history and the data collected from the field. Every single step that is taken for the conservation of Western Ghats is our aim and concern. **I would like to express my heartfelt gratitude to The Cocoon Initiative and the Dasra for creating this wonderful opportunity. I would also like to express my deepest gratitude to my family members, the GREEN Team members, Mr. Siddharthan and Mr. Hentry who helped with language translation, and the driver Mr. Velu Bose** who supported me during this four-month journey. Thank you

P. S. Bose
Secretary, GREEN

MY IDEA OF SABBATICAL:

Since 2020, I had a feeling of promoting second line leadership for my organization and taking off my time forest, rejuvenation and new learning on the secret spots of Western Ghats hills –right from Kanyakumari to Gujarat in the north. Collect palm leaf manuscripts (in temples, Mutts), then stay with my family together sharing, caring and promoting my health.

PLACES WHERE I WISH TO BE DURING THE SABBATICAL

Selected places of Western Ghats and sacred groves for photography and collection of data on endangered fauna and flora in Kerala, Tamil Nadu, Karnataka and konkan ranges in Maharashtra state, right from Agasthiya hills to Gujarat state.

I proposed my desire for the Sabbatical year to explore and take up research at Western Ghats by visiting the places, meeting the indigenous communities, collecting traditional resources about herbals, rare plants, animals, caves and collecting palm leaves (Olai Suvadikal). I worked for the rural development and environment protection for a period of 35 years in the communities through GREEN. I developed a strong desire to explore the richness of the Western Ghats, Identify the reasons and the gaps generated between men and wildlife and the resources of the forest, traditional practices by indigenous people living in the forest, their life style and

practice of herbal medicines. During my travel I visited interior mountain hills, identified rare animals and species, discussed with the elders, collected details of medicinal and herbal plants and its use, collected numbers of palm leaves (Olai Suvadikal)

I am a native of Western Ghats, born from a De-notified community and witnessed the ongoing destruction of Western Ghats causing its original biodiversity and environmental disorders. I found many people ignored about the richness of Western Ghats and forgotten it is the source of life. I had the concern that the richness of the Western Ghats should be protected and the Sabbatical visit provided an opportunity for my learning, finding the root causes, discussion with the people of the soil and explore the hidden resources.

My effort is not just a visit but learn, research and document the resources and develop Science of the Forest and Ecosystem. I planned to document all my leanings and collection into a book and present to the future generation. Therefore, it is not an activity report but a research documentation.

I have taken four months of Sabbatical experience and started my traveling into Western Ghats on 01 Nov 2024 and concluded on 28 Feb 2025. I traveled in Six states covering Tamilnadu, Kerala, Karnataka, Maharastra, Goa and Gujarat and visited 56 districts. During the four months I travel into 06 states of Western Ghats for 90 days

The details of places travelled as follow...

01. Tamilnadu – 14 Districts
02. Kerela – 14 Districts
03. Karnataka – 12 Districts
04. Maharastra – 12 Districts
05. Goa – 02 districts
06. Gujarat –02 districts

The details of my travel as follow:

Month &Year	Places to be seen	Tentative Dates of field trips	Collection of Palm Leaf Manuscripts
November 2024	10 places in Kerala & Tamil Nadu states	11 days in first trip and again 11 days in the second trip (22 days in total)	8 days with two spells
December 2024	8 places in Karnataka state	One trip from 1st December 20th December 2024	21st to 31st December 2024
January 2025	Six places in Maharashtra and Goa	2nd January 2025 to 12 th January 2025& 20th January to 31st January 2025	13th to 19 th January 2025
February 2025	4 places in Gujarat state.	1st February to 24th February 2025.	25st February to 28 th February 2025.
Total	**Six states (28 places)**	**90 days**	**30 days**

The reflections emerged during your sabbatical

I had the following questions and reflection before and during my sabbatical year

As a native of Western Ghats living in Chinnamanur, in Theni District, we lived a peaceful life and followed traditional farming practices and there was no harm to the present ecosystem of Western Ghats. But I witnessed, the Western Ghats are losing biodiversity due to habitat loss and fragmentation, unsustainable agriculture, climate change, and human-wildlife conflict.

01. What are the causes for Deforestation?
02. How the present plan plantation system such as Monoculture of tea, coffee, and rubber displaces natural forests.
03. How the structures of Roads and dams fragment habitats and disrupt ecological connectivity?
04. How the unsustainable agriculture system and regular use of chemical input destroys habitats and erodes soil?
05. How the life style of indigenous co-exited with natural living among habitats?
06. What are the causes for erratic rainfall, raising temperatures and extreme weather events at Western Ghats region?
07. What are the rare plants and herbal that still exit and unexplored?
08. How to bring attention and concern among the present generation to protect Western Ghats?
09. How can contribute to my community by taking up conservation efforts on Western Ghats after my 35 years of experience in my development activities?
10. Why the tribal and indigenous community are forced to evacuate their living place at Western Ghats and what the actual forces behind them?
11. Why tourism and promoting and conducting worship, pilgrimages and festival celebrations in the name of Gods are encouraged at hills and mountains even though it is a known factor that affects the ecosystem and wildlife?

These are the question I developed before and during my visit. I am able to find and collect some of the immediate answers and still work on my collected data and chronically order my findings for the use of the communities and present generation.

My strong memory stayed with me from sabbatical days:

I am so much convinced that learning and updating on a particular issue through various reference is quite different from practically visiting a place and collecting the data from the people and site visit. Though I had the desire to take initiatives for the protection and conservation of Western Ghats, I never thought that I will have the opportunity to travel to the possible extensions of Western Ghats covering six states. I have the following memory still remain with me…

01. The peaceful simple life style of indigenous people living in the forest places wherever I visited. They do not do any simple harm to the nature and their eco friendly life is a great lesson for us.

02. I got the opportunity to collect the palm leaves (Olai Suvadikal) during my visit. I felt so happy and humble to receive it in my hands. It was as so sensitive moment and I received with bowing and still I am keeping it my pooja room.

03. My memories are still fresh with all my encounters with the Tribal people, the food I have taken with them and learning their culture.

04. I had the opportunity to learn about various species of herbal plants and the treatment process by the respective tribal health advisors.

05. It is great learning from the tribal communities about their communication system through their body movements and sound languages. They approach birds and develop friendly talk through their sounds and voices.

06. I found all the traditional communities living in the mountains do not posses' individual properties but they own everything in common and they are convinced that all the resources are belong to every people and to all fauna and flora.

My personal struggles with during the sabbatical days:

When I prepared for the Sabbatical period, I prepared myself to meet all challenges. However, I faced the following struggles during my visit.

01. I planned my visit during the winter. When I travelled into dense forest areas we are attacked by insects and leeches and struggled for travelling.

02. During the visiting period, I witnessed many festival celebrations. It caused threat to wildlife. I heard continued terrible voices of wildlife which feared my travel.

03. We struggled every time to get permission from the Forest Department. It delayed our planned activities.

04. In some places we are unable to proceed due to forest fire.

05. I struggled with timely food and accommodation. But I managed myself with the available resources.

Insights and leanings from my sabbatical days for the conservation efforts:

Conservation and protection of Western Ghats is macro level issue. Based on my work experience through GREEN and the learning obtained through Sabbatical period I will implement the following learning...

01. To promote conservation efforts in our working area through our project target people at micro level to start the initiatives
02. Document all my learning and prepare a book and publish it the use of present generation and other research activities.
03. We promote youth to active part at Forest Friends Club to work collectively for the conservation efforts taken by forest department.
04. To promote coordination among the traditional medical practices into a collective forum retain the medical resources and share with one another.
05. Totally we have collected 65 palm leaves (Olai Suvadikal) and establish a Resource Information Center and further document the inside content of the palm leaves.
06. We have identified new 26 species un-named. We will proceed to get a name from International Code of Zoological Nomenclature (ICZN).
07. We will present a code of proceeding for the control of tourism to the mountain areas and reduce pollution and commercialization.
08. We will prepare and publish booklets and brochures on endangered species, animals and fauna flora to create awareness and conservation efforts for protection.

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Save Western Ghats

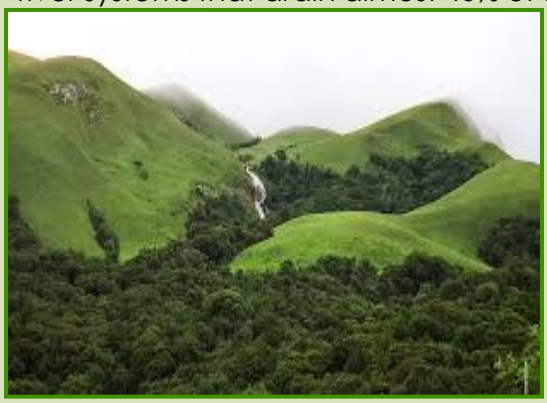
("It is time to protect biodiversity and conservation of Western Ghats")

About Western Ghats:

The Western Ghats, also known as the Sahyadri, is a mountain range that stretches 1,600 km (990 mi) along the western coast of the Indian peninsula. Covering an area of 160,000 km2 (62,000 sq mi), it traverses
the states of Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu. The range forms an almost continuous chain of mountains along the western edge of the Deccan Plateau, from the Tapti River to Swamithoppe in Kanyakumari district at the southern tip of the Indian peninsula. The Western Ghats meet with the Eastern Ghats at Nilgiris before continuing south.

Geologic evidence indicates that the mountains were formed during the break-up of the supercontinent of Gondwana. The mountains came along the west coast of India somewhere in the late Jurassic and early Cretaceous periods when India separated from the African continent. The mountains can be roughly divided into three parts: the northern section with an elevation ranging from 900–1,500 m (3,000–4,900 ft), the middle section starting from the south of Goa with a lower elevation of less than 900 m (3,000 ft), and the southern section where the altitude rises again. The Western Ghats have several peaks that rise above 2,000 m (6,600 ft), with Anamudi (2,695 m (8,842 ft)) being the highest peak. The average elevation is around 1,200 m (3,900 ft).

The Western Ghats form one of the major watersheds of India, feeding many perennial river systems that drain almost 40% of the land area of the country. Because of the higher



elevation of the Deccan plateau on the west, most rivers flow from eastwards towards the Bay of Bengal, resulting in chiselled eastern slopes and steeper western slopes facing the Arabian Sea. The Western Ghats play an important role in determining the climate and seasons in India. It blocks the rain-bearing monsoon winds flowing eastward from the Arabian Sea, resulting in rainfall along the western coast. By the time the air rises above the mountains, it becomes dry, forming a rain shadow region with very little rainfall on the leeward side towards the interior of the Deccan plateau.

The Western Ghats region is a biodiversity hotspot. It contains a large number of different species of flora and fauna, most of which are endemic to this region. At least 325 globally threatened species occur in the Western Ghats. The region was declared as a UNESCO World Heritage Site in 2012.

Bio-diversity

The Western Ghats region is a biodiversity hotspot. It consists of nearly 30% of all the species of flora and fauna found in India, most of which are endemic to this region. At least 325 globally threatened species occur in the Western Ghats.

Flora:

The Western Ghats consist of four tropical and subtropical moist broadleaf terrestrial ecoregions of the Indomalayan realm, with the northern portion of the range generally drier than the southern portion. These include the following:

Terrestrial eco-regions of Western Ghats

Region	Area	Areas covered
North Western Ghats montane rain forests[30]	**11,900 sq mi (31,000 km²)**	**Goa, Karnataka, Maharashtra, Tamil Nadu**
South Western Ghats montane rain forests[31]	**8,700 sq mi (23,000 km²)**	**Kerala, Tamil Nadu**
North Western Ghats moist deciduous forests[32]	**4,831 sq mi (12,510 km²)**	**Gujarat, Karnataka, Maharashtra**
South Western Ghats moist deciduous forests[33]	**2,382 sq mi (6,170 km²)**	**Karnataka, Kerala, Tamil Nadu**

Other types of ecosystems include dry deciduous forests on the leeward rain shadow region, scrub forests at the foothills, peat bogs, and swamps. Montane grasslands are found in high altitude locations in the south Western Ghats interspersed with sholas, a unique type of stunted tropical montane forest found in the valleys between the mountains.

Earlier sources indicated about four to five thousand vascular plant species of which nearly one-third was endemic to the region. Later studies and publications have recorded 7,402 species of flowering plants occurring in the Western Ghats of which 5,588 were described as indigenous, 376 are naturalized exotics, and 1,438 species are cultivated or planted. Among the indigenous species, 2,253 species are endemic to India and of them, 1,273 species are exclusively confined to the Western Ghats. 645 tree species were recorded with a high endemic ratio of 56%. There are 850 – 1000 species of bryophytes including 682 species of mosses (28% endemic) and 280 species of liverworts (43% endemic), 277 species of pteridophytes and 949 species of lichens (26.7% endemic).

Fauna

The Western Ghats are home to thousands of species of fauna, including at least 325 globally threatened species. As per a 2010 report, following is the distribution of faunal species in the Western Ghats apart from more than 6,000 insect species.

Fauna of Western Ghats (2010)

Taxonomic group	Species	Endemic	% Endemic	Endangered
Mammals	**120**	**14**	**12%**	**31**
Birds	**508**	**19**	**4%**	**15**
Amphibians	**121**	**94**	**78%**	**43**
Reptiles	**156**	**97**	**62%**	**5**
Fishes	**218**	**116**	**53%**	**1**

The Western Ghats region has one of the highest tiger population, estimated at 985 in 2022. The Western Ghats ecoregion has the largest Indian elephant population in the wild, with an estimated 11,000 individuals across eight distinct populations. Other mammals include endangered and vulnerable species such as the lion-tailed macaque, Nilgiri tahr, leopard, Nilgiri langur, dhole, and gaur. The endemic Nilgiri tahr, which was on the brink of extinction, has recovered and had an estimated 3,122 individuals in 2015. Smaller endemic species include the Malabar large-spotted civet, Nilgiri marten, brown palm civet, stripe-necked mongoose, Indian brown mongoose, small Indian civet, and leopard cat.

Nilgiri tahr

As per a 2014 report, at least 227 species of reptiles are found in the Western Ghats. The major population of the snake family Uropeltidae is restricted to the region. Several endemic reptile genera and species occur here, with the region having a significant population of mugger crocodiles. The amphibians of the Western Ghats are diverse and unique, with a high proportion of species being endemic to the tropical rainforests of India. New frog species have continued to be discovered in the 21st century. Frogs of the genera *Micrixalus, Indirana*, and *Nyctibatrachus*, toads like *Pedostibes, Ghatophryne*, and *Xanthophryne*, arboreal frogs like *Ghatixalus, Mercurana*, and *Beddomixalus*, and microhylids like *Melanobatrachus* are endemic to this region.

There are at least 19 species of birds endemic to the Western Ghats including the endangered rufous-breasted laughingthrush, the vulnerable Nilgiri wood-pigeon, white-bellied shortwing, and broad-tailed grassbird, the near threatened grey-breasted laughingthrush, black-and-rufous flycatcher, Nilgiri flycatcher, and Nilgiri pipit, and the least concern Malabar (blue-winged) parakeet, Malabar grey hornbill, white-bellied treepie, grey-headed bulbul, rufous babbler, Wayanad laughingthrush, white-bellied blue-flycatcher, and the crimson-backed sunbird.

Fishes and molluscs

There is a higher fish species richness in the southern part of the Western Ghats. There are 13 genera entirely restricted to the Western Ghats

The most species-rich families are the Cyprinids (72 species), hillstream loaches (34 species; including stone loaches, now regarded a separate family), Bagrid catfishes (19 species), and Sisorid catfishes (12 species). The region is home to several ornamental fishes like the Denison (or red line torpedo) barb,[60] melon barb, several species of *Dawkinsia* barbs, zebra loach, *Horabagrus* catfish, dwarf pufferfish and dwarf Malabar pufferfish. The rivers are also home to *Osteobrama bakeri*, and larger species such as the Malabar snakehead, and Malabar mahseer.

A few are adapted to an underground life, including some *Rakthamichthys* swamp eels, and the catfish *Horaglanis* and *Kryptoglanis*. 97 freshwater fish species were considered threatened in 2011, including 12 critically endangered, 54 endangered, and 31 vulnerable. The reservoirs in the region are important for their commercial and sport fisheries of rainbow trout, mahseer, and common carp.[65] There are more than 200 freshwater fish species including 35 also known from brackish or marine water.[66] Several new species have been described from the region since the last decade (e.g., *Dario urops* and *S. sharavathiensis*).
Seasonal rainfall patterns in the Western Ghats necessitate a period of dormancy for its land snails, resulting in their high abundance and diversity, including at least 258 species of gastropods from 57 genera and 24 families. A total of 77 species of freshwater molluscs (52 gastropods and 25 bivalves) have been recorded from the Western Ghats, but the actual number is likely higher. This includes 28 endemics. Among the threatened freshwater molluscs are the mussel species Pseudomulleria dalyi, which is a Gondwanan relict, and the snail Cremnoconchus, which is restricted to the spray zone of waterfalls. According to the IUCN, four species of freshwater molluscs are considered endangered and three are vulnerable. An additional 19 species are considered data deficient.

Tamil lacewing, an endemic butterfly

Insects

There are roughly 6,000 insect species. Of the 334 Western Ghats butterfly species, 316 species have been reported to occur in the Nilgiri Biosphere Reserve. The Western Ghats are home to 174 species of odonates (107 dragonflies and 67 damselflies), including 69 endemics. Most of the endemic odonate are closely associated with rivers and streams, while the non-endemics are typically generalists. There are several species of leeches found all along the Western Ghats.

Threats and conservation

Historically, the Western Ghats were covered in dense forests which formed the natural habitat for wildlife along with the native tribal people. Its inaccessibility made it difficult for people from the plains to cultivate the land and build settlements. After the establishment of British colonial rule in the region, large swathes of territory were cleared for agricultural plantations and timber. The forests in the Western Ghats were severely fragmented due to clear-felling for plantations. The introduction of non-native species threatened the rare endemic species and habitat specialists, which depleted faster than other species. Complex and species-rich habitats like the tropical rainforests are much more adversely affected than other habitats. The primary threats to fauna were not only

from habitat loss, but also from overexploitation, illicit grazing, mining, poaching, and introduced species.

The Government of India has established many protected areas, including two biosphere reserves, 13 national parks to restrict human access, several wildlife sanctuaries to protect specific endangered species, and many reserve forests. The Nilgiri Biosphere Reserve, comprising 5,500 km^2 (2,100 sq mi) of the forests, forms the largest contiguous protected area in the Western Ghats. In August 2011, the Western Ghats Ecology Expert Panel (WGEEP), appointed by the Union Ministry of Environment and Forests to assess the biodiversity and environmental issues of the Western Ghats, designated the entire region as an Ecologically Sensitive Area (ESA) and assigned three levels of Ecological Sensitivity to its different regions. Subsequent committees formed have recommended various suggestions to protect the region. In 2006, India applied to the UNESCO Man and the Biosphere Programme (MAB) for the Western Ghats to be listed as a protected World Heritage Site. In 2012, 39 sites divided into seven clusters across the Western Ghats, were declared as World Heritage Sites.

Habitat preservation in the Western Ghats can help enhance biodiversity in the hotspot

- The Western Ghats of India are rich in biodiversity and species endemism owing to their unique terrain and habitats.

- Several habitat and climatic factors influence evolutionary processes and play an important role in shaping this diversity.

- Biodiversity enriches ecosystem services providing reasons to develop better policy and management strategies for habitat preservation.

The Western Ghats of India are broadly divided into three subdivisions — the northern, central and southern — separated by the Goa gap and the Palghat gap respectively. Due to their climatic stability and terrain ruggedness, they are a museum and cradle of species diversity. Over the years, a series of studies on a range of habitats in the Western Ghats have shown how drought, rainfall and elevation, influence evolutionary processes and play an important role in shaping this rich diversity.

Habitat preservation and restoration is vital to conserve and enhance biodiversity, which in turn can boost the various ecosystem services they provide.

The habitat-diversification connection:

In one of the first studies on rock dwelling fauna, published in January 2023, a group of scientists found that even species that can adjust to extremely variable climates on lateritic plateau habitats are vulnerable to changes to land-use pattern, such as agro-forestry and paddy cultivation. Habitats classified as wastelands are vulnerable to land-use change which reduces the area of suitable habitat for the amphibian and reptile species found here, negatively impacting their diversity and abundance. While most studies focus on land-use change impacts on forested habitats, the understanding of how it affects biodiversity in unique lateritic plateaus has remained limited.

In the study, which is currently a preprint that needs to be certified by peer review, researchers from the Nature Conservation Foundation, Bombay Environmental Action Group, and Reliance Foundation compared the prevalence of two endemic herpetofauna in the northern Western Ghats — Seshachari's caecilian (*Gegeneophis seshachari*) and white-striped viper gecko (*Hemidactylus albofasciatus*) — with a commonly found snake, the saw-scaled viper (*Echis carinatus*), as well as the composition of other rock-dwelling animals across undisturbed plateau sites, agroforestry plantation sites and abandoned paddies on plateaus. They found that the responses of species to land-use change were context specific.

Studies on land-use change impacts on forested habitats and their impacts on biodiversity in unique lateritic plateaus has remained limited.

The conversion of lateritic plateaus to agroforestry plantations and paddy negatively impacted the threatened and endemic reptile *H. albofasciatus* and the generalist snake *E. carinatus*. But interestingly, *G. seshachari*, an endemic amphibian that occurs in forests and plateaus, was more prevalent in the abandoned paddy than in less-disturbed plateaus and orchards in the Western Ghats.

In another study from 2022, of Myristica swamps in the Western Ghats, scientists from the Ashoka Trust for Research in Ecology and the Environment (ATREE) found that seasonal flooding also influences species diversity – particularly that of the nutmeg species famously known in the region. The study found that seasonal flooding in the Western Ghats diversified the ecologically important Myristicaceae family of which Myristica fragrans, commonly known as *jaiphal* (nutmeg), is also economically important as a source of local livelihood.

Insect species also abound in plenty in the Western Ghats (WG). A separate 2021 study of 19 species of scolopendrid centipedes shows that as the latitude increases, the diversity of the insects decreases. The southern WG had the highest diversity and endemism. On the other hand, the northern WG, despite having low diversity, had high values of endemism represented by distinct lineages adapted to life in lateritic plateaus, which is characterised by poor soil conditions and high seasonality.

Factors driving high diversity

Another recent study from December 2022 has found that the diversity gradient in the Western Ghats is likely driven by high geo-climatic stability in the southern region and the tendency of species to retain their ancestral traits for moist and seasonal sites. Besides, the higher topographic heterogeneity in the lower latitudes, allow for both persistence and higher diversification rates. Across all evolutionary depths, while some lineages do manage to occur in the more seasonal and drier northern WG, it is the south in which higher diversity persists. This has been attributed to low seasonality and higher water availability, notes the paper which is currently a pre-print and not yet certified by peer review.

While climatic variables in terms of drought seasonality, rainfall and elevation shape the evolutionary diversity, there are also several habitat related factors that drive this diversity.
Another study (currently under review in the journal Limnology and Oceanography) examined temporary rock-pools on the lateritic plateaus in the northern Western Ghats.

These habitats are often overlooked, but are known to support diverse, often endemic species, many of which are new to science. The authors followed the trajectory of arthropod communities in these pools throughout their filling and drying cycles. Mihir Kulkarni, scientist at Centre for Cellular and Molecular Biology and the lead author in this study, says rich biodiversity in these habitats can be best preserved and maintained by protection of the entire landscape which harbours multiple pools differing in their environmental conditions rather than individual pools.

Rising threats and conservation measures

Many species in the Western Ghats are under pressure due to rapid change of habitat patterns. The loss of diversity and its effect on ecosystem services highlight the importance of conservation in the region.

For example, a study by ATREE, published in the journal Plant Diversity, shows that rattans, or canes are one of the most important non-timber forest products supporting the livelihood of many forest-dwelling communities in south and northeast India. But due to increased demand for rattan products, rattans have been extracted indiscriminately.

Loss of habitat and poor regeneration have resulted in dwindling rattan populations, necessitating an urgent attempt to conserve existing rattan resources. The study identified at least two to three sites of extremely high species richness outside the existing protected area network that should be prioritized for in situ conservation.

Similarly, the diversion of Myristica swamps for agriculture in Western Ghats and south-east Asia is pushing many Myristicaeae species to extinction. According to the IUCN Red Data List, 174 species are threatened from the Indian subcontinent and Southeast Asia, along with 9 of the 10 species native to Madagascar. Extensive and premature harvesting have led to low seed viability.

"The species could have reached the 'endangered' level. This calls for a proper assessment to look into the matter," said Shiva Prakash, the lead author of one of the papers on Myristica swamps. He added that efforts to restore swamps and other habitats with the support of state forest departments have helped preserve species including of *Myristicaceae* in the Western Ghats. These have also demonstrated that preservation and restoration can help biodiversity conservation.

According to Jahnavi Joshi, from the Centre for Cellular and Molecular Biology, "The Maharashtra part of the Western Ghats is home to unique biodiversity. A large portion of the forests in the region is privately owned. These are getting degraded due to periodic clear-felling and converted into rubber, cashew and mango plantations." Her group is documenting the impacts of habitat degradation and conversion on biodiversity and is working on ecological restoration with local stakeholders.

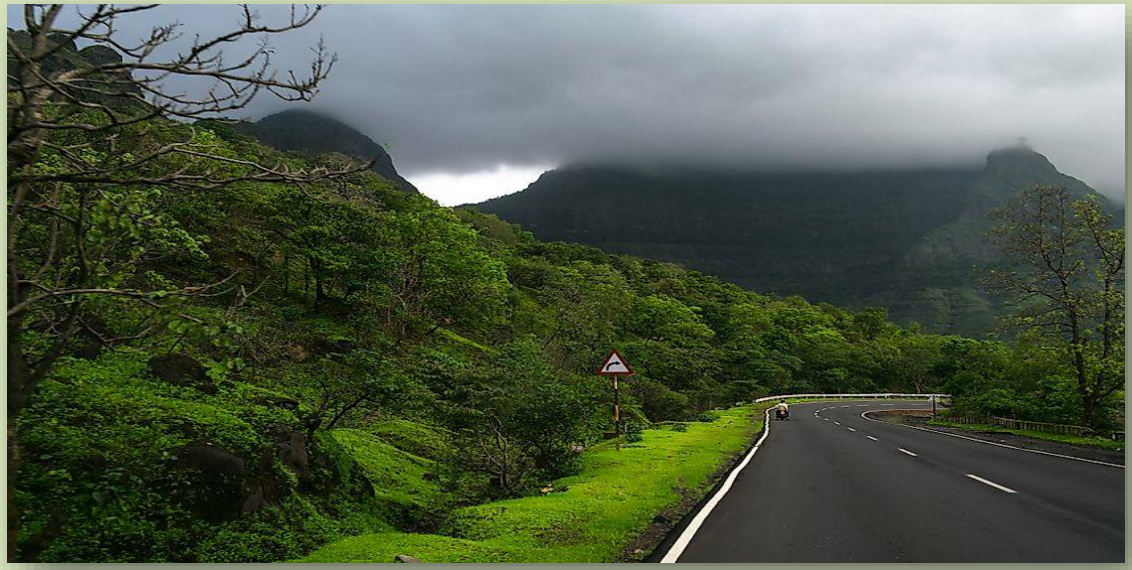
Such studies emphasise the need to develop strategies for long-term conservation in the Western Ghats. While ecological and evolutionary insights provided by these studies can help inform conservation policy, unpacking evolutionary history of traits can provide insights into adaptive evolution and support conservation efforts. The researchers underline that restoration of habitats and preservation of their diversity could be taken up for nature-based conservation of species.

Western Ghats Biodiversity Hotspot

Malabar giant squirrels in the forests of the Western Ghats biodiversity hotspot.

As one of the world's "hottest biodiversity hotspots" and a UNESCO World Heritage Site, the Western Ghats is on the conservation watch-list for being a rich but highly vulnerable region in urgent need of biodiversity conservation efforts. Despite the negative effects of human activity and climate change, new species continue to be added to the endemic list of species that are recorded here including 16 birds, 124 reptiles, 159 amphibians, 16 mammals, 189 fishes, 69 odonates, 36 butterflies, and 1,600 flowering plants.

Also referred to as 'Sahyadri', the Western Ghats is a highland region of rolling hills and snow-covered mountains that are about 45 to 65 million years old, and stretch for 1,600 km along the western coast of India. The Western Ghats begins from the town of Songadh, at the south of Tapti River near the Gujarat-Maharashtra border and extend till Kanyakumari, at the southernmost tip of India. Covering a total area of 160,000 sq. km, the Western Ghats traverses the six Indian states of Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu, and Kerala. The Ghats reach their final point at the Marunthuvazh Malai, in the village of Swamithope, in the state of Tamil Nadu. The Nilgiri Mountains located in the southern part of the Western Ghats serves as its meeting point with the Eastern Ghats.



"Malshej Ghat is a mountain pass in the Western Ghats range in the Thane-Pune Road of Maharashtra, India".

The northern hills of the Western Ghats have an average elevation of 1,220m and are comparatively much lower and gentler than the taller southern hills. The extensive mountain chain of the Western Ghats is interrupted by a few gaps, of which the Goa Gap and the Palghat Gap are the most prominent. Situated in the Indian State of Kerala on the boundary between the Idukki and Ernakulam districts is the Anamudi Mountain, which rises to an elevation of 2,695m and is the highest point in the Western Ghats.

The Western Ghats perform vital hydrological and watershed functions and forms one of the four watersheds of India that feeds the perennial rivers draining about 40% of the entire Indian subcontinent. Many significant river systems originate in the Western Ghats, including the Godavari, Krishna, Kaveri, Tungabhadra, Thamiraparani, and their tributaries. These rivers host numerous economically important fishes and carry large volumes of rainwater during the summer monsoons. Several waterfalls are found in the Western Ghats including Jog, Dudhsagar, Athirappilly, Shivanasamudra, etc. Some of the principal man-made lakes that are found here include Ooty, Karlad, Devikulam, Kodaikanal, etc.

Some major rock types found in the Western Ghats are granites, charconites, khondalites, and leptynites along with crystalline limestone, iron ore, dolomites, and anorthosite. The southern hills also contain sufficient quantities of bauxites.

Climate

The climate of the Western Ghats varies greatly with altitude and the area's distance from the Equator. The lower reaches of the Ghats experience a 'tropical humid' climate which is moderated by the area's proximity to the sea. During the monsoons, the Western Ghats act as a barrier to the rain-bearing clouds. Therefore, the windward side receives comparatively higher rainfall than the eastern part of the Ghats which is located in the rain-shadow area.

Biodiversity in India's Western Ghats

When one thinks of the world's great rainforests the Amazon, Congo, and the tropical forests of Southeast Asia and Indonesia usually come to mind. Rarely does India—home to over a billion people—make an appearance. But along India's west coast lies one of the world's great tropical forests and biodiversity hotspots, the Western Ghats. However, it's not just the explosion of life one finds in the Western Ghats that make it notable, it's also the forest's long—and ongoing—relationship to humans, lots of humans. Unlike many of the world's other great rainforests, the Western Ghats has long been a region of agriculture. This is one place in the world where elephants walk through tea fields and tigers migrate across betel nut plantations. While wildlife has survived alongside humans for centuries in the region, continuing development, population growth and intensification of agriculture are putting increased pressure on this always-precarious relationship.

"The Western Ghats are home to more than 1,000 vertebrate species and nearly 5,000 angiosperms [flowering plants] including many that are endemic to the region. What also makes the Western Ghats a crucial conservation region is the fact that it harbors large, contiguous populations of charismatic megafauna such as tigers, Asian elephants and gaur (a large wild cattle)," the researchers explained to mongabay.com in an interview. "Endemism [species found no-where else] is particularly high among amphibian, reptile and plant groups, and these groups contain perhaps the most threatened species. Point endemism (species known to occur in just one location) is particularly common among amphibians,"

The word 'ghats' refers to a series of steps leading to a sacred river. Here, the steps are really a long range of hills and mountains covered in tropical vegetation. These hills drain

water into large river systems which according to the researcher benefits 'over 200 million people'. A wholly unique forest, the Western Ghats also serves as a longstanding agricultural area. According to the researchers, 75 percent of the Western Ghats is unprotected and largely used in various ways for agriculture. Despite such widespread human presence, the researchers say the Western Ghats' biodiversity and human populations have long lived in a relatively balanced state.

"Human-modified landscapes in the Western Ghats, although densely populated by people (261 per square kilometer), show two features that are favorable for biodiversity conservation," the authors explain.

"First, the human land use is largely restricted to plantation agriculture, horticulture and forestry resulting in high tree cover across the region. Second, and more importantly, patches of forest, riparian vegetation and swamps are still to be found on private lands, community lands and government lands, interspersed with production areas. These features combine to create favorable habitat and dispersal corridors for a number of organisms, ranging from invertebrates to mega-fauna." Yet, as in much of the world, the situation is changing rapidly for the forests of the Western Ghats, perhaps too rapidly.

"Intensive production land use continues to expand, at the expense of both traditional, relatively biodiversity-friendly land use and remnant natural habitats. We are at a very crucial juncture at the moment," the authors say, adding that an influx of people, increased consumption, and big development projects are putting additional pressure on the landscape. So, how do we protect the biodiversity-friendly features of agricultural landscapes in the Western Ghats in the face of these emerging threats before its too late?

The key, according to the researchers, is to think outside the box by looking towards alternate conservation models that complement the existing network of protected areas. Conserving the unprotected forests that serve as rest-stops in human-modified landscapes for the rainforest's many moving parts, and pushing for a return to the long-standing tradition of biodiversity-friendly agriculture are the most important tasks in the Western Ghats.

"Safeguarding and restoring these natural remnants might have a greater positive impact on biodiversity conservation than, say, solely promoting diverse shade plantation over monocultures. A holistic approach that covers both strategies would, of course, be ideal," the researchers say, adding that for any expansion of forest protection would require "[looking] at protection schemes which permit for multiple uses of landscapes. Options such as 'community reserves' and 'conservation reserves' which exist in the

current conservation policy but are mostly under-utilized need to be considered more seriously".

Fortunately, the people of the Western Ghats do not largely view wildlife as competition or pests, the authors point out. In general, even big destructive mammals, such as elephants, are not persecuted in the area. The region, they say, has a healthy conservation ethic. But without creative, forward-looking plans and regulations, combined with earnest implementation of laws governing both wildlife conservation and land ownership rights, the tenuous balance between the people and the biodiversity (and in that sense the whole ecosystem) of the Western Ghats may not last.

"It is hard for us to say whether people's attitudes to biodiversity and conservation are changing, but the growing human population coupled with increasing consumption automatically reduces the space available for biodiversity. Along with this growth, our ability to harm biodiversity—deliberately or inadvertently—is constantly increasing, through improved technology, more potent agricultural chemicals and other forms of agricultural intensification. These two drivers together can be devastating for biodiversity in the Western Ghats human-modified landscapes in the very near future," they warn.

In an August 2011 interview four researchers discuss the special characteristics of one of India's greatest tropical forests, the Western Ghats; the challenges given the needs of humans as well as wildlife; and the need for more research in the region.

A background review of agriculture and biodiversity in India

Executive Summary

1. BACKGROUND India has achieved sustainable economic growth over the past three decades. By the early 1990s, India instituted economic liberalization measures, which included industrial deregulation, privatization of state-owned enterprises, and reduced controls on foreign trade and investment. These steps, coupled with the country's endowment of natural resources and its young and growing labour force, helped to accelerate the country's growth, which averaged nearly 7% per year from 1997 to 2017. Over the past few decades, the manufacturing and services sectors have increasingly spearheaded the country's economic growth, while the agriculture sector's contribution has declined from more than 50% of GDP in the 1950s to 16.8% in 2017.

However, agriculture remains the mainstay of the economy and a major source of employment to nearly half of the 1.28 billion Indians. In 2016, about 54.6% of the total population was engaged in agriculture and the sector accounted for 47% of the total employment. India ranks second worldwide in arable land (159 million hectares); it is

second largest producer and number one exporter of rice; second top world producer of wheat; second world producer of groundnuts, fruits, vegetables; and sugarcane; first in Jute and the world largest producer of milk. About 85.5% smallholders operate on less than two hectares mostly producing rice, wheat, pulses, spices, vegetables and other cereals. There are two major agricultural seasons in India: Kharif (summer, from April to September) and Rabi (winter, from October to March). Rice is predominantly cultivated in Kharif while wheat is Rabi's main crop.

2. PROBLEM DEFINITION: Challenges to sustainable agriculture and biodiversity in India Globally, food systems are now the source of 60% of terrestrial biodiversity loss, 33% of soil degradation and 61% of the depletion of commercial fish stocks. The situation in India is almost consistent with these global statistics. Addressing the negative impacts on biodiversity is critical, given that India is one of the 17 megadiverse countries in the world. India is well endowed with biodiversity and has been identified as one of the eight important "Vavilorian" centres of origin and crop diversity. The country has about 8% of the total worldwide biodiversity with an estimated 49,000 species of plants, 10% of which are endemic. It boasts of faunal diversity including 25000 fishes, 197 amphibians, 408 reptiles, 1,200 birds and 350 mammals.

The southern part of India including the southern Western Ghats encompass more than 6000 species of higher plants, 2000 of which are endemic. Of the 34-world biological 'hot spots' (areas of greater biological endemism in the biosphere), four are in India, the Eastern Himalayas, Western Ghats, Andaman and Nicobar Island chain, and North East of India and part of Indo-Burma. As well as scoring highly on biodiversity indicators, India is also considered as a repository for traditional knowledge of biological resources. With respect to agricultural biodiversity, India is a center of origin and diversity of crops, with 811 cultivated plants and 902 of their wild relatives documented in 2015. India also contains a broad spectrum of native breeds of farm animals. According to the IUCN, 758 species of plant and animal are listed as threatened. iii in terms of drivers and pressures, India experiences threats to biodiversity from agricultural conversion, a major driver of deforestation in some regions.

Land use change, driven by agricultural expansion, is creating fragmentation and loss of forests, grasslands, wetlands and other habitats. Agricultural intensification, agrochemicals, and eutrophication from agriculture runoff are causing pressures on biodiversity both on terrestrial and marine habitats. The pressures of livestock grazing on forests and grasslands are severe. India has the world's largest livestock population, constituting 15% of the global total in 2.4% of the global geographical area. High density of livestock population contributes to the degradation of soils. Of the 10 biogeographic zones of India, 9 are experiencing threats to biodiversity from agricultural and livestock activities.

In addition to agricultural impacts, several other factors have been cited as leading causes of India's biodiversity loss including escalating population, habitat degradation and fragmentation, landscape change, pollution, climate change, invasive alien species and over exploitation of natural resources. On the other hand, the agriculture sector itself is facing numerous challenges. To attain food self-sufficiency, India adopted the 'Green Revolution' strategy in the mid-1960s. This heightened the use of modern technology, high yielding crop varieties, chemical fertilizers, irrigation facilities, and improved farm implements and crop protection measures. By the 1980s, India was largely self-sufficient in food grain production. However, the drive to increase agri-food production has had a major toll on the environment, leading to loss of soil fertility, soil erosion, soil toxicity, diminishing water resources, pollution of underground water, salinity of underground water, increased incidence of human and livestock diseases, and global warming.

Today, India is one of the countries with the highest rate of greenhouse gas emissions in agriculture coming second after China. While agriculture is a key driver of environmental degradation, it is above all other industries, the most reliant upon a well-functioning environment. Consequently, it is vulnerable to temperature extremes, water availability, atmospheric soil and water pollution, pest and disease outbreaks, biodiversity loss, tropospheric ozone, high winds, among others.

Presently, Indian agriculture is facing the critical challenge of feeding an escalating human population (1.25 billion) under increasingly declining soil quality, land and water scarcity and changing climatic conditions. Water shortage is a serious threat to sustainable agriculture in India. Irrigation, the most common alternative to rainfed agriculture, has led to alarming rates of ground water exploitation and depletion. India's water availability per capita was over 5,000 m3 per annum but is projected to decline to 1,500 m3 by 2025.

The agriculture sector, which is the largest user of water, accounting for about 80% of the water withdrawals, is likely to be the main victim. It is projected that India's water availability for agricultural use could decline by 21% by 2020, which would result in yield reduction of irrigated crops, especially rice. iv Although currently no major studies exist to show the effects on agriculture, climate change still poses potential threats to the sustainability of agriculture and food security in India, especially given that about 62% of India's cropped area is rainfed. Nonetheless, some projections have been made. For instance, a study by Singh et al. (2017), indicated that by 2050, 15% – 40% of the rainfed rice cultivating areas would be at risk of decline in climate suitability or become completely unsuitable. However, they highlighted variations across the country with the eastern and northern India being at more risk than central and western parts of the country, which could benefit from increased precipitation.

According to the Government of India (2008), every 1 °C increase in temperature reduces the Rabi crop (wheat) production by 4 – 5 million tonnes. Overall, the agricultural system is both a driver and a victim of environmental change.

3. CURRENT SITUATION: India's national level strategies and policies India has embraced sustainable agriculture and biodiversity conservation, through a variety of national level strategies and policies, which have evolved over time. These include Twelfth Five-Year Plan (2012-2017) which emphasized sustainable management of natural resources and agriculture. In addition, the National Agricultural Policy (NAP) 2000 sets out clear objectives and measures for all the important sub-sectors of agriculture. Until 2020, this policy aims to attain an agricultural growth rate of more than 4% per annum through the efficient use of natural resources and a combination of other measures. The main elements of the policy include: Efficient use of natural resources, while conserving soil, water and biodiversity• Growth with equity, i.e. growth which is widespread across regions and farmers• Growth that is demand-driven and caters to the domestic markets and maximizes benefits• from exports of agricultural products in the face of challenges arising from economic liberalization and globalization. Growth that is sustainable technologically, environmentally and economically.• Furthermore, the National Policy for Farmers (NPF) 2007 was implemented with the main objectives of improving agricultural productivity to improve net income of farmers. It emphasizes increased productivity, profitability, institutional support, and improvement of land, water and support services. On 6 February 2014, the Government approved the National Agroforestry Policy, making India one of the first countries to adopt agroforestry policy. It is envisaged that the policy will enable farmers to reap the benefit of agroforestry to meet the country's population demand for food, fodder, firewood and timber; conserving biodiversity and protecting wildlife; and holding and repairing soils, against a backdrop of shrinking land and water resources for agriculture and the threat of climate change.

India is undertaking many steps to halt and reverse the pressures on biodiversity arising from the agri food sector. For instance, the promotion of organic farming through a certification scheme has seen an increase from 42,000 hectares in 2004 to 1,050,000 hectares in 2010 of area under organic farming. India has added three million hectares of forest in the last decade through targeted programs such as Green India Mission and reformed fertilizer pricing to encourage soil biodiversity. India is also party to a number of international conventions that promote forest and biodiversity conservation. These include: 'Convention on Biological Diversity (CBD), 1992. India has come up with various national strategies, legislation and administrative instruments to address the obligations under the conventions. For instance, under the CBD (1992), the country has implemented its National Biodiversity Action Plan (NBAP) since 2008. The NBAP is broadly aligned to the global Strategic Plan for Biodiversity 2011 – 2020 adopted under the aegis of the

Convention on Biological Diversity (CBD) in 2010. The plan was updated in 2014 during which time 12 National Biodiversity Targets were developed using 20 Aichi Biodiversity Targets as a framework. In line with the Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets, India's NBAP is developed with the aim of addressing the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society and reducing the direct pressures on biodiversity and promoting its sustainable use.

In its effort to address the effects of climate change in the country, on June 30, 2008, India officially released its National Action Plan on Climate Change. The action plan outlines several steps required to advance development and climate change-related objectives. By 2016 India had spent Rs.157.14 crore (about US$ 17.2 million) on Integrated Farming System activities (promoted under Rainfed Area Development – a key component of National Mission for Sustainable Agriculture under National Action Plan on Climate Change) which covered about 32,740 ha comprising 4,245 ha of livestock based farming system, 9,727 ha of dairy based farming system, 1,609 ha of fishery based farming system, 7,408 ha of horticulture based farming system, 5,105 ha of agro-forestry based farming system, 472 ha of silvi-pasture based farming system and 4,174 ha of cropping system with peripheral plantations (Government of India, 2017). India has also expressed interest in combating global climate change. At the 2015 United Nations Climate Change Conference, India submitted an Intended Nationally Determined Contribution (INDC) and made a commitment to reduce the emissions intensity of its GDP by 20 to 25 percent by 2020 from 2005 level.

4. **ACCOUNTING FOR ECOSYSTEM IMPACTS AND DEPENDENCIES** Despite well intended national policies and strategic plans, there is a long road ahead to close the gap between aspiration and application. Mainstreaming biodiversity and ecosystem values into the agrifood value chain remains a major challenge. Consequently, the expansion of agricultural land in India remains the key drivers to ecosystem services and biodiversity loss. There is increased concern on the potential environmental effects from agriculture. However, there is paucity of studies assessing environmental impacts of agri-food systems across the value chain in India. A few studies conducted mostly at farm gate point towards significant impacts on biodiversity, climate change and natural resources. One case study is outlined here. vi Agricultural land use to meet the demands of a growing population, changing diets, and lifestyles is a key driver of biodiversity loss in India Biodiversity offers several benefits, including pollination and nutrient cycling, that are key to human health and the economy. Unfortunately, in the past 500 years, over 300 vertebrate species have been obliterated, and many more are under threat of extinction; and agriculture is a key driver of biodiversity loss (European Commission, 2016). A study by Chaudhary and Kastner (2016) employed the countryside species area relationship (SAR) model to estimate the mammals, birds, amphibians and reptile's species lost due to agricultural land use in 804 regions globally. The study combined this

measure of species lost with high spatial resolution global maps of crop yields to compute species lost per ton for 170 crops in 184 countries. Then, the study linked the impacts per ton with the bilateral trade data of crop products to calculate the land use biodiversity impacts embodied in international crop trade and consumption. Finally, the impacts per ton were multiplied by each country's volumes of current crop production (in tons) to identify which crop causes high land-use impacts. This process helped to identify the hotspots of biodiversity loss due to global agricultural land use. The findings showed that wheat, rice and maize land use contributed to 2,220 species lost (40% of global agricultural land use impacts). Such results did not come as a surprise because together these three crops occupy 40% of global cropland. Surprisingly, crops such as sugarcane, palm oil, coconut, cassava, rubber and coffee contributed to 23% of global land use impacts, which was quite high given that together they only occupy less than 10% of global cropland. The Figure below shows the top-ranking countries for biodiversity impacts due to consumption, exports and imports.

Conservation Efforts in the Western Ghats

The Western Ghats is one of the world's ten biodiversity hotspots. This means that it contains a large number of endemic species, or those found nowhere else on Earth. In fact, about 30% of the Western Ghats' flora and fauna are endemic. This includes such iconic species as the Nilgiri tahr and the Lion-tailed macaque.

Conservation efforts in the Western Ghats are focused on protecting this unique biodiversity. One major effort is the establishment of protected areas. These areas include national parks, wildlife sanctuaries, and reserve forests. Protected areas help to conserve habitat and allow wildlife to flourish.

Another important conservation effort is the management of invasive species. Invasive species can cause great harm to native ecosystems and threaten the survival of endemic species. In the Western Ghats, efforts are underway to control invasive plants and animals. This includes removing them from invaded areas and preventing their spread into new areas.

Why biodiversity is important to humans:

Biodiversity is important to humans for many reasons.

- Firstly, biodiversity provides us with food and other resources. Over 1 billion people worldwide rely on plants and animals from the forest for their livelihoods.

- Secondly, biodiversity helps to regulate the Earth's climate and ecosystems. For example, trees and other plants absorb carbon dioxide from the atmosphere and release oxygen back into it. This helps to keep the Earth's climate stable.

- Thirdly, biodiversity helps us to protect our own health. For example, many medicines are made from plants. In addition, by keeping ecosystems healthy, we can help prevent the spread of diseases.

- Fourthly, biodiversity is important for our psychological well-being. Contact with nature can help to reduce stress and improve our mental health.

- Finally, biodiversity is important because it is unique and irreplaceable. The loss of even a single species can have consequences for an entire ecosystem.

- Overall, biodiversity is essential for the survival of humankind. We must do everything we can to protect it.

Western Ghats Future Prospects

Sustainable Development: Balancing conservation with sustainable development is crucial for the future of the Western Ghats. This involves adopting eco-friendly practices in agriculture, tourism, and infrastructure development to minimize environmental degradation.

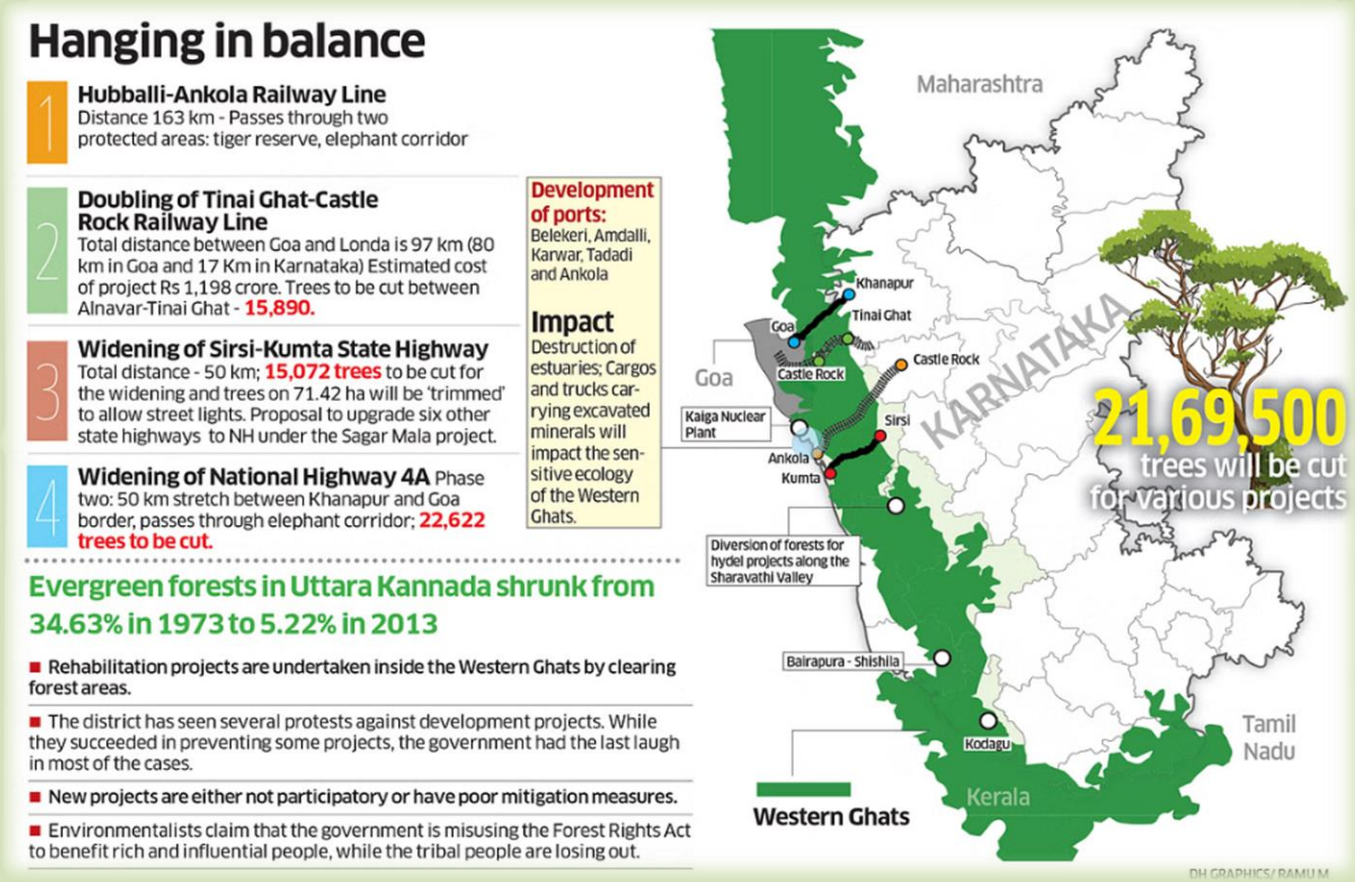
Climate Adaptation: Building resilience to climate change is essential for the Ghats' ecosystems and communities. Measures include restoring degraded habitats, creating green corridors, and implementing disaster preparedness plans.

Community Engagement: Involving local communities in conservation efforts is vital for long-term success. Empowering indigenous peoples, supporting traditional livelihoods, and promoting sustainable land-use practices can enhance conservation outcomes.

Conservation Efforts in the Western Ghats

Western Ghats face numerous threats from human activities such as deforestation, mining, and agricultural expansion. In response, a variety of conservation efforts have been initiated to preserve this ecological treasure.

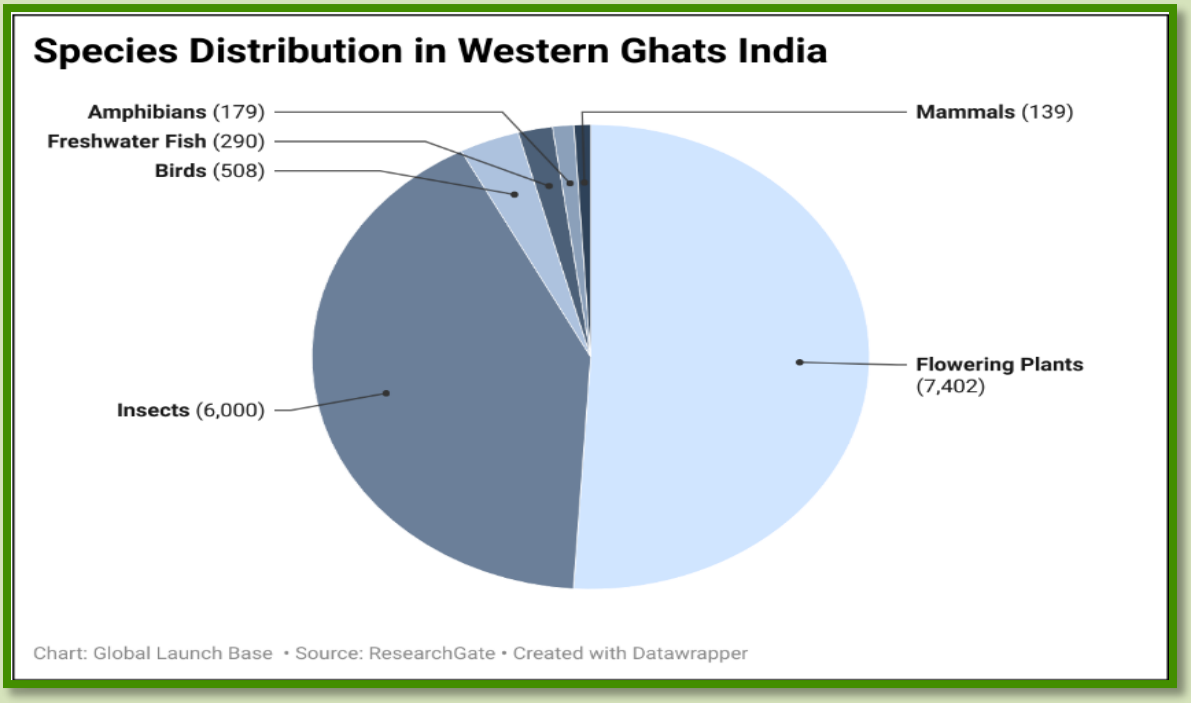
Figure 1: Western Ghat *(Source: Deccan Herald)*



Biodiversity Significance

The Western Ghats are renowned for their rich biodiversity, hosting over 7,402 species of flowering plants, 139 mammal species, 508 bird species, 179 amphibian species, 6,000 insect species, and 290 freshwater fish species. Many of these species are endemic, meaning they are found nowhere else on Earth. This incredible diversity is attributed to the Ghats' unique geographical features and climatic conditions, which create a variety of habitats ranging from tropical rainforests to montane grasslands.

Figure 2:
Species Distribution in Western Ghats India



Major Threats

Despite its ecological importance, the Western Ghats face significant threats:

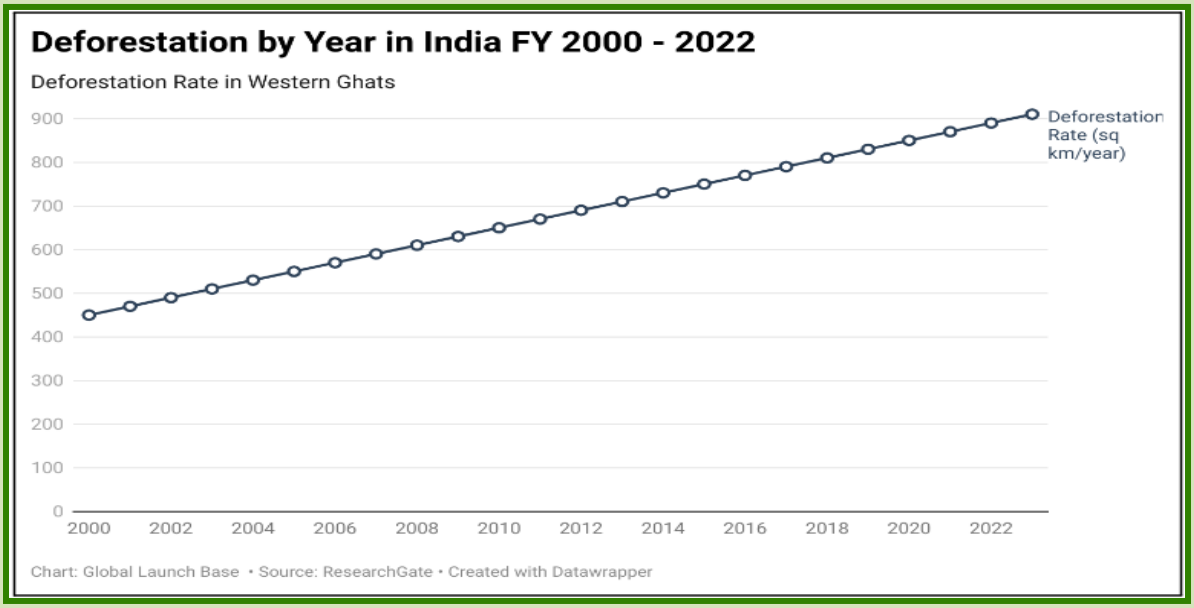
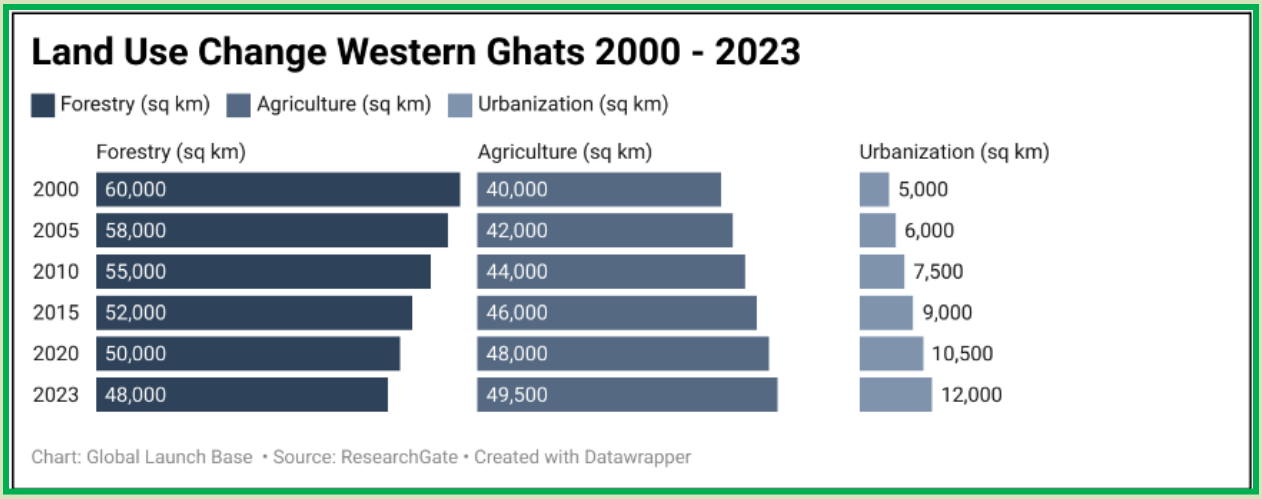


Figure 3: Deforestation by Year in India FY 2000 – 2022

Figure 4:
Land Use Change Western Ghats 2000 - 2023



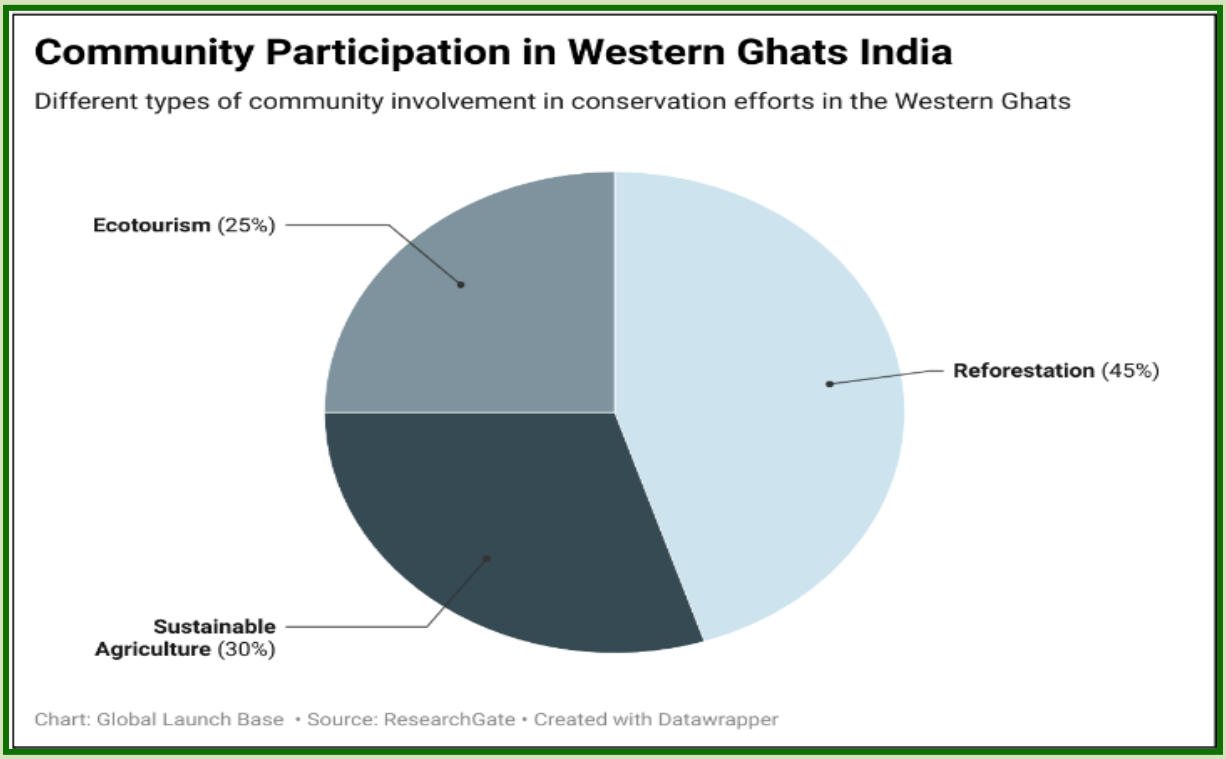
1. **Deforestation**: Logging and land conversion for agriculture and urbanization have led to large-scale deforestation, fragmenting habitats and endangering species.
2. **Mining**: Mining activities for resources such as iron ore and bauxite have resulted in habitat destruction and pollution.
3. **Hydropower Projects**: Construction of dams for hydroelectric power has altered river ecosystems, impacted aquatic life and displaced local communities.
4. **Climate Change**: Changing climate patterns threaten to disrupt the delicate balance of the Ghats' ecosystems, affecting species distribution and health.

Conservation Strategies

Project Name	Start Year	End Year	Outcome Description
Western Ghats Reforestation	2005	2010	Increased forest cover by 15%; Improved water retention capacity
Agroforestry Initiative	2012	2015	Enhanced biodiversity; Increased local community income through sustainable agriculture practices
River Restoration Program	2008	2012	Restored riparian ecosystems; Improved water quality and aquatic biodiversity
Wildlife Corridor Creation	2014	Ongoing	Facilitated wildlife movement; Reduced human-wildlife conflict
Mangrove Restoration	2010	2018	Restored mangrove ecosystems; Improved coastal protection from storms and erosion
Sustainable Tourism Initiative	2016	Ongoing	Promoted eco-friendly tourism practices; Raised awareness about conservation among tourists

Figure 5:
Community Participation in Western Ghats India

To address these challenges, a range of conservation strategies have been implemented:



1. **Protected Areas**: Establishing national parks, wildlife sanctuaries, and biosphere reserves is crucial for safeguarding critical habitats. Notable protected areas in the Western Ghats include the Silent Valley National Park, Periyar Wildlife Sanctuary, and the Nilgiri Biosphere Reserve.

2. **Community Involvement**: Engaging local communities in conservation efforts has proven effective. Initiatives such as the Joint Forest Management (JFM) program involve locals in managing forest resources, providing them with incentives for sustainable practices.

3. **Restoration Projects**: Reforestation and habitat restoration projects aim to revive degraded landscapes. The efforts include planting native species, controlling invasive species, and rehabilitating watersheds.

4. **Wildlife Corridors**: Creating and maintaining wildlife corridors is essential for ensuring genetic flow and movement of species between fragmented habitats. Projects like the Mysore-Nilgiri Corridor facilitate the migration of large mammals like elephants and tigers.

5. **Research and Monitoring**: Continuous research and monitoring are vital for adaptive management. Organizations like the Ashoka Trust for Research in Ecology and the Environment (ATREE) conduct extensive studies on the Ghats' biodiversity and ecosystem health.

6. **Sustainable Practices**: Promoting sustainable agricultural and forestry practices helps reduce the ecological footprint. Organic farming, agroforestry, and eco-tourism are examples of sustainable livelihoods that benefit both the environment and local communities.

Way Forward

Preventive Approach: Considering the changes in climate, which would affect the livelihood of all people and hurt the nation's economy, it is **prudent to conserve the fragile ecosystems.**

This will cost less compared to the situation prone to calamities than spending money /resources for restoration / rejuvenation. Thus, any **further delay in the implementation will only accentuate degrading** of the most prized natural resource of the country.

- **Engaging With All Stakeholders:** A proper analysis based on scientific study followed by **consensus among various stakeholders** by **addressing respective concerns** is required urgently.

- **Holistic view of threats and demands** on the forest land, products and services, devising strategies to address these with clearly stated objectives for the authorities involved must be taken.

- **Addressing the Concerns of Local People:** Arguments go that the idea of demarcating an ecologically sensitive area is inherently against people and their developmental aspirations. However, many of the local people might have no information on what is an ESA; whether it will derail development in the region and what are the alternative models of development. The issue can be discussed through **detailed public consultations** so that the policy is not seen to have a top-down approach.

- **Role of State Governments:** The states must recognise the dangers of destroying the ecosystem especially when India has been facing the brunt of the climate crisis. They must realise that the climate crisis is a reality, and instead of delaying the decision-making process, **devise more decisive climate-proofing actions** to save the valuable Western Ghats.

- **Empowering Local Communities:** The WGEEP emphasised that it **is the people at the grassroot level** who have the knowledge and are tied to the environment should have the motivation to safeguard the region.

- The way forward lies in the **pursuit of genuine democratic decentralisation and empowering local communities** in villages and cities. The people of Western have previously pioneered progressive initiatives such as the People's Planning Campaign in Kerala. The spirit of such movements should now be restored to **effectively counter resource exhaustion.**

There are no two views on protecting the Western Ghats, but also, there is a need to strike a balance between safeguarding the forests and the right to livelihood of the local people.

It is important to realise that the Western Ghats or any natural resource for that matter, is not just ours to destroy. It is everyone's duty to preserve it for posterity.

Let's Secure WESTERN GHATS

Today the entire world is experiencing erratic climate digression. Kerala's milieu is not distinct. The 2015-16 drought in Kerala was a precursor of the ensuing climate deviation. The Cyclone Ockhi, the torrential rains, the mudslides, and the devastating floods, all that followed are an eye-opener to the state as well as to the people. The heavy downpour and the torrential rains of 2018 and 2019 devastated the entire state, especially the regions of Western Ghats.

Previously only torrential rains of lengthy span, can trigger mudslides and landslides. But, right now a single heavy downpour can elicit potential landslides. The disastrous floods of 2018 and 2019 have catastrophic consequences in Kerala's physical, social, environmental and economic spheres - Kerala's plains and river basins, spanning roughly 50 km from the mountains to the sea, have become waterlogged, mud and sludge slit dumped, houses/buildings shattered and contagious diseases sprout up. The state's economy was crippled, many lost life and livelihood, the primary sector guttered down.

The recent disasters in Kavalappara, Pettimudi, Pathumala, Koottickal, and Kokkayar serve the realization that tragedies are impending and scientific interventions are indispensable to prevent and minimize the effects of imminent calamities. It is unanimous that the ecological biodiversity of western ghats needs to be safeguarded without fail. It is in this context the Nava Keralam karma padathi 2 -a mission mode of Government of Kerala has intervened by simultaneously strategizing techniques to resolve the prevailing issues and to confront challenges of the future by synchronizing large scale people's participation with the highest viable technology.

The worldwide scientific community has recognized the disruption of stream networks on slopes as a natural cause of landslides. Systematically tracing and reclaiming the entire watercourse networks of the Western Ghats will be a pragmatic solution to prevent the impending disasters. Such an action will secure the lives & livelihoods of the local residents and will preserve the ecosystem of the Western Ghats. The revitalisation of water courses is a great task and Navakeralam Karmapaddhati-2 envisages to achieve it by mobilizing the masses on a large scale through the participatory campaigns and through coordination of the Local Self-Government Institutions, the Mahatma Gandhi National Rural Employment Guarantee Scheme, State IT Mission, and Rebuild Kerala Initiative. It is expected that this innovative project will serve as a role model which can be replicated to other vulnerable landslide prone regions of the country.

The Western Ghats, an abundant repository of natural resources, homes to an exceptional environment and biodiversity, have a tremendous impact on Kerala's greenery, water availability, and agro fertility. The panoramic beauty of western ghats offer visual treat, making these regions of God's own Country alluring. The Western Ghats

provides immense tourism potential-economically and socially. Responsible tourism lures the local residents towards a better economic stability. Countless tourist attractions, including splashing rivers, bustling streams, majestic waterfalls, scintillating climate, fascinating landscapes, explorable trekking and abundance of flora and fauna - an experience in a lifetime. This fascinating environment should be sustained well and good for the posterity, and a secure living to the local inhabitants is to be ensured.

DETAILS OF SPECIES FLORA FAUNA IN WESTERN GHATS

Flora and Fauna:

The Western Ghats are home to over 5000 species of plants, with more than 50% of them endemic. Here one can see an abundance of evergreen and semi-evergreen trees, ferns, shrubs (many which have medicinal properties), fungi, and over 40 species of wild orchids. The large mammals have been eliminated due to excessive hunting but this environment supports an amazing range of small animal diversity (mammals, birds, reptiles, amphibians, arachnids and insects) which we have documented and recently published as a book.

Wild Orchids

Mojo is home to over 40 species of wild orchids which flower in different seasons. Ground orchids such as Pectelis gigantea, Habeneria longicornieulata, Satyrium nepalense emerge from a bulb and blossom in September/October. Most orchids are epiphytes — which means they live non-parasitically on trees for support and derive moisture and nutrients from the atmosphere. Examples of these are several species of Dendrobium and Bulbophylum, Trias, Aerides, Eria, Coelogyne and Vanda. Many flowers in the dry months between January and April, while others are adapted to flower in the monsoon rains. We have also documented a couple of species previously not recorded from Kodagu — Pachystoma pubescence and Diploprora championii.

Mammals

Mammals documented here include wild boar, barking deer, civets (2 species), Slender loris, Nilgiri marten, mongoose, porcupine, Black-naped hare and a variety of other rodents and bats.

Birds

Kodagu is home to over 250 species of birds, and almost half of them can be spotted in this area. Endemic species include Malabar grey hornbill, Malabar whistling thrush, Malabar trogon, Crimson backed sunbird, White bellied blue flycatcher, Flame throated bulbul, White-bellied tree pie and others. Winter visitors such as golden and black-naped orioles and the enigmatic Paradise flycatcher are commonly seen.

Herptofauna

With our numerous streams, tanks and dense canopies, Mojo is a hot-spot for herptofauna. The annual rains coax an incredible array of amphibian and reptile life out into the open which we are constantly documenting.

The gliding frogs (Rhacophorus malabaricus and its smaller and extremely rare cousin Rhacophorus lateralis) seem to be a favorite with everyone but there is much more to see. Here one can find many rare endemic species of reptiles such as the flying lizard – Draco dussemeri, Nilgiri forest lizard, Malabar pit viper, Kodagu striped caecilian, Blue shieldtail and more. Rat, cat and vine and wolf snakes are common and, if you are really lucky, you may even sight a King cobra.

Arachnids and Insects

Scorpions and spiders comprise the class Arachnida. Like serpents, they have been much maligned (thanks to Hollywood) and are feared. However, they are essential components of a balanced ecosystem and a farmers' best friend. We have an amazing diversity of spiders here including the **rolled leaf spider** (genus Poltys, species unknown) which was documented for the first time in India, here at Mojo Plantation and published in Sanctuary Asia.

Insects are the most successful group of animals on our planet. They have been around for 300 million years and occupy all niches. They are remarkable for their diversity and mind-boggling numbers (Scientists have calculated that ant alone out-weigh all the humans on earth). There are an estimated 20- 30 million species of which less than 1 million have been documented. Many insects have co-evolved with plants and are critical for their (and our) survival. Yet, we have relegated them to the role of 'pests. In a healthy eco-system, populations are kept in a fine balance through prey/predator/parasite relationships.

FLORISTIC DIVERSITY IN WESTERN GHATS: DOCUMENTATION, CONSERVATION AND BIOPROSPECTION– A PRIORITY AGENDA FOR ACTION

ABSTRACT

Western Ghats, being one of the global hotspots of biodiversity, supports an enormous vegetal wealth, which over the years is undergoing great stress due to anthropogenic disturbances. This region which forms the "Malabar Botanical Province" according to phytogeographers is a narrow stretch running from the hills south of Tapati River in the north to Kanyakumari in the south along the west coast of India covering the states of Goa, Maharashtra, Karnataka, Tamil Nadu and Kerala. The narrow stretch of Western Ghats running approximately 1500 km encompasses a considerable gradient of climatic conditions which have resulted in the development of diverse forest types ranging from the dry scrub types to the semi-evergreen and evergreen forests. Details of these forest types and their floristic composition are discussed. The development of the tropical rain forests in the southern Western Ghats and the 'sholas' in the Nilgiris region are the most outstanding features of Western Ghats. The entire Western Ghats biogeographic region is a major genetic estate with an enormous biodiversity of ancient lineage. Nearly 5800 species of flowering plants occur here of which 56 genera and 2100 species are endemic. Karnataka alone harbours 3900 species belonging to 1323 genera and 199 families while Nilgiris have 2611 species of flowering plants. Some dominant families are Poaceae, Leguminasae, Orchidaceae, Acanthaceae, Euphorbiaceae, Asteraceae, Lamiaceae and Rubiaceae.

Analysis of endemic species reveals that Western Ghats being much older in age compared to Himalayan mountains, support a large majority of relict or palaeoendemics. Another unique feature of the endemic flora of Western Ghats is the prevalence of monotypic genera such as Adenon, Calacanthus, Polyzygus, Erinocarpus, Frerea, Griffithella, Haplothismia, Jerdonia, Lamprochaenium, Nanothamnus, Wagatea and Willisia. Some of the arborescent genera having maximum endemic taxa are Memecylon (16 spp.), Litsea (15 spp.), Symplocos (14 spp.), Cinnamomum (12 spp.), Syzygium (11 spp.), Actinodaphne (9 spp.), Glochidion (9 spp.), Grewia (9 spp.), Diospyros (8 spp.), Dalbergia (7 spp.), Hopea (6 spp.), Drypetes (6 spp.), Poeciloneuron (2spp.), Blepharistemma, Erinocarpus, Meteoromyrtus, Otonepheli um and Pseudoglochidion. The latter five genera are again monotypic. The flora of Western Ghats, particularly southern W. Ghats shows close affinity with the flora of Sri Lanka, supporting the view that Sri Lanka was connected to South India during the geologic past. Some important species common to both regions are listed. Agasthyamalai hills, Anamalai ranges, Nilgiris and the Palni hills are the hyperdiversity

areas in Western Ghats which are also the hotspots pockets. The Western Ghats region is also a rich germplasm center of number of wild relatives of our crop plants such as the cereals & millets, legumes, tropical & sub-tropical fruits, vegetables, spices & condiments and a few others. Speciesof Piper, Oryza, Myristica, Elettaria, Amomum, Zingiber, Phaseolus, Vigna, Atylosi a, Cinnamomum and Curcuma show great variability in southern Western Ghats.

The alarming rate of loss of biodiversity in Western Ghats is a major concern today. Shifting cultivation, grazing, indiscriminate lopping, extraction of timber and fuel wood, spread of invasive alien weeds, recurrent forest fires and selective removal of certain species such as the medicinal plants have all resulted in severe destruction of the virgin forests which now survive only as pockets in the mountains summit areas. The accelerated population growth followed by expansion of agriculture, introduction of plantation crops like tea, coffee, rubber have resulted in the extermination of many taxa, endangering a number of economically important timber and other species. Discussing the major strategies for conservation, the author prioritizes certain issues for urgent action. Inventory of base line data and development of computerized databases, assessment of genetic diversity at least in wide spread taxa, identifying and conserving and monitoring the hotspot pockets of biodiversity (19 such sites are identified by the author), protection of sacred forests and special habitats, establishment of gene bank/seed bank, conservation of critically endangered species are some issues suggested for action. Discussing the utilization and management of the bio resources of Western Ghats, the author outlines the immense opportunities for Bioprospection, particularly chemo- prospecting in wild medicinal and aromatic plants, which is much neglected. Recent developments in molecular biology and biotechnology have made it possible to scan the biodiversity for molecules with potential for commercial application. Problems and prospects associated with the bioprospection of the floristic diversity are discussed. Finally, the author calls for urgent attention for generating the trained manpower in taxonomy for shouldering this big responsibility of inventorization and conservation of the rich biodiversity of Western Ghats.

INTRODUCTION

Floristic diversity refers to the variety and variability of plants in a given region. It refers to the number of types or taxa in a given region or group. Floristic diversity can be measured at any level from overall global diversity to ecosystem, community, species, populations, individuals and even to genes with in a single individual. The present write up deals with the floristic diversity of Western Ghats in the former sense, i.e., the number of individual species the region. India is one of the 12 mega diversity centers of the world where Western Ghats and the Eastern Himalayan region constitute 2 of the 25 biodiversity hotspots (Myers, 1988) representing a storehouse of several promising

economically important plants. Western Ghats or 'Sahyadris'form a chain of mountains parallel to west coast almost stretching from Tapti River in the north to Kanyakumari in the south, covering a total area of about 160,000 km^2. It lies between 220 N to 80 N and covering western border of the states of south Gujarat, Maharashtra, Karnataka, Tamil Nadu and Kerala. The Western Ghats, to a large extent, controls the ecology and biogeography of peninsular India. Phytogeographically, the Western Ghats is divided into four divisions on the basis of floristic composition i.e. (1) from river Tapti to Goa, (2) from Kalinadi to Coorg, (3) the Nilgiris and (4) the Anamalai, Palni and Cardamon hills (Rao, 1994). The Western Ghats rise up abruptly in the west to a highly dissected plateau up to 2900 m (Dodda Betta) in height and descend to the dry Deccan plains below 500 m in east. The climate is also extremely variable. The rainfall varies from 5000 mm per annum in windward areas to less than 600 mm in the leeward or rain shadow areas with prolonged dry season.

The present paper attempts to highlight the diversity of vast plant resources of Western Ghats region in a conservation perspective. However, no attempt is made to discuss the infra-specific diversity of taxa, which requires considerable amount of original research. Although the lower groups of plants (Pteridophytes, Lichens, Bryophytes) form a conspicuous feature of vegetation of Western Ghats and contribute significantly to the floristic diversity, these are also not dealt in the present discussion.

VEGETATION DIVERSITY

The climatic and altitudinal gradient has resulted in a variety of vegetation types, from evergreen to semi-evergreen; from moist deciduous to dry deciduous formations. In the higher hills stunted montane communities have also developed. Four major forest types and 23 different forest sub types have been recognized in Western Ghats based on ecological factors and floristic composition (Pascasl, 1982, 1988; Ramesh et al., 1997). In brief, the following forest types have developed in Western Ghats – (i) the dry scrub vegetation (ii)the dry deciduous forests (iii)moist deciduous forests (iv) the semi-evergreen forests (v) the evergreen forests (vi) the shoals and the (vii) the high-altitude grasslands. Again, each of these forest types have numerous subtypes, formations or associations comprising of a variety of floristic composition. Only briefly the floristic composition of these forest types is discussed here.

The dry scrub vegetation occurs at the foothills, particularly along the eastern side of Western Ghats and these forests merge with the forests of Deccaan region. The vegetation is mostly comprised of thorny species like Barleria prionites, B. cristata, Eranthemum roseum, Hemigraphis latebrosa, Rungia repens, Dicliptera foetida, Aerva sanguinolenta, Mimosa pudica, Acacia spp., Commiphora berryii, Dichrostachys cinerea, Scutia circumscissa, Pterolobium hexapetalum,Toddalia asiatica, Opuntia dillenii, Dicoma tomentosa, Azima tetracantha, Solanum trilobatum, Euphorbia

antiquorum, Dodonaea viscosa, Capparis spp, Xeromphis spinosa, Carissa congesta, Rhus mysorensis, Erythroxylum monogynum, Balanites aegyptiaca and a few others. The tree species are sparse and are stunted like Anogeissus latifolia, Bauhinia racemosa, Cochlospermum religiosum, Cassia fistula, Careya arborea, Semecarpus anacardium, Albizzia lebbeck, Ixora brachiata, Radermachera xylocarpa, etc. The climbers are few and are represented by Hemedismus indicus, Ventilago maderaspatana, Smilax zeylanica and Argyreia spp. The herbaceous flora in these forests can be observed only during monsoon and are represented by numerous grasses like Apluda varia, Eragrostis unioloides, Heteropogon contortus, Setaria glauca and others like Polycarpaea aurea, Crotalaria spp., Indigofera spp. and Barleria buxifolia.

The dry deciduous hill forests are found on the eastern side at elevations of 500-1000 m. The rainfall varies from 800-2000 mm. Typically species like Diospyros montana, D. sylvatica, Eriolaena quinquelocularis, Sterculia urens, Anogeissus latifolia, Butea monosperma, Emblica officinalis, Grewia tiliaefolia, Pterocarpus marsupium, Terminalia spp, Albizzia amara, Bombax ceiba, Mitragyna parvifolia, Givotia moluccana, Melia composita, Cassia fistula and a few others. At comparatively higher rainfall areas bamboo species like Dendrocalamus strictus and Bambusa arundinacea also appear. The shrubby species in these forests are represented by Flacourtia indica, Securinega leucopyrus, Carissa congesta, Callicarpa tomentosa, Xeromphis spinosa, Meyna laxiflora, Ziziphus spp and the invasive Lantana camara. Often climbers like Asparagus racemosus, Cryptolepis buchanani, Cayratia pedata, Canavalia gladiata, Glycine wightii, Dregea volubilis, Calycopteris floribunda and Convolvulaceae members cover the vegetation.

Moist deciduous forests mostly occur between 600-1000 m elevation at windward side were rainfall in comparatively higher. Important timber species like Terminalia crenulata, Dalbergia latifolia, Lagerstroemia microcarpa, Pterocarpus marsupium, Pterygota alata, Schleichera oleosa, Tectona grandis grow luxuriantly here. Other tree species are Haldina cordifolia, Dillenia pentagyna, Miliusa tomentosa, Terminalia alata, T. paniculata, T. chebula, Shorea roxburghii, Xylia xylocarpa, Stereospermum colais, Vitex altissima and smaller trees like Trema orientalis, Cassia fistula, Kydia calycina, Clausena heterophylla, Oroxylum indicum, Grewia tiliaefolia and others. Bambusa arundinacea forms huge clumps in exposed places. During monsoon, these forests resemble an evergreen forest with dense canopies over tapped by large climbers like Gouania microcarpa, Ichnocarpus frutescens, Diploclisia glaucescens, Dioscorea spp., Ventilago maderaspatana, Teramnus labialis, Derris heyneana, Naravelia zeylanica, Hiptage benghalensis, Mucuna spp. and the gigantic Entada purseatha. The epiphytic flora- ferns, orchids, mosses are also rich and often completely cover the tree trunks. The diversity of herbaceous flora is also quite rich and are represented by diverse families.

The semi-evergreen and evergreen forests appear at higher elevations usually along the windward side where rainfall is very heavy (2000-35000 m). The evergreen forests are supposed to be the climax type of forests also termed 'wet evergreen forests', 'montane subtropical evergreen forests' by some authors. The forests are storyed with distinct species composition. The dominant species of the upper storey are Artocarpus hirsutus, Euphoria longan, Elaeocarpus tuberculatus, Hopea parviflora, Mangifera indica, Sterculia guttata, Holoptelia integrifolia, Hydnocarpus pentandra, Fagraea ceilanica, Knema attenuata, Diospyros ebenum, Canarium strictum, Neolitsea cassia, Myristica dactyloides, M. malabarica, Palaquium ellipticum, Calophyllum polyanthus, Litsea floribunda, Vateria indica, Cullenia exarillata, Garcinia gummigutta, Lophopetalum wightianaum and numerous others. The endemic genus Poeciloneuron with two species, P. indicum, P. pauciflorum occur only in evergreen forests from Mysore southwards. The typical tropical family, Dipterocarpaceae is well represented here. Dipterocarpus, Hopea, Shorea, Vatica, Vateria are the important genera. About nine species are restricted to southern Western Ghats.

The second storey trees are medium sized and belong to Aporusa lindleyana, Antidesma menasu, Carallia brachiata, Acrocarpus fraxinifolium, Beccaurea courtallensis, Elaeocarpus glandulosus, Holigarna ferruginea, H. beddomei, Persea macrantha, Pterospermum xylocarpum, Macaranga tomentosa, Sapindus laurifolius, Meliosma simplicifolia and a host of others. The ground flora is composed of a number of shrubs and herbs belonging to Strobilanthes, Psychotria, Begonia, Elatostema, Ophiorhiza, Impatiens, Scutellaria, and many Zingiberaceae members. Ground orchids like Habenaria, Zeuxine, Pectelis, Nervelia, Malaxis are also common. Along ravines and marshy areas, the prickly Calamus, Angiopteris, Cyathea are remarkable. The epiphytic flora in these forests is also very dense and belong to diverse angiosperms, ferns, lichens, and mosses.

The Silent Valley forests in Western Ghats are the true surviving Tropical Rain forests in India and is really a store house of plant wealth. The forests abound in orchids, timber trees, spices, medicinal plants and so on. Manilal (1988, 1995) reports ca 1000 angiosperms belonging to 134 families and 23 rare or new species from Silent Valley alone. Some of the typical trees of this region are Palaquium ellipticum, Cullenia exarillata, Myrstica dactyloides, Elaeocarpus glandulosus, Litsea floribunda, Mesua nagassarium, Cinnamomum malabaricum Calophyllum polyanthum, Garcinia morella, Actinodaphne campanulata and numerous lianas and climbers, shrubs and herbs.

The Shola forests (in Nilgiris) are characteristically seen along the folds of rolling downs at a height of 1600 m, where moisture content is very high. These forests are isolated

compact evergreen patches composed of stunted trees with crooked braches. Shola forests in western Ghats are a hightly threatened community today. The species diversity is remarkably very high. Some dominant species are Hydnocarpus alpina (Dipterocarpaceae), Michelianilagirica (Magnoliaceae), Mahonialeschenaultii (Berberidaceae), Gardeniaobtusa (Rubiaceae), Cinnamomumwightii (Lauraceae, At alantiawightii (Rutaceae), Garciniacambogia (Clusiaceae), Ilexdenticulata (Aquifolia ceae), Microtropisramiflora(Leguminaceae), Meliosmawightii (Sabiaceae), Acronychi a pedunculata (Rutaceae), Eurya nitida (Theaceae, igustrum robustum (Oleaceae), Ternstroemia gymnanthera (Ternstroemiaceae) and the tree Compositae, Vernonia arborea.

The open meadow bordering the shoal forests support a variety of colorful herbs like Anemone rivularis, Ranunculus reniformis, Cardamine hirsuta, Hypericum mysorense, Impatiens nilagirica, Parnassia chinensis and shrubs like Osbeckia cupularis, Gaultheria fragrantissima, Symplocos laurina, Rhodomyrtus tomentosus, etc. Rhododendron arboreum (nilagiricum?) is a Pleistocene relict that survives in the Nilgiris hills. The flora here shows close affinity with the flora of Khasi & Jaintia hills of Meghalaya.

The Grasslands in Western Ghats usually occur at higher elevations (above 1800 m) in the Nilgiris, Anaimali, Palnis, Bababudangiris, and Caradomum hill ranges, and are composed of Saccharum spontaneum, Imperata cylindrica, Arundinella setosa, Chrysopogon hackelii, Eulalia trispicata, Themeda triandra, and Jansenella griffithiana. Nuamerous colourful angiospermic herbs and shrubs like Hypericum japonicum, Osbeckia leschenaultiana, Gaultheria fragrantissima, Rhus fairholmianus, Phlebophyllum kunthianus, Anaphalis aristata, Strobilanthes kunthianus, Rumex nepalensis, Exacum bicolor, Lilium neilgherrense, Lobelia nicotianaefolia Polygala siberica, Striga asiatica, Walhenbergia gracilis, Crotolaria notonii, Knoxia mollis, Indigofera pedicellata and several Acanthaceae and Lamiaceae members. Phoenix humilis is another characteristic species on the hill slopes.

Some of the Outstanding features of Vegetation of Western Ghats are Development of tropical rain forests (with fair representation of typically tropical families like Dipterocarpaceae, Myrsticaceae, Clusiaceae), presence of tall trees with buttresses, Occurrence of lianas, canes and profuse epiphytes, development of cauliflory, ground layer and tree trunks with a carpet of mosses, ferns, orchids and lichens and absence of dominance of any one species. Development of Myristica swamp is another unique feature. Myristica swamps in the southern Western Ghats occur in the bottom of valleys inundated during a greater part of the year. The floor of the swamps is traversed by the characteristic, looped knee roots of Mysristica spp. The commonly encounterd species are Myristica dactyloides, M. fatua, M. malabarica, Knema attenuata, and other species like Hydnocarpus alpina and Lophopetalum wightianum. Myristica swamps in

Western Ghats are a threatened community today (Krishnamoorthy, 1960, Nair & Daniel, 1986).

FLORISTIC DIVERSITY

The Western Ghats is one of the major tropical evergreen-forested regions in India and possess enormous plant diversity. The richness of floristic diversity of the region has been brought out by Gamble, 1915-1936; Fyson, 1932; Nair & Daniel, 1986; Rao, 1994; Nayar, 1996. Further, several State and District floras (Cooke, 1901-1908; Fyson, 1932; Gamble, 1915-1936; Ahuja & Singh, 1963; Manilal, 1988; Matthew, 1981-1984 & 1999; Mohanan & Henry, 1994; Nayar, 1996; Ramachandran & Nair, 1988; Rao, 1985-86; Sasidharan & Sivarajan, 1996; Rao & Razi, 1981; Saldanha & Nicolson, 1976; Saldanha, 1984, 1996; Keshava Murthy & Yoganarashiman, 1990 and Yoganarashiman et al., 1981) also highlight the diversity and richness of the flora of the region. About 12000 species from lower groups to flowering plants are estimated to occur here. About 2100 endemic flowering plants have been reported from out of 5800 flowering plant species in this mega endemic area (Rao, 1994, Yoganarasimhan, 2000, Nair & Henry, 1983). This constitutes approximately 27 % of the total Indian flora. Agasthyamalai (200 km2) support 2000 species; The Nilgiris support ca 2611 species while Silent Valley (90 Sq Km) supports 1300 species. Most of the District floras published in recent years reveal that most of them have more than 1200 species. (Rao & Razi, 1981; Keshava Murthy & Yoganarasimhan, 1990; Saldanha, 1984; Saldanha & Nicolson, 1976; Yoganarasimhan et al., 1981; Manilal, 1988; Ramachandran & Nair, 1988; Chandrabose et al.,1988; Mohanan &Henry, 1994; Mohanan & Sivadasan, 2002; Ramaswamy et al., 2001). There are about 1215 species of arborescent taxa in the Western Ghats flora. Again, several genera have more than 5 endemic species (Table - 1). Presence of about 60 endemic genera including 49 monotypic genera makes the region floristically unique and significant. There are about 1286 endemic species in southern Western Ghats alone (Nayar, 1996).

The flora of Western Ghats reveals close affinity with E. Africa, Malaysian and Sri Lankan flora. W. Ghat flora supports Gondwana origin of landmass comprising S. America, Madagascar, India, Malaysia islands, Sri Lanka, Australia and Antarctica. Past connection of peninsular India with surrounding continents explains the distribution of certain genera like Hernandia,

Lindenbergia, Pittosporum, Acrotrema, Gomphandra, Nothopodytes, Sarcostigma, Hy dnocarpus, etc. in Western Ghats, Africa and some in S. America. The endemic genus Poeciloneuron (Bonnetiaceae) in Western Ghats has allied genera in S. Aamerica. Similarly, 10 genera of Orchidaceae and 52 species of Andropogoneae (Poaceae) of Western Ghats also occur in Africa. In fact, grasses are very well represented in Western Ghats. It is estimated athat about 400 species of grasses occur

in Kerala alone. According to Mehrotra & Jain (1982) of the 329 species of Andropogoneae about 250 species occur in Western Ghats and in plains of south India. Similarly, the genus Isachne is represented by 20 species in the region out of the total of 29 species in India. Again, of the 12 species of Garnotia in India, 9 species occur in Western Ghats (Prakash & Jain, 1979). Bamboos are also well represented in Western Ghats. Out of the ca. 100 species in India 25 species belonging to 8 genera occur here.

Orchids are a fascinating group which are popular among plant lovers mainly because of the long losting and attractive flowers. The group includes both epiphytic and terrestrial species. Of the ca 1230 species in India more than 300 species are expected to occur in Western Ghats. Some of the ornamental species are Acanthephippium bicolor, Pecteilis gigantea, Rhynchostylis retusa, Vanda spp., Dendrobium spp., Aerides spp., Eulophia spp., and Paphiopedilum druryi. However, new taxa and new reports of orchids are being constantly madefrom this region indicating the need for further exploration in various under expored regions in Western Ghats.

Acanthaceae, Leguminosae and Asteraceae are other families well represented in Western Ghats. Out of the 500 species of Acanthaceae in India, Santapau (1951) has recorded 38 genera and 130 species from Bombay & Khandala region alone. The genus Strobilanathes (senu. lato) of the family Acanthaceae is remarkable in having nearly 46 species in the rain forests of Western Ghats (Naair & Daniel, 1986). The family Leguminosae exhibits extra ordinary lifeform diversity ranging from loafty trees of the rain forests to shrubs and herbs in the grasslands; from lianas to tender climbers/creepers alaong the fringes of forests. Several economically important timber species, medicinal plants, wild relatives of cultivated plants belong tho this family. Asteraceae with about 800 species in the country is represented by nearly 50% of the total in Western Ghats. The genus Vernonia again has all lifeforms like herbs, shrubs, climbers and even trees (Vernonia monosis & V. travancorica). According to Rau & Narayana (1985), of the 50 species of tribe Vernonieae from south India, nearly 45 species occur in Western Ghats.

The family Asclepiadaceae with 57 genera and 260 species in India is remarkably well represented in Western Ghats. More than 95 species ((30%) occur in Western Ghats which include 7 endemic genera and 50 endemic species. Of the 45 species of Ceropegia, 35 species are from Western Ghats which include 26 endemics (Ansari, 1984).

Among monocots, Araceae, Commelinaceae, Arecaceae and Zingiberaceae are richly represented in Western Ghats. The family Araceae with 29 genera and 126 species in India is represented by more than 30 % in Western Ghats. Of the 42 species of Arisaema in India 13 species occur in Western Ghats. Commelinaceae with 90 species in India is represented by ca. 50 species in Western Ghats, of which about 17 species are endemic to southern Western Ghats (Kammathy, 1983).

Similarly, Western Ghats supports a good diversity of biologically interesting plants like the insectivorous species (Droseraceae, Lentibulariaceae,) parasitic plants (Lauraceae, Cuscutaceae, Orobanchaceae, Scrophulariaceae, Viscaceae), saprophytes (Burmanniaceae, some orchids). It is certainly not possible to highlight the enormous floristic diversity in each of the groups of Western Ghats and only certain peaks that stand out conspicuously are touched in this article. Diversity in certain important taxa of Western Ghats is provided in Table- 2 & 3. Yet, the floristic diversity of Western Ghats is incompletely known. Also, constantly new taxa, new reports from Western Ghats are being made by taxonomists. Therefore, Systematic survey, documentation, and evaluation of the rich floristic diversity and Bioprospection of the rich flora of Western Ghats is now an urgent task. Keeping in view, the threats operating in this region and also the importance attached to the biodiversity of the region under the National Biodiversity Action Plan, this task has become all the more important. Bioprospection of the flora and identifying better genes/molecules/species in different groups of economic plants would be highly rewarding.

Table - 1: Some arborescent genera of Western Ghats having more than 5 endemic species

Genera	No. of species	Genera	No. of species
Memecylon	16	Litsea	15
Symplocos	14	Cinnamomum	13
Syzygium	11	Actinodaphne	9
Glochidion	9	Grewia	9
Diospyros	8	Dalbergia	7
Jambosa	7	Hopea	6
Drypetes	6	Mallotus	6
Aglaia	5	Cryptocarya	5
Garcinia	5	Holigarna	5
Terminalia	5	Humboldtia	5
Euonymus	5		

Table 2:

Some taxa of Western Ghats having high diversity in them

Taxa	Number of genera & species (Approximate)
Poaceae	120 genera; 430 species
Leguminosae	85 genera; 350 species
Orchidaceae	60 genera; 285 species
Acanthaceae	45 genera; 125 species
Cyperaceae	21 genera;170 species
Euphorbiaceae	55 genera; 150 species
Asteraceae	58 genera; 150 species
Lamiaceae	25 genera; 120 species
Rubiaceae	40 genera; 110 species
Asclepiadaceae	30 genera; 95 sspecies

Table - 3

Diversity of some taxa of Western ghats vis a vis Indian region

Taxa	No. of species inIndia	Species in Western Ghats
Ceropegia	44	35 (26 endemics)
Arisaema	42	13
Commelinaceae	81	45 (17 endemics)
Impatiens	223 (incl. 23 vars.)	88 (most are endemics)
Orchids	1000	250
Palms	--	21
Andropogoneae	329	250
Isaachne	29	20
Asclepiadaceae	280	90
Vernonieae	--	45
Pittosporum	11	7
Piper	--	15
Cinnamomum	--	15
Litsea	--	16
Calophyllum	--	5
Garcinia	--	12
Myristica	--	4
Dioscorea	--	21 species; 27 varieties

Diversity in wild relatives of crop plants/economically important species:

Western Ghats is a major genetic estate of wild relatives of crop plants with an enormous biodiversity of ancient lineage. The region is a store house of wild relatives of cereals and millets (Panicum psilopodium, Oryza coaractata, Pennisetum glaucum, Chionachne koenigii, C. semiteres, Coix gigantea and Trilobachne cookie); legumes(Atylosia albicans, A. goenisis, A. trinervia, A. elongata , A. platycarpa, A. graniflora, A. mollis, A. nivea , A. scarabaeoides, A. sericea, A. villosa (all wild relativesof cultivated Cajanus), Canavalia virosa, C. maritime, Macrotyloma uniflorum, Sphenostylis bracteata, Mucuna pruriens, Vigna sublobata, V. vexillata, V. pilosa, V. umbellata, V. dalzelliana, and V. khandalensis; Tropical and subtropical fruits(Artocarpus heterophyllus, A.lacucha, Garcinia indica, Diospyros spp., Ensete superbum, Mangifera indica, Mimosops elengii, Spondias pinnata, Ziziphus oenoplea, Z. rugosa, Rubus ellepticus, R. niveus, R. alceifolius ; Vegetables (Abelmoschus angulosus, A. moschatus , A. manihot, A. ficulneus, Amorphophalus paeonifolius, Cucumis setosus, Luffa graveolens, Momordica cochinchinensis, M. subangulata, Solanum indicum, Trichosanthes anamalaiensis, T. bracteata, T. cuspidata, T. perrottetiana and T. villosula; Oil seeds (Sesamum laaciniatum, S. prostratum); Spices and Condiments(Cinnamomum zeylanicum, Myrstica dactyloides M. malabarica, Piper nigrum, P. schmidtii, P. longum, Zingiber purpureum, Z. officinale, Z. zerumbet, Costus speciosus and Elettaria caradomum . In addition, wild relatives of Coffee and sugarcane are also well represented.

The medicinal plant diversity in Western Ghats is also of a very high order. The region is known as the 'Emporium of medicinal Plants.' Due to varied physiographic and physiognomic factors, medicinal plant diversity is very high both in terms of species diversity as well as infra specific diversity. Roughly, 1500 species of medicinal plants from out of the total of 5000 species of Western ghats are reported (Yoganarasimhan, 1996, 2000). A few important ones in this category are listed (Table- 4) The floristic diversity of wild aromatic plants in Western Ghats is also incompletely known. While medicinal plants have received some attention, other groups such as the essential oil yielding plants of the region are least studied. There are more than 200 such aromatic species in different ecosystems of Western Ghats and are predominantly spread among Lamiaceae, Asteraceae, Rutaceae, Zingiberaceae, Lauraceae, Oleaceae and Poaceae (table–5 & 6). While species diversity is assessed to some extent, infra specific diversity in these aromatic species is least known. Nevertheless, many species like Hyptis sauveolens, Blumea lacera, B. hieracifolia, B. membranacea, Cymbopogon flexuosus, Ocimum basilicum, Plectranthus mollis exhibit remarkable morphological variations in the region. Western Ghats with a wide variety of ecological habitats certainly provides for numerous ecotypes / chemotypes in some of these wild aromatic species. Species-specific surveys followed by interdisciplinary investigations by Taxonomists, Molecular

biologists, Geneticists, Phytochemists and Ecologists must be undertaken to assess the extent of total diversity and also the 'elite' populations in the wild aromatic plants.

Table - 4

Medicinal Plant species diversity in Western Ghats

Species	Family
Trichopus zeylanicus	Trichopodaceae
Utleria salicifolia	Periplocaceae
Janakia arayalpathra	Periplocaceae
Myristica malabarica	Myristicaceae
Adenia hondala	Passifloraceae
Artocarpus hirsutus	Moraceae
Cinnamomum travancoricum	Lauraceae
Cinnamomum wightii	Lauraceae
Piper barberi	Piperaceae
Vateria indica	Dipterocarpaceae
Ochreinauclea missionis	Rubiaceae
Syzygium travancoricum	Myrtaceae
Hydnocarpus alpina	Dipterocarpaceae
Michelia nilagirica	Magnoliaceae
Mahonia leschenaultii	Berberidaceae
Gardenia obtusa	Rubiaceae
Cinnamomum wightii	Lauraceae
Atalantia wightii	Rutaceae
Garcinia cambogia	Clusiaceae
Ilex denticulata	Aquifoliaceae
Microtropis ramiflora	Leguminaceae
Gymnosporia montana	Celastraceae
Rhus mysorensis	Anacardiaceae
Scutia circumscissa	Rhamnaceae
Plecospermum spinosum	Ulmaceae
Pterolobium hexapetalum	Caesalpiniaceae
Xeromphis spinosa	Rubiaceae

Toddalia asiatica	Rutaceae
Ziziphus spp.	Rhamnaceae
Acacia spp.	Mimosaceae
Sagearaea dalzelli	Annonaceae
Dysoxylum malabaricum	Meliaceae
Holigarna arnottiana	Anacardiaceae
Syzygium mungudam	Myrtaceae
Memeylon malabaricum	Melastomaceae
Diospyros paniculata	Ebenaceae
Humboldtia vahliana	Leguminosae
Buchanania lanceolata	Anacardiaceae
Myrstica malabarica	Myristicaceae
Nothapodytes foetida	Icacinaceae
Maesua nagassarium	Clusiaceae
Aphanamyxis polystachya	Meliaceae
Semecarpus anacardium	Anacardiaceae
Butea monosperma	Papilionaceae
Hymenodictyon orixense	Rubiaceae
Phyllanthus amarus	Euphorbiaceae
Mucuna pruriens	Papilionaceae
Asclepias curassavica	Asclepiadaceae
Celastrus paniculatus	Celastraceae
Abrus precatorius	Papilionaceae
Cissus quadrangularis	Vitaceae
Plumbago zeylanica	Plumbaginaceae
Tylophora indica	Asclepiadaceae
Gymnema sylvestre	-do-
Withania somnifera	Solanaceae
Centella asiatica	Apiaceae
Ocimum sanctum	Lamiaceae
Boerhavia diffusa	Nyctaginaceae
Tinospora cordifolia	Menispermaceae
Bacopa monnieri	Scrophulariaceae

Wrightia tinctoria	Apocynaceae
Strychnos spp	Loganiaceae
Pterocarpus marsupium	Fabaceae
Mallotus philippensis	Euphorbiaceae
Knema attenuata	Myrsticaceae
Dioscorea spp.	Dioscoreaceae
Anamirta cocculus	Menispermaceae
Alangium salviifolium	Alangiaceae
Gmelina arborea	Verbenaceae
Ichnocarpus frutescens	Apocynaceae
Helicteres isora	Sterculiaceae
Entada purseatha	Mimosaceae
Aristolochia indica	Aristolochiaceae
Alstonia scholaris	Apocynaceae
Zanthoxylum rhetusa	Rutaceae
Acrocarpus fraxinifolius	Caesalpiniaceae
Gluta travancorica	Anacardiaceae
Stephania japonica	Menispermaceae
Elaeocarpus spp.	Elaeocarpaceae
Narenga alata	Rutaceae
Murraya paniculata	Rutaceae

Table 5:

Diversity of aromatic species in Western Ghats

Family	Genus	Species
Rutaceae	10	18
Asteraceae	7	10
Zingiberaceae	6	12
Lauraceae	2	5
Lamiaceae	17	47
Myrtaceae	1	3
Oleaceae	1	9

Geraniaceae	2	2
Verbenaceae	1	1
Lamiaceae	1	2
Ericaceae	1	1
Flindersiaceae	1	1
Chenopodiaceae	1	1
Burseraceae	2	2
Euphorbiaceae	1	1
Apiaceae	1	1
Poaceae	1	3
Total	56	120

Table - 6

Diversity of Wild Aromatic species of Western Ghats

S.No.	Name of the species	Family
1	Acalypha fruticosa*	Euphorbiaceae
2	Acronychia pedunculata	Rutaceae
3	Alpinia calcarata *	Zingiberaceae
4	Alpinia malaccensis *	Zingiberaceae
5	Amomum masticatorium *	Zingiberaceae
6	Anisochilus carnosus	Lamiaceae
7	Anisochilus paniculatus *	Lamiaceae
8	Anisochilus robustus *	Lamiaceae
9	Anisomeles heyneana *	Lamiaceae
10	Anisomeles indica *	Lamiaceae
11	Anisomeles malabarica *	Lamiaceae
12	Artemisia nilagirica var. nilagirica *	Asteraceae
13	Atalantia monophylla	Rutaceae
14	Atalantia racemosa	Rutaceae
15	Becium filamentosum	Lamiaceae
16	Blumea lacera *	Asteraceae
17	Blumea lanceolaria *	Asteraceae

18	Blumea mollis *	Asteraceae
19	Boswellia serrata*	Burseraceae
20	Calamintha umbrosa*	Lamiaceae
21	Centratherum punctatum*	Asteraceae
22	Chenopodium ambrosioides *	Chenopodiaceae
23	Chloroxylon swietenia *	Flindersiaceae
24	Cinnamomum gracile	Lauraceae
25	Zingiber zerumbet *	Zingiberaceae
26	Cinnamomum sulphuratum *	Lauraceae
27	Cinnamomum verum	Lauraceae
28	Clausena dentata *	Rutaceae
29	Clausena heptaphylla	Rutaceae
30	Clausena willdenovii*	Rutaceae
31	Commiphora caudata*	Burseraceae
32	Curcuma aeruginosa*	Zingiberaceae
33	Curcuma aromatica *	Zingiberaceae
34	Curcuma neilgherrensis*	Zingiberaceae
35	Cymbopogon coloratus*	Poaceae
36	Cymbopogon flexuosus*	Poaceae
37	Cymbopogon martinii*	Poaceae
38	Endostemon viscosus*	Lamiaceae
39	Eryngium foetidum*	Apiaceae
40	Gaultheria fragrantissima	Ericaceae
41	Geranium nepalense	Geraniaceae
42	Globba ophioglossa	Zingiberaceae
43	Glycosmis pentaphylla*	Rutaceae
44	Gomphostemma eriocarpon *	Lamiaceae
45	Hedychium coronarium *	Zingiberaceae
46	Hedychium flavescens *	Zingiberaceae
47	Hyptis suaveolens *	Lamiaceae
48	Isodon coetsa	Lamiaceae
49	Isodon wightii	Lamiaceae
50	Janakia arayalpathra	Asclepiadaceae

51	Jasminum auriculatum *	Oleaceae
52	Jasminum azoricum var. travancorense *	Oleaceae
53	Jasminum cordifolium	Oleaceae
54	Jasminum malabaricum*	Oleaceae
55	Jasminum rigidum	Oleaceae
56	Jasminum ritchiei	Oleaceae
57	Jasminum sambac	Oleaceae
58	Jasminum scandens	Oleaceae
59	Jasminum sessiliflorum	Oleaceae
60	Kaempferia galanga *	Zingiberaceae
61	Kaempferia rotunda *	Zingiberaceae
62	Laggera crispata *	Asteraceae
63	Lavandula gibsoni	Labiataea
64	Lavandula bipinnata	Labiataea
65	Cyathocline purpurea	Asteraceae
66	Pimpinella adscendens	Asteraceae
67	Leonotis nepetiifolia*	Lamiaceae
68	Leucas ciliata*	Lamiaceae
69	Leucas lavandulifolia *	Lamiaceae
70	Leucas marrubioides	Lamiaceae
71	Leucas stelligera *	Lamiaceae
72	Leucas vestita var. vestita *	Lamiaceae
73	Limonia acidissima *	Rutaceae
74	Limonia crenulata	Rutaceae
75	Mentha arvensis*	Lamiaceae
76	Mentha spicata *	Lamiaceae
77	Murraya indica *	Rutaceae
78	Murraya koenigii *	Rutaceae
79	Murraya paniculata *	Rutaceae
80	Neolitsia zeylanica	Lauraceae
81	Ocimum americanum	Lamiaceae
82	Ocimum basilicum *	Lamiaceae
83	Ocimum gratissimum*	Lamiaceae

84	Ocimum kilimandscharicum *	Lamiaceae
85	Ocimum tenuiflorum *	Lamiaceae
86	Orthosiphon diffuses *	Lamiaceae
87	Orthosiphon thymiflorus *	Lamiaceae
88	Paramignya monophylla	Rutaceae
89	Pelargonium graveolens	Geraniaceae
90	Plectranthus amboinicus *	Lamiaceae
91	Plectranthus aromaticus	Lamiaceae
92	Plectranthus barbatus *	Lamiaceae
93	Plectranthus coleoides *	Lamiaceae
94	Plectranthus deccanicus	Lamiaceae
95	Plectranthus malabaricus *	Lamiaceae
96	Plectranthus mollis *	Lamiaceae
97	Plectranthus subincisus	Lamiaceae
98	Plectranthus zeylanicus *	Lamiaceae
99	Pleiospermum alatum	Rutaceae
100	Pluchea tomentosa *	Asteraceae
101	Pogostemon benghalensis *	Lamiaceae
102	Pogostemon heyneanus	Lamiaceae
103	Pogostemon mollis	Lamiaceae
104	Pogostemon paniculatus *	Lamiaceae
105	Salvia coccinea *	Lamiaceae
106	Salvia leucantha *	Lamiaceae
107	Salvia plebeia	Lamiaceae
108	Scutellaria violacea *	Lamiaceae
109	Scutellaria wightiana *	Lamiaceae
110	Sphaeranthus indicus	Asteraceae
111	Syzygium aromaticum *	Myrtaceae
112	Syzygium cuminii	Myrtaceae
113	Syzygium lineare	Myrtaceae
114	Thymus vulgaris *	Lamiaceae
115	Toddalia asiatica var. floribunda *	Rutaceae
116	Toddalis asiatica var. gracile	Rutaceae

117	Vitex trifolia *	Verbenaceae
118	Zanthoxylum ovalifolium *	Rutaceae
119	Zanthoxylum tetraspermum	Rutaceae
120	Zingiber zerumbet *	Zingiberaceae

The life support species which offer very valuable subsidiary food are also very numerous. Several wild plants are consumed as vegetables, as fruits or as seeds. Only a few important ones are listed here. Alangium salviifolium, Antidesma acidum, A. menasu, Artocarpus sp., Baccaurea courtallensis, Calamus rotung, Canthium travancoricum, Emblica officinalis, Flacourtia indica, Mangifera indica, Dioscorea spp., Phoenix humilis, Physalis spp., Rubus spp., Syzygium cuminii, Caryota urens and several Colocasia and Alocasia spp.

ENDEMIC AND MONOTYPIC TAXA OF WESTERN GHATS

The issue of endemism in Western Ghats has been discussed by many botanists from time to time (Chatterjee, 1940, 1962; Maheshwaari, 1976; Nayar, 1980, 82; Rao, 1972; Subramanyam & Nayar, 1974; Aahmedulla & Nayar, 1987; Nair & Daniel, 1986; Nayar & Ahmedulla, 1984; Ramesh & Pascal, 1981). Western Ghats are only next to Himalaya in having high number of endemic plants. Although Western Ghats are a part of the continental area, they are protected by vast sea along the western side, Vindhya and Satpura ranges on the northern side, semi-arid Deccan plateau on the eastern side and Indian Ocean on the south which act as barriers for plant migration and hence act as a kind of oceanic island in supporting a large number of endemic plants. According to Subramanyam & Nayar, 1974; Blasco, 1970, 1971, the high summits of Western Ghats with their characteristic climate are comparable to islands as regards the distribution of endemic species. According to Nayar (1982) there are 56 (now 60) endemic genera and 2100 (38 %) species in the Peninsular India. Among these 49 genera are monotypic. Unlike Himalayas, most of the endemics in the Western Ghats are palaeo-endemics. Southern Western Ghats, particularly Agastyamalai hills are the richest in endemics followed by Wynad and Annamalai hill ranges (Table -7). Further, an analysis of endemism in various taxa reveals that Poaceae with 13 genera and 155 species is the largest among endemics. The family Orchidaceae has approximately 100 endemic species in Western Ghats. Aacanthaceae with 8 genera ((Kanjarum, Carvia, Gantelbua, Nilgirianthus, Phlebophyllum, Pleocaulus, Taeniandra and Xenacanthus); Asclepiadaceae with 7 genera (Baeolepis, Decalepis, Frerea, Janakia, Oianthus, Seshagiria and Utleria) and 35 species are other large families as regards endemic plants are concerned. There are also 21 aroborescent genera having more than 5 endemic species in Western Ghats (Table 1). Among the evergreen tree species ca. 352 species (56 % of the total evergreen species) are reported to be endemic to Western Ghats (Ramesh & Pascal, 1997).

Table – 7

Distribution of endemic species in Western Ghats

Center/ Region	Area (km^2)	Endemics
Agasthyamalai	2450	189
Anamalai high range	8000	94
Palni hills	2068	43
Wyanad – Kodagu	12800	150
Shimoga – Kanara	12000	58
Mahabaleshwar -Khandala	11000	63
Konkan – Raigad	20000	50
Marathwada – Satpuda	100000	27

Similarly, the large genus Crotalaria has ca.30 % of the species endemic to the region. Some of the other genera having high concentration of endemic species are Nilgirianthus and Phlebophyllum ca. 27 species; Ceropegia 26 species; Habenaria 17 species; Isachne 14 species; Dichanthium 11 species. Some of the arborescent endemicgeneraare Blepharistemma, Erinocarpus, Meteoromyrtus, Otonephelium, Poe ciloneuron, Pseudoglochidion (except Poeciloneuron all other genera are monotypic). Another unique feature of the endemism in Western Ghats is the prevalence of high endemic species among arborescent genera (Table - 1).

Monotypic genera are those which are represented by only one species having no closely related genomes anywhere else in the world and hence have conservation significance. There are about 236 monotypic genera in India of which 49 genera are monotypic in Western Ghats. Rana & Ranade (2009) have provided a detailed account of monotypic genera in India and according them Poaceae with 32 monotypic genera is the largest family in India followed by Leguminosae (15 monotypic genera) and Asteraceae (with 12 monotypic genera) in Indian flora. A few important monotypic genera which are also endemics in Western Ghats are listed in Table -8.

Table – 8

Some monotypic endemic genera in Western Ghats

Acrotrema arnotttianum Wight	Dilleniaceae
Adenoon indicum Dalz.	Asteraceae
Chandrasekharaniakeralensis Nair, Ramachandran & Sree Kumar	Poaceae
Hubbardia heptaneuron Bor	Poaceae
Indobanalia thyrsiflora (Moq.) Henry & B. Roy	Amaranthaceae
Indopoa paupercula (Stapf) Bor	Poaceae
Janakia arayalpathra Joseph & Chandrasekaran	Asclepiadaceae
Kanjarum palghatense Ramamurthy	Acanthaceae
Kingiodendron pinnatum (Roxb. ex Dc.)	Leguminosae
Kunstleria keralensis Mohanan & Nair	"do"
Lamprachaenium microcephalum (Dalz.) Benth.	Asteraceae
Limnopoa meeboldii (Fischer) Hubb.	Poaceae
Moullava spicata (Dalz.) Nicolson	Leguminosae
Nanothamnus sericeus Thoms.	Asteraceae
Otonephelium stipulaceum (Bedd.) Radlk.	Sapindaceae
Paracautleya bhatii R.M. Smith	Zingiberaceae
Polyzygus tuberosus Dalz.	Apiaceae
Proteroceras holtumii Joseph & Vajravelu	Orchidaceae
Pseudodichanthium serrafalcoides (Cooke & Stapf) Bor	Poaceae
Santapaua madurensis Balak. ex Subr.	Acanthaceae
Seshagiria sahyadrica Ansari & Hemadri	Asclepiadaceae
Silentvaleya nairii Nair & Bhargavan	Poaceae
Solenocarpus indica Wight & Arn.	Anacardiaceae
Trilobanche cookie (Stapf) Sch. ex Henr.	Poaceae
Triplopogon romasissimus (Hack.) Bor	Poaceae

DIVERSITY OF AQUATIC AND MARSH PLANTS

The aquatic and marsh vegetation of India is quite rich and diverse. Approximately the world's half of the aquatic plants occur in Indian region and again more than 50% of the total aquatic flora of India occur in Western Ghat region. There are 10 dicootyledonous and 11 monocotyledonous purely aquatic families. Podostemaceae, Hydrocharitaceae are some of the dominant families. A number of aquatic plants are also endemic, of which Podostemaceae with about 20 species tops the list (Nagendran & Arekal,1981). There are various forms of aquatic plants in Western Ghats like Free floating forms (Eichhornia crassipes, Pistia stratiotes, Spirodela polyrrhiza, Lemna spp., and Pteridophytes like Azolla pinnata, Salvinia spp., and some algal members), Rooted aquatics with their foliage floating(Nelumbo nucifera, Nymphaea nouchalii, Nymphoides indica), Submerged aquatics(Vallisneria spiralis,Ottelia alismoides, Nechamandra alternifolia, Hydrilla verticillata, Najas graminea, Limnophila indica, Potamogeton pectinatus and Ceratophyllum demersum) Emergent hydrophytes (Scirpus maritimus, S. articulatus, Elaeocharis palustris, Phragmites karka, Sacciolepis interrupta, Lymnophyton obtusifolium, Monochoria vaginalis, Sagittaria spp.,Butomos umbellatus, Rorippa nasturtium-aquaticum and a few more). In addition to trhe pure aquatic plant species, there are diverse varieties of marsh or wetland plants, which are too numerous to list.

BIOPROSPECTION AND HUMAN WELFARE

The bio resources of Western Ghats are is quite rich. Almost all groups of economically significant plants grow here which include numerous lives saving drug plants, nutraceuticals, life support species, wild aromatic species, ornamental species, metal tolerant species, wild genetic resources and so on. While many species await discoveries, the flora is getting depleted in an alarming rate. Therefore, not just conservation of these bio-resources in the region but also their sustainable utilization for human welfare is the priority agenda. Today, with advancements in molecular biology and biotechnology, Bioprospection of the flora for better genes, better molecules, better medicinal plants have become easier and faster. But this involves the active collaboration of field botanists, taxonomists, ecologists, molecular biologists and biotechnologists, which unfortunately almost non existent in India. The prospects for Bioprospection on Western Ghat flora is quite high. The enormous florsitc diversity, enormous habitat variation resulting in vast infra-specific variation, chemo-prospecting in wild aromatic plants, wild food plants, Bioprospection of flora for better genotypes in bio-fuel plants (*Jatropha, Caralluma*, *Pongamia*, *Boswellia* and many others.

Bioprospection of the flora for metal tolerant genes for environmental bioremediation - in members of Caryophyllaceae, Ceratophyllaceae, Portulaccaceae, Tamaricaceae, Salvadoraceae, Thymeleaceae and Fabaceae are certain challenging areas. Added to this, there are excellent taxonomists (who can scan the entire biodiversity and short list species for Bioprospection), and biotechnologists with excellent laboratory facilities in the country. What is needed is the actual collaboration and joint programames on Bioprospection so that product development at global level (based on wild flora of Western Ghats) becomes a reality for the ultimate human welfare.

Bioprospection in medicinal and aromatic plants

Western Ghats, as an emporium of several wild aromatic plant species with an enormous diversity in them offers an immense scope for Bioprospection, particularly chemo- prospecting in wild aromatic plants. Some short-listed aromatic species like *Acronychia pedunculata*, *Chloroxylon swietenia, Cymbopogon flexuosus*, *Blumea lanceolaria*, *Artemisia nilagirica* var. *nilagirica, Ocimum gratissimum*, *Curcuma pseudomontana*, *Clausena dentata* and *Limonia acidissima* have already shown prospects for their development and popularization in the region. Although the quality and quantity of the required compounds is not satisfactory, the existing diversity can be used to improve and develop these crops. Molecular biologists, Biotechnologists and Geneticists can also play a lead role in genetic improvement of some of these short-listed species. There is also an urgent need for bioprospection of medicinal flora of Western Ghats, particularly tree flora which to some extents are neglected. There is *ca*.490 arborescent medicinal taxa in Western Ghats of which 308 (62.8%) are endemic and medicinally important for various diseases from cancer to rheumatism. Intensive phytochemical screening is essential for identifying active compounds from all populations within a taxa as tropical trees are well known for their variability. *Nothapodites foetida* (Icacinaceae) – an evergreen tree of Western Ghats is found to contain camptothecine, an antileukaemia and antitumoral compound. Camptothecine (0.005%) was earlier found only in *Camptotheca acuminata* (Nyssaceae) occuring in China, whereas the species from Western Ghats contains 0.1%, promising for treatment of cancer. Ethnopharmacological studies are also required for fully understanding their therapeutic value.

MAJOR THREATS AND CONSERVATION OF DIVERSITY

The Western Ghats being on the threshold of development and with increased population pressure has already lost much of its prime forests and unique habitats. The whole area has already been listed as one of the world's 'hottest hotspot' areas (Myers, 1988, Myers et al., 2000). There are several threats operating in the region, which have not only destroyed many unique habitats of flora but also favoring the spread of many invasive, alien species, which are further deteriorating the plant wealth of the region.

In brief, ever increasing population growth, selective removal of specific groups of plants, extensive practice of shifting agriculture by local people, extension of townships , road construction on Hills creating accessibility of remote areas, degradation and fragmentation of forests for various plantation crops such as coffee, fruits, vegetables, spices (Pepper, cardomum, nutmeg, areca nut, etc.), 'modernisation' leading to change of llife style and cultural values of local tribals, free access and unregulated exploitation of bioresources in the region, tourists influx and their greed for collection of specific groups of ornamental plants (orchids, begonias, *Impatiens* spp., etc.), dependence of plant based industries solely on wild resources of biodiversity, wrong policies of the government that allow unregulated export of timber, bamboos and other forest products impoverishing the biodiversity sink of the region, unplanned economic upliftment of the people, spread of certain alien invasive weeds such as *Eupatorium, Mikania, Parthenium* and others endangering the native flora are some noticeable threats in Western Ghats. Nearly 40 % of natural forest vegetation in Western Ghats has disappeared during the past 8-10 decades (Menon & Bawa, 1997). Already the low elevation evergreen forests dominated by *Dipterocarpus* spp. have become the most threatened community. (Pascal, 1982; Ramesh et. Al., 1997). Similarly, the other low elevation species like *Buchanania barberi, Cynometra beddomei, Dialium travancoricum, Hopea Jacobi, Inga cynometroides, Syzygium chavaran, Buchnania lanceolata* have almost reached the stage of extinction. As a consequence of the deforestation, many groups of plants (ornamental plants, medicinal plants (table 10), biologically interesting plants, aromatic species) have already become critically endangered or even presumed to be extinct (Table -11) and several species have not been recollected after their Types (Table-12) and are also facing the threat of extinction. Aromatic plant species like *Pogostemon nilagiricus*, P. *travancoricus*, *P. wightii*, Plectranthus *nilgherricus*, *P. wightii*, *P. walkeri*, Moonia *heterophylla*, Ocimum *adscendens*, Cinnamomum *travancoricum* and *C. wightii*, which were at one time abundant on the hill slopes have now become scarce. Further, Infestation of alien weeds like *Parthenium hysterophorus*, *Mikania micrantha, Eupatorium odoratum, Mimosa invisa,* etc., have taken a heavy toll of native and naturalaized species (Table -9). In fact, Invasive alien species are considered as the second major threat to native flora only after habitat destruction. Extinction of local populations due to spread of alien weeds was recognized as early as 1872 by Darwin. Invasive aliens severely compete with native flora for space, light, nutrients and water. The density and competitive ability of weeds and native species play a crucial role in the outcome of competition between them. Although clear cut assessments on biodiversity erosion in native taxa are not available, the very presence of these invasive species over extensive areas, indicates the elimination of diversity in native flora. Again, although clear cut species extinctions are not observed, fragmentation of native species/populations has pushed many native herbaceous species on road to extinction.

Loss of species due to invasive weeds from an area can attract the attention of botanists but loss of genetic variability (due to population extinction) goes unnoticed, which is the case in many native flora. Assessment of such fragmented species in different biogeographic zones including Western Ghats is a challenging but priority agenda. Erosion of diversity has been observed in several taxa (Table -9) since the introduction of *Parthenium* in south India, at a time when Flora of Mysore district was just published (Rao & Razi, 1981). Therefore, it is an urgent task to initiate collaborative programmes aiming at conservation of the rich flora of Western Ghats. While *in situ* conservation of these species is partly taken care of by the establishment of several protected areas like the Nilgiris Biosphere Reserve, Agasthyamalai Biosphere Reserve, Kalakad-Mundandurai Tiger Reserve, Indra Gandhi National Park, Silent Valley National Park, Bandipur National Park, Kudremukha National Park, Nagarahole National Park, Giant Squirrel Wildlife Sanctuary, Idukki Wildlife Sanctuary, Eravikulam Wildlife Sanctuary, Wayanad Wildlife Sanctuary, Periyar Wildlife Sanctuary, Parimbikulam Wildlife Sanctuary, Shendurney Wildlife Sanctuary, Peppara Wildlife Sanctuary, etc., many species out side the reserve do not find a place in any *in situ* programmes. Even within the protected Biosphere Reserve areas there is a always a severe threat by the invasive weeds. Experience has shown that entry of even one single invasive species can eliminate hundreds of local species in just a short period of time. Therefore, regular monitoring of the population of these species is necessary. It is also advisable to identify certain pockets rich in aromatic species within the larger protected areas and give extra protection, so that these species are freely multiplied in nature.

Table -9:

Distribution of native / naturalized species affected by invasive weeds

Species	Family
Abutilon indicum	Malvaceae
Acalypha indica	Euphorbiaceae
Alternanthera echinata	Amaranthaceae
Alysicarpus vaginalis	Papilionaceae
Amaranthus spinosus	Amaranthaceae
Andrographis paniculata	Acanthaceae
Anisomeles indica	Lamiaceae
Asystasia dalzelliana	*Acanthaceae*

Boerhaavia diffusa	Nyctaginaceae
Cassia occidentalis	Caesalpiniaceae
Chenopodium album	Chenopodiaceae
Indigofera cordifolia	Papilionaceae
Indigofera linifolia	Papilionaceae
Indigofera trita	Papilionaceae
Chenopodium ambrosioides	Chenopodiaceae
Cleome viscosa	Capparidaceae
Convolvulus arvensis	Convolvulaceae
Corchorus tridens	Tiliaceae
Crotalaria medicaginea	Papilionaceae
Croton bonplandianum	Euphorbiaceae
Cucumis callosus	Cucurbitaceae
Digera alternifolia	Amaranthaceae
Euphorbia hirta	Euphorbiaceae
Euphorbia orbiculata	Euphorbiaceae
Euphorbia prostrata	Euphorbiaceae
Evolvulus alsinoides	Convolvulaceae
Gomphrena serrata	Amaranthaceae
Hedyotis aspera	Rubiaceae
Hybanthus enneaspermus	Violaceae
Tribulus terrestris	Zygophyllaceae
Polycarpon prostratum	Caryophyllaceae
Polygala chinensis	Polygalaceae
Portulacca oleracea	Portulacaceae
Rungia repens	Acanthaceae
Scoparia dulcis	Scrophulariaceae
Solanum nigrum	Solanaceae
Tephrosia purpurea	Papilionaceae
Trianthema portulacastrum	Aizoaceae
Ipomoea muricata	Convolvulaceae
Mollugo cerviana	Molluginaceae
Physalis minima	Solanaceae
Polycarpaea corymbosa	Caryophyllaceae

Table - 10

Some Endemic and Endangered medicinal plant species of Western Ghats

Trichopus zeylanicus	Trichopodaceae
Utleria salicifolia	Periplocaceae
Janakia arayalpathra	Periplocaceae
Myristica malabarica	Myristicaceae
Adenia hondala	Passifloraceae
Artocarpus hirsutus	Moraceae
Cinnamomum travancoricum	Lauraceae
Cinnamomum wightii	Lauraceae
Piper barberi	Piperaceae
Vateria indica	Dipterocarpaceae
Ochreinauclea missionis	Rubiaceae
Syzygium travancoricum	Myrtaceae

Table - 11

Some extremely rare taxa of Western Ghats (presumed to be extinct?)

Neuracanthus neesianus	Acanthaceae	N. Arcot dist., Tamil Nadu
Bunium nothum	Apiaceae	Nilgiri hills; Sri Lanka
Pimpinella pulneyensis	Apiaceae	Kodaikanal Sholas, Tamil Nadu
Ceropegia maculata	Asclepiadaceae	Tamil Nadu; Kerala: Sri Lanka
Oianthus deccanensis	Asclepiadaceae	Chatursringhi hills, Pune, Maharashtra
Vernonia recurva	Asteracea	Annamalai hills, Tamil Nadu
Impatiens anaimudica	Balsaminaceae	Anaimudi slopes, Idukki district, Kerala
johnii	Balsaminaceae	Kalar valley, Idukki dist., Kerala
Ilex gardneriana	Aquifoliaceae	Nilgiri hills
Begonia canarana	Begoniaceae	Western Ghats
Salacia malabarica	Elastraceae	Coorg, Karnataka & Travancore hills, Kerala
Euonymus serratifolius	Celastraceae	Annamalai & Nilgiri hills, Tamil Nadu

Dipcadi concanense	Liliaceae	South India
Urginea poyphylla	Lilliaceae	Deccan peninsula
Abutilon ranadei	Malvaceae	Ambaghat, Maharashtra
Eugenia argentea	Myrtaceae	Wynad forest, Kerala
E. singampattiana	Myrtaceae	Tirunelveli dist., Tamil Nadu
Syzygium bourdillonii	Myrtaceae	South India
S. palaghatense	Myrtaceae	Palaghat hills, Kerala
Anoectochilus rotundifolius	Orchidaceae	Madurai dist. Tamil Nadu
Vanda wightii	Orchidaceae	Nilgiris hills, Tamil Nadu
Eragrostis rottleri	Poaceae	E. Coast of Tranquebar, S. India
Eriochrysis rangacharii	Poaceae	Paikara in Nilgiri district, Tamil Nadu
Hedyotis hirsutissim	Rubiaceae	Nilgiri dist. Tamil Nadu
Opercularia ocolytantha	Rubiaceae	Karnataka, Kerala
Ophiorrhiza barnesii	Rubiaceae	Travancore, Kerala
O. brunonis	Rubiaceae	Hills of Kerala, Tamil Nadu, Karnataka
Ophiorrhiza radicans	Rubiaceae	Kerala: Sri Lanka
Pavetta oblanceolata	Rubiaceae	Kerala
P. wightii	Rubiaceae	Nilgiri hills, Coonoor, Tamil Nadu
Wendlandia angustifolia	Rubiaceae	Courtallum & Tirunelvelli, Tamil Nadu
Madhuca bourdillonii	Sapotaceae	Quilon dist., Kerala
M. insignis	Sapotaceae	Mangalore, Karnatka
Carex christii	Cyperaceae	Nilgiri hills, Tamil Nadu
Isoetes dixitii	Isoetaceae	Maharashtra
Isoetes sampathkumarnii	Isoetaceae	Karnataka
Plectranthus bishopianus	Lamiaceae	Palni hills, Tamil Nadu
Ophiorrhiza caudata	Rubiaceae	Kerala
O. pykarensis	Rubiaceae	Nilgiri hills

Table - 12

Some Western Ghats taxa not collected after their Types

Species	Family	Locality
Sageraea grandiflora	Annonaceae	Quilon, Kerala 1894.
Vernonia multibracteata	"do"	Idduki, Kerala, 1880.
V. recurva	"do"	Annamalai hills, Tamil Nadu, 1957
Eugenia singampattiana	Myrtaceae	Tirunelvelli, Tamil Nadu, 1864-74.
Syzygium palghatense	"do"	Palghat, Kerala
Neuracanthus neesianus	Acanthaceae	N.Arcot, Tamil Nadu, 1850.
Nothopegia aureo-fulva	Anacardiaceae	Tirunelveli hills, Tamil Nadu
Crotolaria fysonii	Fabaceae	Palani hills, Madurai, 1899
Actinodaphne bourneae	Lauraceae	Pulneys, Tamil Nadu, 1897
Actinodaphne lanata	"do"	Nilgiris , Tamil Nadu 1889
Begonia anamalayana	Begoniaceae	Anamalai hills, 1864
B. canarana	"do"	Mangalore, 1851
Neanotis carnosa	Rubiaceae	Kulhatti, Kadur, 1897
Pavetta travancorica	Rubiaceae	Courtallum hills
Eugenia argentea	Myrtaceae	Wynaad,1892
Syzygium kanarensis	"do"	N. Canara
Memecylon sisparense	Melastomataceae	Sispara
Euonymus serratifolius	Celastraceae	Wynaad,1864
Salacia malabarica	"do"	Travancore hills
Ostodes integrifolius	Euphorbiaceae	Wynaad
Humboldtia bourdilloni	Fabaceae	Kerala
Dialium travancorium	"do"	Ponmudi forest
Phyllanthus megacarpa	Euphorbiacea	Nilgiri hills
Syzygium courtallense	Myrtaceae	Courtallum hills
Wendlandia angustifolia	Rubiaceae	Courtallum hills
Abutilon ransdei	Malvaceae	Ratnagiri,
Achyranthus coynei	Amaranthaceae	Khandala
Barleria gibsonioides	Acanthaceae	Maharashtra
B. sepalosa	"do"	Concan
Caralluma truncato-coronata	Asclepiadaceae	N. Canara
Cryoptocoryne cognata	Araceae	Concan
Cynoglossum ritchiei	Boraginaceae	Belgaum
Dysophylla stocksii	Lamiaceae	Concan
Leea talbotii	Leeaceae	Yellapur & Karwar
Neanotis ritchiei	Rubiaceae	Belgaum
Maba micrantha	Ebenaceae	Western Ghats
Viscum mysorense	Loranthaceae	Arasikere (Karnataka)

Conservation of such species which are not covered by protected areas under *ex-situ* conditions, in botanical gardens and other germplasm preservation centers is another aspect that is strongly recommended. The institutes like Central Institute of Medicinal and Aromatic Plants, Lucknow, which primarily deals with medicinal and aromatic plants has already several collections of medicinal and aromatic species in their gene bank. The collections should be further strengthened. The author at CIMAP Resource Centre at Bangalore initiated a programme of introduction, evaluation and multiplication of as many medicinal and aromatic species of Western Ghats as possible. So far, 70 species are being grown and conserved in the conservatory. While *ex-situ* conservation helps in conservation of the selected rare and endangered species, such centers also provide for the study of their chemistry, reproductive biology, their agro technology and even multiplication. Constant supply of required quantity of material for evaluation of medicinal and aromatic plants is also assured through such germplasm conservation. The pharmaceutical industries and others dealing with the large-scale use of medicinal and aromatic plants must also come forward to identify the locally available such species, introduce them in their collection centers and multiply them so that these are not only conserved, but also help in identifying the elite populations for further investigations and adopting them as future aromatic crops.

India's efforts towards conservation of biodiversity are also praiseworthy. Among the several steps taken for conservation of the biodiversity, the following are important (a) India is a signatory to all International conventions on biodiversity (b) Biological diversity Bill (2000) and National and State Biodiversity Boards for all states established (c) Forty seven plant species from India are included in CITES and Scientific and Management Authorities designated (d) Under Man and Biosphere Reserve programme 15 Biosphere Reserves declared (e) Prepared project documents for all Biosphere Reserves(f) Eighty nine National Parks, 496 Wildlife Sanctuaries, 27 Tiger Reserves, 25 Ramsar Sites, 17 Wetlands areas, 15 Mangrove areas, 6 World Heritage Sites and 4 Coral Reef areas declared (g) Establishment of National Gene banks at different places (h) Publications of Red Data Books by the Botanical Survey of India under the Ministry of Environment and Forests (i) Funding research programmes through DBT, DST and Ministry of Environment and Forests aiming at conservation of rare species and their habitat recovery (j) Financial support for establishment of Botanic Gardens and *ex situ* conservatories for rare and endangered species by Ministry of Environment and Forests. Recently efforts are also on to declare the whole of Western Ghats as a World heritage site. As many as 39 sites scattered in States of Karnataka, Kerala and Tamil Nadu in the Western Ghats are in the UNESCO list of natural world heritage sites and the author hopes that the tag of world heritage site attached to these hills certainly helps in *in situ* conservation of the flora and fauna of the region.

SOME URGENT TASKS FOR FUTURE

Studies on assessment of the floristic diversity in the country are still incomplete. It is said that nearly 30% of the country still remains under explored. There is an urgent need to systematically survey and document all the economically important species in the wild for future bioprospection work.

- Taxonomists and Ecologists should take up studies on assessment of infra specific variations in wild species and develop databases.

- Bioprospection of the medicinal and aromatic species involving Taxonomists, Ecologists, Phytochemists, Molecular biologists, Geneticists, Plant Breeders is also strongly recommended.

- As the flora is fast dwindling due to several anthropogenic factors, priority must be attached to the study of all wild flora.

- As a first step in this direction, it is necessary to establish a chain of conservatories of wild plants, particularly of rare, endangered, endemic and other economically important species.

- The author strongly urges to develop coordinated programmes on all major groups for stock taking and identifying gaps, avoiding duplication of efforts, develop expertise for all groups through training programmes, strengthen biodiversity collection centers (herbaria), identify areas needing further exploration and attempt once for all following co-ordiantated multidisciplinary programmes, attempt assessment of infra-specific diversity in at least few economically important species, develop consolidated National Biodiversity database and distribution maps for all species under central supervision with networking of information among different regional centers. However, the constraints in this direction are also too many, such as, lack of much required cooperation between Taxonomists and Phytochemists, biotechnologists; dearth of required number of good taxonomists / field botanists, vast array of flora with enormous infra-specific variation in taxa spread over vast extension of the geographical boundaries of Western Ghats, incomplete knowledge of our flora and huge cost involved in bioprospection work, etc. are some constraints.

- Serious and meaningful efforts should be initiated to overcome these constraints. Complete inventorization of flora (including infra specific diversity), training and generation of devoted field botanists and taxonomists, close interaction of taxonomists with phytochemists, biotechnologists for successful bioprospection programmes are certain priority agenda suggested with regard to the development of wild plant resources of Western Ghats.

CONCLUDING REMARKS

Western Ghats region is very rich in biological resources, which have not been satisfactorily documented and utilized. The opportunities for inventorization and bioprospection of our flora though limitless, several constraints like lack of trained field botanists/ ethno-botanists, lack of much needed cooperation between field botanists and biotechnologists, apathy towards field-oriented studies have become the limiting factors. There is an urgent need to generate adequate number of taxonomists and field botanists who have become endangered. The limited number of existing agriculture crops may not sustain the ever-increasing population in the coming decades and therefore search for alternate/additional crops is a must. Documentation of all life support species and life saving species in different zones of the country and their utilization can certainly help in our fight against hunger and ailments in coming years. Therefore, serious efforts are needed to initiate truly collaborative programmes involving taxonomists and biotechnologists for Bioprospection of our resources and product development. Conservation of our biological resources is another challenging task needing the attention of all biological scientists. The National Biodiversity strategy and Action Plan (Singh, 2002) rightly summarizes the course of action to be pursued for conservation of the rich flora of India. These are outlined below which should also apply to the conservation of the rich floristic diversity of Western Ghats i. Strengthening and increasing the effectiveness of present Protected Areas ii. Survey, catalogue and study the threatened ecosystems and develop conservation strategies, iii. Identify and map large forest fragments and develop methodology for management of biodiversity iv. Identify, catalogue and study the hyper-diversity areas and develop strategies for their conservation v. Identify over exploited species and reduce anthropogenic pressure by cultivating them vi. Develop strategies that involve indigenous people and in benefit sharing vii. Develop regional and national biodiversity database viii. Incorporate biodiversity concerns in Environmental Impact Assessments and in Forest Working Plans ix. Identify and map grassland/savanna areas and develop management strategies x. Mount a multi-tier education system for public awareness. Lastly establishment of ex-situ conservatories and wilderness areas in every village, town, schools and colleges to accommodate the unique flora of Western Ghats is strongly advocated for which liberal government subsidies be made available.

7 Ways Conservation of Western Ghats & Development Can Coexist

Situated in central India, the Western Ghats are recognised globally as one of the eight biodiversity hotspots in the world. Spanning across several states, this expansive region not only boasts a rich diversity of flora and fauna but also plays a significant role in sustaining life and ecosystems.

Amidst the natural bounty, the Western Ghats have become home to a thriving coffee cultivation industry. The undulating landscape and favourable climate create an ideal environment for coffee plantations, contributing to the economic livelihood of local communities. However, this juxtaposition of nature and agriculture has sparked important conversations about the conservation of western ghats and development in the area. As we explore the nuances, we delve into the intricacies of sustainable agricultural practices, the preservation of natural habitats, and the collective responsibility to ensure the longevity of this unique ecosystem.

The Western Ghats, with its blend of natural beauty and human activity, serves as a microcosm reflecting the broader global challenge of harmonising progress with environmental preservation. By addressing these challenges head-on, we aim to foster a future where the conservation of Western Ghats continues along with sustainable development activities

At Beforest Collective in Coorg, we are exploring the various ways in which we can balance development with conservation, especially with two of our collectives situated along the Shola Grasslands in the Western Ghats.

In this blog, we explore 8 ways of conservation in the western ghats by developing sustainable coffee estates as coffee is one of the major livelihoods in the area and the need for making such intense activities more sustainable is the need of the hour.

Mandating the Conservation of Existing Forests:

Studies show that a 1% increase in soil carbon content can sequester carbon emissions of the last 40 years and provide 700,000 litres of annual water access per acre. Forests act as carbon sinks, and this is why in all our collectives, reforesting and preserving forest cover is the centre of modus operandi, with coffee grown in the wild promoting tree diversity and ushering in produce that is forest-friendly and also conserving natural wonders like the Shola Grasslands which are an integral part of the conservation of the Western Ghats as they are the origin of south Indian rivers.

Treating Coffee Estates as Layers of the Rainforest Ecosystem:

Sustainable coffee farming methods, such as shade-grown coffee, mimic natural forest ecosystems, providing habitat for native flora and fauna. This helps preserve biodiversity in the Western Ghats, which is recognised as one of the world's hottest biodiversity hotspots. Our Poomaale 1.0 Collective in Coorg, nestled in the Western Ghats, is a sustainable coffee estate. It is reversing the impact of decades of land degradation & deforestation through permaculture farming techniques & biodiversity conservation. The 128 acres of land are rich in biodiversity, with habitation restricted to only 13 acres cumulatively. We believe that treating coffee estates as layers of the rainforest ecosystem and functioning as such will help us integrate sustainability into our activities, thereby creating a bridge between conservation and coffee cultivation

Soil Building, Conservation and Water Management:

One of the key factors we recognised for development and conservation to coexist is maintaining the health and conservation of soil and water management. Beforest has taken up many soil-building initiatives like introducing biochar to the soil, creating earthworks such as trenches for moisture retention and supplying the soil with nutrient-rich mixes that help provide long-term nourishment and build soil strength over the years. Activities including mulching, composting, and agroforestry also help maintain soil fertility, prevent erosion, and improve water retention in the soil. These practices mitigate the risk of soil degradation and protect water resources in the Western Ghats.

Today, every kilogram of coffee harvested in our Poomaale 1.0 Collective saves 1000 litres of water. We also built a greywater trench by diverting all the greywater, cow dung & urine from the cowshed and filling it with leaf litter, twigs and some forest soil.

Cultural Preservation, Community Development and Livelihoods:

With a coffee estate comes many responsibilities, and sustainable coffee estates focus highly on creating job opportunities for individuals in remote locations and, in turn, help in the development of households and the community. Moreover, many coffee-growing communities in the Western Ghats have rich cultural traditions and indigenous knowledge related to coffee cultivation. Sustainable coffee initiatives can help preserve

these cultural heritage practices, strengthening the social fabric of local communities and enabling the conservation of the western ghats while bettering communities.

Our Collectives in Coorg, as such, are crowdfunded by member communities who are driven by environmental progress and not just economic and seek harmonious relationships with the locals, incorporating them in the narrative instead of disrupting their way of living and displacement. Over the last 5 years in Poomaale 1.0 Collective, we introduced forest-friendly cultivation activities and are building homes that blend seamlessly into the landscape. The Poomaale 2.0 Collective and the newly-launched Hammiyala Collective are following suit.

Zero Chemical Farming:

Sustainable coffee farming practices minimise the use of synthetic fertilisers, pesticides, and herbicides, reducing chemical pollution and its impact on the environment. This helps maintain water quality in rivers and streams, which are vital components of the Western Ghats' hydrological system. All our produce here grows naturally, without the use of any external nutrition or artificial pest control and with intervention mostly restricted to pruning.

Eco-sensitive Landscape Zoning:

Our sensitive landscape zoning validates our commitment to leave 50% of the estate completely wild. Zoning means allotting spaces for specific uses. It provides a structured framework for land use and guide development in a community or region. This enables the existence of undisturbed zones having abundant wildlife, including big cats, small-clawed otters, elephants, bat colonies, etc. This makes our estate a perfect demonstration of co-existence.

Responsible Tourism:

Sustainable coffee farms can play a big role in the conservation of Western Ghats by offering opportunities for eco-tourism, allowing visitors to experience the natural beauty of the region while learning about sustainable farming practices. This can diversify income streams and contribute to local economies. Blyton Bungalow, as such, has been opening doors for eco-tourism in our coffee estate with events for astrophotography and yoga retreats along with classic Blyton Bungalow activities like nature walks, trekking and hiking across the collectives, stargazing and waterfall trails which takes visitors through a journey of coffee all while creating experiences that are sustainable with proper waste management, minimum use of resources and a focus on slow living.

Conservation and development need not be adversaries; each can complement the other. Sustainable practices and eco-friendly initiatives emerge as the guiding light in this journey. From afforestation programs to community-led conservation efforts, various initiatives are weaving a narrative where progress doesn't come at the expense of nature.

Western Ghats in Tamil Nadu

Western Ghats extend from the Niligris in the north to Marunthuvazh Malai at Swamithope in Kanyakumari district in the south. Height of the Western Ghats ranges from 2,000 to 3,000 metres.

Western Ghats

Western Ghats extend from the Niligris in the north to Marunthuvazh Malai at Swamithope in Kanyakumari district in the south. Height of the Western Ghats ranges from 2,000 to 3,000 metres. It covers an area of about 2,500 sq.km. Though the Western Ghats is a continuous range, it has some passes. The passes are Palghat, Shencottah, Aralvaimozhi, and Achankoil. The Niligris, Anaimalai, Palani hills, Cardamom hills, Varusanadu, Andipatti and Agasthiyar hills are the major hills of Western Ghats

Nilgiri Hills

The Nilgiri hills is located in the Northwestern part of Tamil Nadu. It consists of 24 peaks with more than 2,000 metres height. Doddabetta is the highest peak (2,637 metres) of this hill followed by Mukkuruthi (2,554 metres). Ooty and Coonoor are the major hill stations located on this hill. It has more than 2,700 species of flowering plants and the state animal Nilgiri Tahr is found in this hill.

Doddabetta

Anaimalai

Anaimalai is located in the border of Tamil Nadu and Kerala. It is located to the south of Palghat Gap. Anaimalai Tiger Reserve, Aliyar Reserved Forest, Valparai hill station, Kadamparai hydroelectric Power Plant are located on this hill. Aliyar and Tirumurthy dams are located at the foothills of this range.

Palani Hills

Palani hills are the eastward extension of the Western Ghats. These hills are located in Dindigul district. Vandaravu (2,533 metres) is the highest peak in the Palani hills. Vembadi Shola (2,505 metres) is its second highest peak. The hill station of Kodaikanal (2,150 metres) lies in the south-central portion of the range.

Palani hills

Peaks in Western Ghats	Height(m)
doddabetta	2,637
Mukkuruthi	2,554
Vembadisolai	2,505
Perumalmalai	2,234
Kottaimtalai	2,019
Pagasura	1,918

Cardamom Hills

These hills are also known as Yela Mala hills located in the southwestern part of Tamil Nadu. It acquires its name from the cardamom spice, which is commonly grown here. Pepper and coffee are the other crops cultivated over the hills. They meet the Anaimalai hills in the northwest, the Palani hills in the northeast and Varusanadu and Andipatti hills in the southeast.

Varusanadu and Andipatti Hills

Another eastward extension of Western Ghats is Varusanadu and Andipatti hills. Megamalai (the highway mountain), Kalugumalai, Kurangani hill station, and Suruli and Kumbakarai waterfalls are found on these hills. Srivilliputhur Grizzled Squirrel Wild life Sanctuary is located in the southern slope of these hills in Virudhunagar district. Vaigai river and its tributaries originate in this region.

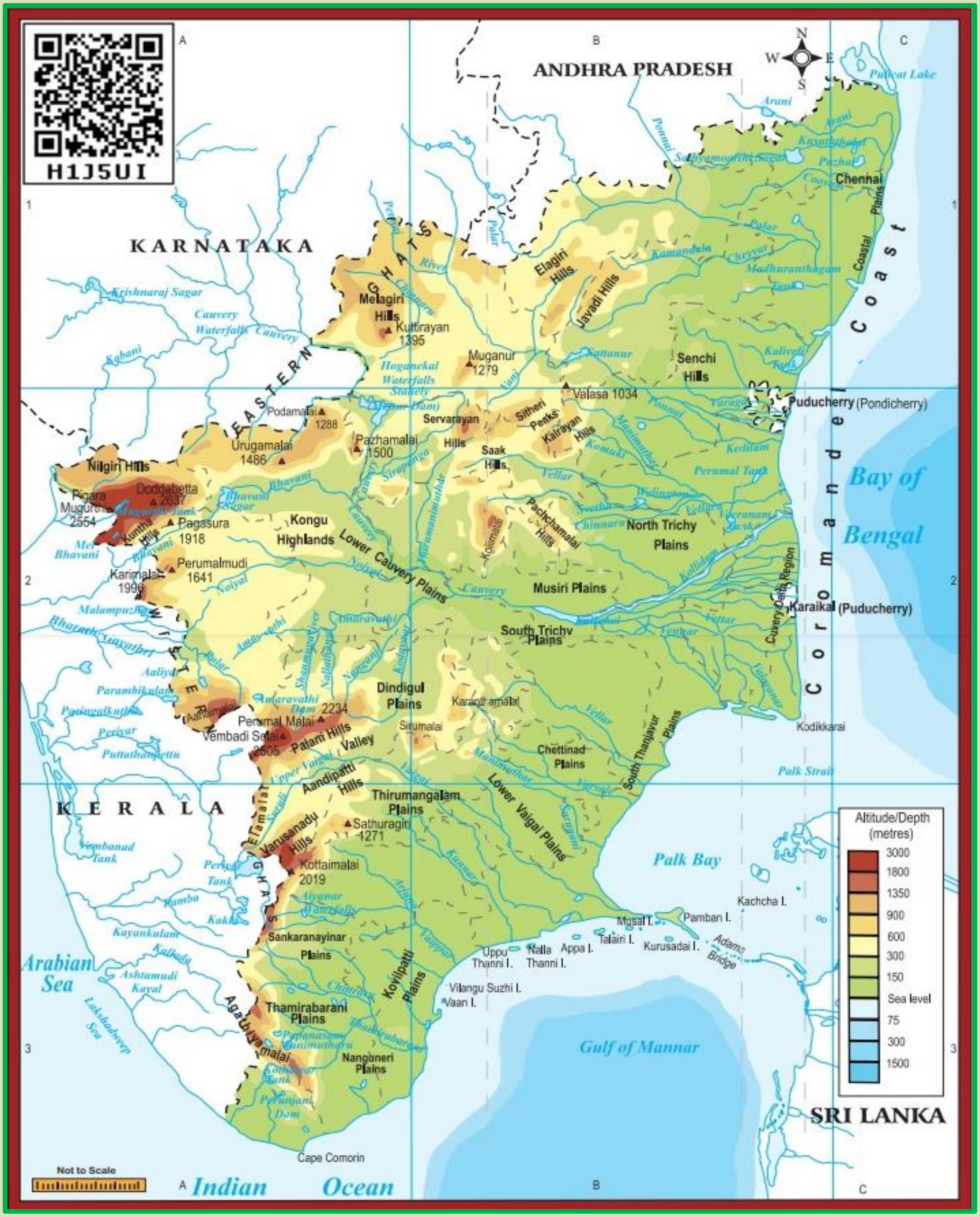
Pothigai Hills

Its major part lies in Tirunelveli district with its southern slope in the Kanyakumari district. Pothigai hills are called with different names such as the Shiva Jothi Parvath, Agasthiyar hills and Southern Kailash. These hills feature richest biodiversity in the Western Ghats. This area is known for its rich evergreen forest, waterfalls and ancient temples. Kalakkad Mundanthurai Tiger Reserve is located in this region.

Mahendragiri Hills

This continous range is situated along the border of Kanyakumari and Tirunelveli districts and is a part of the southern range of the Western Ghats. Its average height is 1,645 metres.

Districts	Hills
Coimbatore	Maruthamalai, Velliangiri and Anaimalai
Dharmapuri	Theertha malai, Chitteri and Vathalmalai
Dindigul	Pazhamalai and Kodaikanal
Erode	Chenni hills and Sivan hills
Vellore	Javadhu, Yelagiri and Rathinamalai hills
Namakkal	Kolli hills
Salem	Servarayan, Kanjamalai and Chalk hills
Kallakurichi	Kalvarayan
Villupuram	Gingee hills
Perambalur	Pachaimalai
Kanyakumari	Marunthuvazhmalai
Tirunelveli	Mahendragiri and Agasthiyarmalai
The Nilgiris	Nilgiri hills


H1J5UI
ANDHRA PRADESH
KARNATAKA
KERALA
Bay of Bengal
Arabian Sea
Indian Ocean
Gulf of Mannar
Palk Bay
Palk Strait
SRI LANKA
Coromandel Coast
EASTERN GHATS
WESTERN GHATS
Chennai
Puducherry (Pondicherry)
Karaikal (Puducherry)
Kodikkarai
Cape Comorin
Nilgiri Hills
Doddabetta 2637
Mukurthi 2554
Pagasura 1918
Perumalmudi 1641
Karimalai 1996
Melagiri Hills
Kuttirayan 1395
Muganur 1279
Elagiri Hills
Javadi Hills
Senchi Hills
Valasa 1034
Podamalai 1288
Urugamalai 1486
Pazhamalai 1500
Servarayan Hills
Sitheri Peaks
Kalrayan Hills
Pachchamalai Hills
Kolli Hills
Kongu Highlands
Lower Cauvery Plains
North Trichy Plains
Musiri Plains
South Trichy Plains
Cauvery Delta Region
Dindigul Plains
Palani Hills
Vembadi Sholai 2505
Perumal Malai 2234
Anaimalai
Aandipatti Hills
Varusanadu Hills
Kottaimalai 2019
Sathuragiri 1271
Thirumangalam Plains
Lower Vaigai Plains
Chettinad Plains
South Thanjavur Plains
Sankaranayinar Plains
Kovilpatti Plains
Thamirabarani Plains
Nanguneri Plains
Agasthiyamalai
Elamalai
Pamban I.
Kachcha I.
Musal I.
Talairi I.
Kurusadai I.
Appa I.
Nalla Thanni I.
Uppu Thanni I.
Vilangu Suzhi I.
Vaan I.
Adams Bridge
Pulicat Lake
Sathyamoorthi Sagar
Krishnaraj Sagar
Hogenekal Waterfalls
Stanely (Mettur Dam)
Bhavani Sagar
Amaravathi Dam
Periyar Tank
Vembanad Tank
Ashtamudi Kayal
Cauvery
Palar
Ponnaiyar
Vaigai
Thamirabarani
Altitude/Depth (metres)
3000
1800
1350
900
600
300
150
Sea level
75
300
1500
Not to Scale

My Sabatical Visit in Tamilnadu:

As I planned for my Sabatical visit n Tamilnadu, I started my journey from Marunthumalai, Kanyakumari, Nilgris mountain region.

I have taken up the eco system study during my visit and found following activities that destroy the conservation system of Western Ghats….

- ✧ Forest Fire either natural and man-made disaster
- ✧ A large migration of Animals to different parts
- ✧ Reduction of Forest Cover for various reason such as occupation and agriculture
- ✧ Corporate involvement and encouragement of forest areas
- ✧ Large expansion of Tea Estates
- ✧ Anti Social activities by human

Biodiversity Hotspot in Western Ghats (Kerala)

Western Ghats and Kerala:

She has been there even before the first buds of civilization sprouted, nurturing the land, sheltering its life and guarding its riches. She could be rightly called as one of the oldest ecosystems in the world - the Western Ghats. This unique mountain system caressing five States in India covers approximately 1,60,000 sq km and runs nearly 1600 km. Starting from the north, near the border of Gujarat and Maharashtra, south of the Tapti River, it runs through the states of Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala ending at Kanyakumari, the southern tip of India.

The mighty Western Ghats, intimately called by the people as *Sahyadri,* originated not as a mountain but as the faulted edge of the Deccan Plateau that separate the plateau from a narrow coastal plain along the Arabian Sea. Being one of the eight hottest hotspots of biological diversity in the world, the Western Ghats is home to more than 5000 species of flowering plants, 139 mammal species, 508 bird species and 179 amphibian species. Not just this, about 325 globally threatened species take refuge in these mighty mountain ranges. Some of the rare animal species found in the Western Ghats include the Malabar large-spotted civet, lion-tailed macaque, Asian elephants, tiger, Black Panther, leopards, great Indian hornbill and Wroughton's free-tailed bat.

Apart from this natural wealth these mountain ranges give shelter to numerous tribal settlements and their culture. These indigenous people have been harmoniously coexisting with nature for centuries. The *Toda, Soliga, Hallaki, Vokkal, Paniya, Adiya,* and *Kuruma* are few of them. In their harmonious cohabitation with nature, they have identified countless secrets lay hidden in the broad bosom of the Western Ghats including several medicinal plants unknown to the outside world.

The land of Kerala is also blessed by the Western Ghats sumptuously. About 40% of its ranges lie in Kerala. Among the 44 rivers of Kerala 41 originate from the Western Ghats. Kerala has the highest point (Anamudi in Idukki District) in the Western Ghats, which is also the highest south of the Himalayas in India. Around the moist-deciduous and evergreen forests of the Western Ghats are plantations such as coffee, tea and cardamom. Moderating the tropical climate of the region, the Ghats present one of the best examples of the monsoon system in the planet.

Recognition came the way of this silent guardian when 39 of her serial sites made it to the UNESCO World Heritage list. Among the 39 serial sites selected by IUCN (International Union for Conservation of Nature), 19 are in Kerala. The inscribed sites include the Silent Valley Park, Eravikulam National Park, Periyar Tiger Reserve, Shenduruney Wildlife Sanctuary, Neyyar, Peppara, Chinnar and Aralam Wildlife sanctuaries, which are some of the preferred ecotourism destinations in the State.

ABSTRACT

Kerala is rich with diverse flora and fauna. It is the major part of the biodiversity hotspot of Western Ghats, which is slowly deteriorating due to extreme human activity and overgrazing of farm animals, deforestation etc. This current situation of devastation and unsustainable situation left unchecked might result in an unalterable consequence which might be threatening to both human as well as wild animals. Thus, the current paper provides a short overview on certain issues in relation to biodiversity hotspot of Kerala

INTRODUCTION

Biodiversity refers to the variety and variability among the living, the ecological complexes in which they occur, and the ways in which they interact with each other and their environment. Recently, biodiversity is a result of a chain of turnovers in the rate of evolution and extinction since the primitive. Evolution and extinction is a natural process in which new species are appearing and some species are disappeared. The literature and geo-biological evidences indicate that number of floral and faunal species have disappeared over the aeons as they failed to adopt to the climatic, and geographical changes. In the present era, the Homo sapiens (Human beings) are the most powerful agents of environmental change driving the latest wave of extinction. The human activities have already caused the destruction of over third of the world's forest. The rapidly escalating human demand for natural resources is causing genes, species and habitats to disappear at an unprotected rate. The IUCN Red List of threatened species indicates that species extinction is on an alarming rate. Since the earliest date of recorded history, the fundamental social, ethical, cultural and economic values of humans have directly or indirectly revolved around biological resources. Diversity in genes, species and ecosystems has contributed immensely to the productivity of agriculture, forestry, fisheries and industry. Especially the tropical forests, which are rich in biological diversity (BH, 2017).

Therefore, we map the area where biodiversity is rich for the conservation. These areas are known as Biodiversity Hotspot (Table 1; Figure 1). In 1988, Norman Myres, a British ecologist defined the parameters to identify the hotspot areas are: 1. Richness in endemic species and 2. Impact by human activities The floral diversity is the biological basis for hotspot designation. To qualify as a hotspot, a region must support 1,500 endemic plant species, 0.5 % of the global total. As per the modern definition, a biodiversity hotspot is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction. The term biodiversity hotspot specifically refers to 25 biologically rich areas around the world that have lost at least 70 % of their original habitat.

Biodiversity Hotspots in India

Among the above regions, the Western Ghats are a chain of hills that run along the western edge of peninsular India. It is popularly known as Sahyadri Mountains. They enjoy high rainfall. They run parallel to the west coast of India and constitute more than 1600 km strip of forests of Maharasthra, Goa, Karnataka, Tamil Nadu and Kerala. They have moist deciduous forest and rain forest. The region shows high species diversity as well as high levels of endemism. There are about 6000 vascular plants belonging to this hotspot of which over 3000 are endemic. About 77 % of the amphibians and 62 % of the reptile are only found in this region. It also enjoys the about 450 bird species, about 140 mammalians, about 260 reptiles and about 175 amphibian's species. world. The state contains more than 4,500 species of flowering plants of which about 1500 taxa are endemic (Figure 3 & 4). There is also equally rich faunal diversity

Major Floral wealth of Kerala as compared to India

The diversity of micro-flora, microfauna and the marine flora and fauna in particular even though not fully explored and is remarkably rich in the state. Kerala has 25.71 % flowering plants ac compared to the total flowering plants of the Country. There are lots of issues and threats on the state as a Biodiversity hotspot of Western Ghats. The major is following:

Encroachments

The state Kerala is one of the land hungry hotspot regions of the country. These issues might have started as early as 1950s due the Government Policies like "Grow More Food", "Arable Land" etc. the policy of the State Government is that all encroachments after 01- 01-1977 will be evicted.

Fire Wood: The people who stay near / in forest areas used to collect fire wood. The uncontrolled collection of firewood is a threat for the biomass and microhabitat of flora and fauna. It leads to degradation of habitats which subsequently alters the species composition and vegetation types. It is estimated that about 0.8 million cubic meters of firewood is illegally removed from the forest per year.

Uncontrolled collection of Non-Timber Forest Produce (NTFP)

NTFP is the livelihood of the tribal communities of any forest areas but the unsustainable harvesting of NTFP collection in the state drawn the many floral species in the RET (rare, endangered and threatened) categories. Kerala is rich of NTFP and about 120 items are listed as commercially important by the Kerala Forest Department. Need training on the sustainable harvesting of NTFP in Kerala.

Forest Fires

The forest fire is one of the most important threats and issues for the Forest and Forest Department of Kerala. The communities who are engaged in grazing livestock often burn the area to get fresh shoots for the cattle and also who involved in illicit activities like Ganja cultivation, Poaching, Tree cutting, NTFP collection etc. Need proper enforcement and awareness programme / training.

Cattle grazing & Man-Animal Conflict:

Cattle grazing in forest are one of the major threat and issues to Biodiversity in Kerala which also leads to the Man-Animal conflict. The grazing removes the biomass and creates problems for the wild herbivores and spread the contagious diseases to wild animals. The trampling leads to soil erosion and also make the region to domination of a single or 2-3 floral species. It should be checked as soon as possible. Most of times wild mega fauna and other faunal and avifaunal species come near the habitat of human and destroy the crops. These events create Man-Animal conflict in Kerala. As a result, the people tend to kill the animals either by poisoning or by other means, like keeping crackers in fruits. This problem is very severe in northern Kerala where cultivation of paddy is extensive. Needful strategies should be adopted soon for this issue.

Poaching

As the state enjoys the charm of Western Ghats having abundance of wild animals, it is a highly suitable areas for poaching and for making the products of faunal species. Some faunal species are being poached for meat. It is a burning issue for the state and creates loss of species from the biodiversity hotspots.

Mining

The Biodiversity Hotspots of Kerala represent the sound riparian species. Mining is a threat to the stability of a landscape, which results in landslides and lowering of water table and it harm the riparian ecology which is found in a very narrow habitat niche in this Biodiversity hotspots of the State.

Tourism & Pilgrimage

The mass tourism and pilgrimage are the major issues of the biodiversity hotspot of Kerala. About 13 million enter into forest. It makes severe changes in the biodiversity hotspot which leads to loss of the biodiversity.

Invasive species

The species does not belong to this Biodiversity Hotspot is damaging to the native species. The most invasive species are Eichornia crassipes, Lantana camara, Oreochromis mossambica (Tilaapia fish), Plecostomus multiradiatus (sucker catfish), Achatina fulica (African Giant Snail) etc. A. fulica is native of East Africa which had created serious pest menace in many parts of the state in the year 2010 which damaged about 500 plant species including vegetables, rubber and coffee plant.

Plantations

In order to meet the timber and pulpwood requirements of the State, in the forested zone of the Highlands, more than 70000 ha of natural forests are converted into forest plantations, mainly of teak and eucalypts. Even though plantations of teak, which is an indigenous species, allow the sustenance of certain amount of plant diversity and provide habitats for less characteristic wild fauna, there is substantial reduction in both the components of natural biodiversity, due to the intense silvicultural operations carried out in such plantations. In the case of Eucalypts, which is an exotic species of very short rotation period, the growth and survival of wild flora and fauna in these plantations is very poor. Also, Eucalypt plantations, raised in the higher altitude grasslands of the State with unique biodiversity, are very harmful to the overall wealth of indigenous biological resources of the State.

The Need of Conservation in Kerala:

Today the entire world is experiencing erratic climate digression. Kerala's milieu is not distinct. The 2015-16 drought in Kerala was a precursor of the ensuing climate deviation. The Cyclone Ockhi, the torrential rains, the mudslides, and the devastating floods, all that followed are an eye-opener to the state as well as to the people. The heavy downpour and the torrential rains of 2018 and 2019 devastated the entire state, especially the regions of Western Ghats.

Previously only torrential rains of lengthy span, can trigger mudslides and landslides. But, right now a single heavy downpour can elicit potential landslides. The disastrous floods of 2018 and 2019 have catastrophic consequences in Kerala's physical, social, environmental and economic spheres - Kerala's plains and river basins, spanning roughly 50 km from the mountains to the sea, have become waterlogged, mud and sludge slit dumped, houses/buildings shattered and contagious diseases sprout up. The state's economy was crippled, many lost life and livelihood, the primary sector guttered down.

The recent disasters in Kavalappara, Pettimudi, Pathumala, Koottickal, and Kokkayar serve the realization that tragedies are impending and scientific interventions are indispensable to prevent and minimize the effects of imminent calamities. It is unanimous that the ecological biodiversity of western ghats needs to be safeguarded without fail. It is in this context the Nava Keralam karma padathi 2 -a mission mode of Government of Kerala has intervened by simultaneously strategizing techniques to resolve the prevailing issues and to confront challenges of the future by synchronizing large scale people's participation with the highest viable technology.

The worldwide scientific community has recognized the disruption of stream networks on slopes as a natural cause of landslides. Systematically tracing and reclaiming the entire watercourse networks of the Western Ghats will be a pragmatic solution to prevent the impending disasters. Such an action will secure the lives & livelihoods of the local residents and will preserve the ecosystem of the Western Ghats. The revitalisation of water courses is a great task and Navakeralam Karmapaddhati-2 envisages to achieve it by mobilizing the masses on a large scale through the participatory campaigns and through coordination of the Local Self-Government Institutions, the Mahatma Gandhi National Rural Employment Guarantee Scheme, State IT Mission, and Rebuild Kerala Initiative. It is expected that this innovative project will serve as a role model which can be replicated to other vulnerable landslide prone regions of the country.

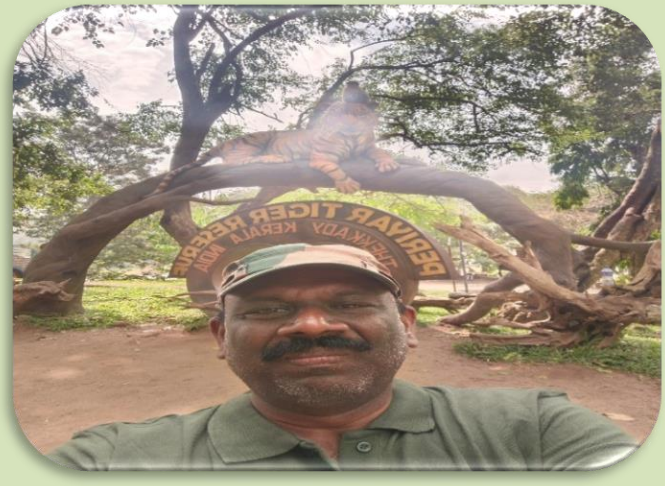
The Western Ghats, an abundant repository of natural resources, homes to an exceptional environment and biodiversity, have a tremendous impact on Kerala's greenery, water availability, and agro fertility. The panoramic beauty of western ghats offer visual treat, making these regions of God's own Country alluring. The Western Ghats provides immense tourism potential-economically and socially. Responsible tourism lures the local residents towards a better economic stability. Countless tourist attractions, including splashing rivers, bustling streams, majestic waterfalls, scintillating climate, fascinating landscapes, explorable trekking and abundance of flora and fauna - an experience in a lifetime. This fascinating environment should be sustained well and good for the posterity, and a secure living to the local inhabitants is to be ensured.

My Sabatical Visit in Kerala:

As I planned for my Sabatical visit n Tamilnadu, I visited Idukki and Vayanadu in Karela Western Ghats Region:

My findings as follow.

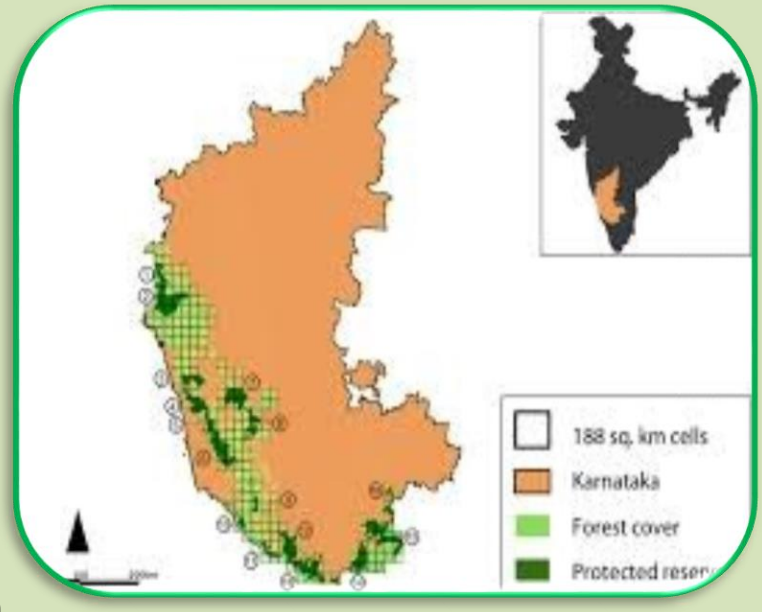
- ✧ Land sildes
- ✧ Flood and diaster
- ✧ Exploitation of Eco System
- ✧ Declining traditional arts and culture
- ✧ Exploitation of forest areas in the name of temples and pilgrimages
- ✧ Large expansion of Agricultural Lands
- ✧ Using large quantity of chemical fertilizers and pesticides which contaminated food production
- ✧ Tourism
- ✧ Anti Social activities by human
- ✧ Failure of regular monsoon result in either flood or draught



THE WESTERN GHATS IN THE STATE OF KARNATAKA

Introduction:

Karnataka in many was epitomises the diversity of India. Karnataka State was formed in 1956 by the merger of Kannda speaking areas of the Bombay and Madras provinces, the princely State of Hyderabad, the whole of Mysore State and the centrally administered State of Kadagu (Coorg). Covering a land area of some 190,000 square kilometres, it is an important state in Southern India with the city of Bangalore as capital. It has a coastline of 400 kms and a seaboard, 10 to 80 km wide, which has had trade links with the outside world for more than a thousand years. Next to the coast a continuous mountain range, 30 to 80 kms in width, rises to a height of 1,800 meters, declining gently to the east to a plateau some 100 m. above sea level. While in the west the rain is in summer in the north east it is in winter. Agumbe in the mountain belt receives over 7,500m rain, and there are places in the north east parts with less than 250m. While we have the Tropical Wet Evergreen forests in the mountain range, we also have, in parts around Bellary, arid conditions, similar to desert.



Geology and Topography

Along the river banks, in holy places in India, steps are formed to facilitate bathing. These are known as 'ghats'. The mountain belt, known in Indian epics as Sahyadri, running parallel to the West coast of India over a length of 1,600 kms. (1,000 miles) is called the Western Ghats, in allusion to the step formation in the northern half. This has resulted from differential erosion of the layers of lava and ash. In Kannda, the local language, the Western Ghat belt is know as Malnad or mountain region. The geology of the Karnataka Western Ghats is Pre-Cambrian, among the oldest in India. Rocks are gneiss with intrusions of granite. The soil is generally lateritic, hardening on exposure, a factor of considerable significance relative to land use practices. The forests occupy the interior tracts of the coastal plain, the foot of the ghats and the mountain range, which rises as a wall, with quite often vertical slopes. East of the crest the gradient becomes less steep and the topography undulating with locally small areas of steep terrain.

Climate

The climate is typical of the tropics with heavy rain received during a short period of the year when the temperature is also high, resulting in humid conditions. A few strong pre-monsoon showers in April and May accompanied by thunder and lightening precede the regular monsoon. The monsoon lasts barely for 15 weeks, during which period more than 90% of the annual rain is received (Ministry of Works and Housing 1982). This is the feature in the entire area, varying only in degree of intensity. By and large, the minimum temperature does not fall below 12°c and the maximum may reach even 45°c at the canopy level (Rai 1990). Rainfall decreases rapidly away from the coast due a rain shadow effect in parts falling from 7500 mm to 750 mm in 50 kms.

Forests and Vegetation

Within an area of 20,000 sq kms. there are four main forest types and twelve sub-types as classified by Champion and Seth (Tiwari 1993). The main types are:

a. Southern Tropical Wet Evergreen Forest
b. Southern Tropical Semi-Evergreen Forest
c. Tropical Moist Deciduous Forest
d. Tropical Dry Deciduous Forest

In addition to the sub-types, there are distinct degradation stages and stages of serial succession providing a bewildering biodiversity. The importance of biodiversity for the future of mankind cannot be overstressed. The survival and well being of a large fraction of today's human population depends crucially on a number of antiobiotics and anti-cancer drugs provided by obscure plants and animals. Yet in harnessing their benefits, we have only made a beginning. No more than 2% of the flowering plants have been screened for useful alkaloids (Chandrashekar undated). Of the 13,000 species of higher plants recorded in India, about 27% or 3,500 species occur in the Western Ghats. Many more species will become known when a systematic survey is undertaken. There are 58 endemic genera mostly confined to the Western Ghats (Abraham 1984). These forests are centres of progenitors or relatives of many cultivated plants e.g. rice, banana, turmeric, pepper, cinnamon and cardamom. It is a centre of genetic diversity for orchids (Chauhan 1993). It is the home of mango with over 100 identified varieties in the wild (Reddy 1993). The value of drugs obtained from, herbs and plants in the Western Ghats is put at Rs800 million per annum (MWH op cit).

Wildlife

The Western Ghat region is extremely rich in wildlife. The area is the home of the Asian elephant whose migratory movements cover the Dry Deciduous and Moist Deciduous forests, with infrequent forages into the Semi-Evergreen and Evergreen Forests. Bison (Bos gaurus) and Sambhar (Cervus unicolor) have a similar range while Spotted Deer (Cervus) is confined to the Deciduous Forests. The companions of Spotted Deer, in lesser numbers are the Barking deer (Mutiacus muntjac) and Mouse deer (Tragulus meminna). Tiger, considered to be at the apex of the wild life community, occurs in reasonable numbers in the Deciduous Forests while Panther is present in larger numbers. Hyena and Jackal frequent the outer limits of the forests and Wild Dogs, though in lesser numbers, are encountered in the entire region. Jungle Fowl are common in the wetter areas and Pea Fowl prefer the drier parts.

Water Resources

The Western Ghats gain elevation rapidly in the west presenting a high escarpment almost parallel to the coast. This causes the heavy moisture laden monsoon winds to part with a major share of their moisture on the western slopes of the ghats. The areas east of the crest receive significantly less rain and are rain shadowed. There are therefore a large number of west flowing rivers with short courses while the east flowing rivers, are fewer in number. The major irrigation projects in Karnataka, Andhra and Tamil Nadu depend on the catchment areas of the ghats. The swift flowing western rivers, which lose height of around 1,300 to 1,500m. in a short distance before joining the sea have very high-power generation potential. The installed capacity of hydel projects in the State at present is 2310 MW (Rudrappa 1993).

Agriculture and Horticulture

The zone with its characteristic features of high erodability of exposed lands and poor moisture retentive capacity is not ideal for agriculture. Despite this a quarter of the land area is under the plough. Irrigation is available in barely 125,000 ha. The major agricultural crops are paddy rice, ragi (a coarse millet), horsegram, and groundnut (Agriculture Finance Corporation 1992). In the sphere of horticulture, are canut from palm trees is important in the northern districts while coffee is important in the south. Amongst the States in India, Karnataka leads in production of coffee and areca and second in cardamom and pepper, all cultivated in the Western Ghats (Agriculture Finance Corporation 1992). 3 Coffee was introduced in the Western Ghats in 1670. (Buchanan - Hamilton, 1807). The cultivation of coffee, in estates, was encouraged by the British beginning in 1870. In the old Mysore parts of Western Ghats, Government land suitable for coffee was classified separately and made available through grants for its cultivation. In Kodagu, land was freely made available for the purposes of coffee cultivation from community privilege areas (Someshwar 1991).

Land Tenure

Individual Privilege Areas

Individual privilege areas are forests outside reserve forest and attached to agricultural land or horticulture gardens for benefiting cultivated crops, mainly for providing mulch. Grants of forests were liberally made in the past for privilege purpose. In Uttara Kannada district, the privilege area for areca was up to eight times the extent under areca. In Kodagu areas up to 300 acres were allocated. Privilege areas are found in all parts of the State in the Western Ghat belt and are known by a variety of names such as 'betta'. The very purpose for which the privilege is granted, for lopping, guarantees degradation of trees and forest cover in these areas.

Community Privilege Areas

Prior to reservation of forest, the land belonged to the Revenue Department. Hence, the Forest Settlement Officer who conducted the reservation, was from the Revenue Department. At the time of reservation, an essential criterion investigated by the Forest Settlement Officer was the extent of forest land available outside the reservation areas (Cleghorn 1861, Stebbing 1921). These lands are intended to meet the local needs of small timber, firewood and fodder. Community privilege areas in the malnad belt were equal in extent to the reserved blocks (Shyam Sunder and Parameshwarappa 1987). The Royal Commission on Agriculture in India (1928) had suggested that there should be two divisions within the Forest Department. The first for managing protection forest, preservation of which is desirable on climatic or physical grounds and also commercial forests. The second for managing minor forests, fuel plantations, village woodlands and such areas classified as waste land or unclassed forest. This indicates the extent of the second category of land with tree cover during the period.

Contribution of the Western Ghats Forests to the People

The importance of the forests in the Western Ghats to society at large has been aptly described as follows: "The Ghats influence to a great extent the climate of the plains and possess the resources of water power and above all the restorative hopes to the ecological upsets of the plains. Until and unless adequate measures for development without destruction, for a balanced utilisation and conservation of the environment are ensured in these hills, most of the present problems of the plains will remain unsolved affecting the economy of the entire area adversely" (MWH op cit).

In rural India firewood is the most common source of fuel, used as a nonmonetised item; as a result, 90% of all wood grown ends up as fire wood. As stall feeding is uncommon, cattle depend on public lands for fodder. In hill regions the use of mulch collected from the forests has been integrated into agriculture and horticulture systems. In the Western Ghats, forests have provided these requirements since the days of settled agriculture. The pressing question now is can this be sustained.

It was the considerations of ecological and environmental benefits which accrue from forests, and which extend far beyond the immediate forest zone, that resulted in the National Forest Policy of 1952 (Ministry of Food and Agriculture 1952). It was noted that: "The accident of a village being situated close to a forest does not prejudice the right of the country as a whole to receive the benefits of a national asset. While therefore the needs of the local population must be met to a reasonable extent, national interests should not be sacrificed because they are not directly discernible nor should the rights and interests of future generations be subordinated to the improvidence of the present generation.

" The latest policy statement of the Ministry of Environment and Forests in 1988 while not disputing the importance of forest from ecological and environmental points of view, has stressed that rights and concessions enjoyed by people living within and near forests should be fully protected. Their domestic requirements of fuelwood, fodder, minor forest produce and construction timber should be the first charge on forest produce. In other words, the significance of forests for the well being of the country as a whole does not take priority over resource use for the local population (Shyam Sunder 1992).

This appears to be more from an understanding of the situation on the ground rather than from an ecological or environmental perspective. Much has changed between 1952 and 1988. As indicated earlier, reservation had excluded a considerable extent of the original forest, to meet the rural needs (Brandis 1897).

How a Karnataka district is rapidly losing lush forest cover

- The Uttara Kannada district of Karnataka, among districts with high forest cover, is rapidly losing the forests to infrastructure projects.

- According to a latest study, the forest cover in Uttara Kannada has reduced from 74.19 percent in 1973 to 48.04 percent in 2018. Construction of dams in Kali River basin in the district has halved the evergreen forest cover.

Over the last four decades, the forest cover in the Uttara Kannada district of Karnataka has declined due to the rising number of unplanned infrastructure and agricultural activities. Studies have shown that power projects, construction of dams and encroachment of forest land for horticultural and agricultural practices in the district have affected the ecology and biodiversity of the region.

According to a study by the researchers of the Indian Institute of Science (IISc), Bengaluru and Indian Institute of Technology (IIT), Kharagpur, the forest cover in Uttara Kannada has reduced from 74.19 percent in 1973 to 48.04 percent in 2018, with loss of evergreen forests dropping from 56.07 percent to 24.85 percent. The loss of forest cover stated in the study is owing to activities such as the construction of dams along the Kali River after 1975 without appropriate rehabilitation measures.

The increase in single-tree (monoculture) plantations such as teak, eucalyptus and acacia by the state forest department as part of social forestry scheme, conversion of the area under forests to agriculture, horticulture or private plantations, setting up of forest-based industries and the nuclear power plant at Kaiga amid the evergreen forests are some other major reasons of deforestation cited in the study.

T.V. Ramchandra, a professor with the Centre for Ecological Sciences, IISc, and the lead author of the study told Mongabay-India that Uttara Kannada is among the districts with the highest forest cover in the entire country. As per the record, 80 percent of the area is supposed to be forest land but the shrinking forest cover shows the lack of government regulations and intention to preserve the environment.

Located in the central Western Ghats, Uttara Kannada district is among the eight biodiversity hotspots in India and hosts many species of flora and fauna. The natural forests are home to species of more than 4,600 flowering plants (38 percent endemic), 330 butterflies (11 percent endemic), 156 reptiles (62 percent endemic), 508 birds (4 percent endemic), 120 mammals (12 percent endemic), 289 fishes (41 percent endemic) and 135 amphibians (75 percent endemic).

Ramchandra explained that the field ecological survey suggests that the area consists of 1,068 species of flowering plants. The flora in the contiguous forests of the interior parts of the district includes the most threatened and vulnerable species such as *Wisneria triandra* and *Holigarna beddomei*. Wild animals such as tiger, leopard, wild dog and sloth bear, and prey animals like barking deer, spotted deer, wild boar, sambar, gaur were also found in the area.

Several rivers such as the Kali, Gangavali (Bedthi), Aghanashini and Sharavati originate in the area, ensuring water and food security for 24.5 crore (245 million) people. The regulation of water flow for rivers Kali and Sharavati for hydro-electric power generation has large-scale impacts on the landscape structure and the ecological integrity of the area. The monoculture (both forest plantation and horticulture) plantations and exploitation of timber in the Aghanashini River basin have led to the decline in forest cover from 86.08 percent in 1973 to 50.65 percent in 2018, the study noted.

It highlighted that while the moist deciduous forest cover in Aghanashini riverscape has increased from 9.79% to 25.76% in the 1973-2018 period, the evergreen forest cover has declined from 72.15% to 24.09% during the same period. Agricultural activity increased from 4.46 percent to 16.38 percent, while horticultural practices, such as areca nut gardens, have increased from 3.63 percent to 10.68 percent during the same period, especially along the river valleys and stream courses.
The study noted that during the last 40 years about 64,355 hectares of forest land has been diverted for various non-forestry activities such as paper industries, hydroelectric and nuclear power projects and commercial plantations.

Rapid urbanisation is another major factor

The spurt in urban growth can be seen around major towns such as Sirsi, Siddapura, Karwar, Hubballi, Ankola, Kumta, Honnavar and Dandeli. In these areas, the encroachment of forest lands and conversion to agriculture, horticulture and private plantations are prevalent throughout the district. This has led to the loss of native vegetation and straying of wild animals into human habitations, leading to higher instances of human-animal conflicts.

Sathodi waterfall in Uttara Kannada. The district is among the eight biodiversity hotspots in India. Photo by Hema Priyadharshini/Wikimedia Commons.

There has also been an increase in constructed area from 0.1 percent to 4.87 percent in the Gokarna-Kumta area and Sirsi. There has also been a reduction in the interior forest cover from 73.28 percent to 17.78 percent in the 1973-2018 period, the study noted.

Construction of a series of dams in the Kali River basin at Supa, Kodasalli and Kadrahas resulted in a loss of forest cover from 87.26 percent to 54.24 percent, while the evergreen forests cover dropped from 61.82 percent to 30.5 percent. Similar levels of stress by human-related activities were witnessed in the Sharavati river basin, where the forest cover has declined from 61.97 percent to 47.55 percent.

Pressure of infrastructure projects to increase

In the recent times, there are three major projects that have been passed in the area: the Hubballi-Ankola Railway line, which will affect 596 hectares of pristine forest; the Kaiga Atomic Power Plant expansion, which would lead to cutting of trees in 54 hectares of forest area; and the Sharavati pumped-storage hydroelectric plant, which requires clearing of 150 hectares of forest in the Sharavati Lion Tailed Macaque Sanctuary (home to the lion-tailed macaque, which is endemic to the area and classified as endangered by the International Union for Conservation of Nature).

A.N. Yellapa Reddy, the governing council member of the Foundation for Ecological Security of India and former conservator of forest in Uttara Kannada, stated the government does not want to save the environment. He said the legislators just want to fill their pockets by these projects. He said the destruction started in the early 1980s when the government constructed various dams in the area.

Reddy said that he protested against many projects but the government didn't listen to him, forcing him to resign. "The projects, which are approved now, if implemented, will end biodiversity in Uttara Kannada and the Western Ghats completely. Once these projects are implemented, there will be no human existence remaining in the area as the floods and droughts, various diseases like COVID-19, Nipah virus, Zika virus will destroy everything," Reddy warned.

The government was not ready to let a region rich with natural resources go from its boundaries. To make a dominance of Malayalis here, the Thiru-Kochi government formulated the High Range Colonisation Scheme encouraging the landless to migrate to the High Ranges for growing food. Under the HRC scheme too, the government offered a block of five acres of forest to the landless. Financial aid of Rs 1000 to build a house and buy farm tools was also offered to each family.

Religious and caste organisations were given the responsibility of the land distribution process. Applications were called for; thousands of people applied; lots were taken to decide who should be given land; 8000 acres of thick forest were demarcated for this; surveys were conducted in four areas- Kallar in Udumbanchola taluk and Kanthallur, Marayur and Deviyar in Devikulam.; plans were prepared; locations for houses and places of worship were decided. The biggest was the Kallar Pattom Colony with 1397 housing plots in 6860 acres; each of five acres.

"During the Grow More Food Campaign, the government encouraged people to migrate to the High Ranges, clear forests, and grow food. Whereas the HRC scheme was completely organized, designed and engineered by the government," points out T Rajesh, an employee with the Nedumkandam village office. He is the author of Idukki Charithrarekhakal, a book in Malayalam on the land issues in Idukki. His grandfather migrated to the High Ranges in 1950 from Meenachil in Kottayam. Rajesh perused old land documents for two years. Labelling all the people living in the High ranges as "encroachers" is painful for us, the third generation born and brought up in Idukki, says he.

But he confesses that along with each wave of mass migration, largescale encroachment and destruction of fragile ecosystems had also taken place.

It was the policies of the government, before and after independence, that led to migration, encroachment, destruction of the forests, and messing up of the title deed issues. The arrangement of dual administration of CHR- land under the revenue department and trees under the forest department continued even after the formation of Kerala. This created a lot of confusion between the two departments.

The large-scale encroachment of forests in the 1940s and the1950s during the Grow More Food and other schemes, had created concerns at the government level by the end of the 1950s itself. The state government had even formed two commissions to assess the encroachment issues. The state also came out with the legislation, the Kerala Forest Conservation Act, in 1961. But encroachment continued.

In fact, after the formation of the state, forest encroachment has been regularised four times changing the cutoff dates for eviction: 4 January 1957, 1 January 1960, 1 January 1968, and the final cut-off date was fixed as 1 January 1977.

However, the government could not implement its policies. In 1980, when the Forest Conservation Act was enacted by the Centre, CHR again became a reserved forest under the definition in the new legislation. This led to a lot of legal complications. The law made it 39 mandatory to get the Centre's approval for diverting the forest land for non-forest purposes. In CHR, the land was under the revenue department. By then people had made huge investments in CHR converting forest land for all sorts of infrastructure development activities. The Congress-led government at the Centre yielded to the persistent requests from the Congress-led state government for diverting "forest land" to give title deeds to the pre-1977 "encroachers".

In 1993, the state government formulated a set of new rules "Kerala Land Assignment (Regulation of Occupation of Forest Land before 1.1.1977" and started to distribute title deeds. This paved way for a long-drawn legal battle between the environmentalists and the state government. The Supreme Court issued its verdict on this case in 2009 favouring the state government.

"The period from 1993 to 2009 was a period of fear and uncertainty for thousands of families, the legal occupants as well as the encroachers," points out Rajesh. They could not buy, sell land, or get loans from banks. The Gadgil committee was appointed close to the heels of the Supreme Court verdict. "Naturally many people thought it was a scheme for evicting them from the occupied land."

Construction of dams, starting with the Mullaperiyar in 1887, has also contributed to the destruction of forests. With 18 dams, Idukki tops the districts in Kerala as for the number of dams. Most of those who came to Idukki as construction labourers stayed back while townships like Cheruthoni emerged in forest land.

The initial encroachments were in search of better livelihood opportunities by the poor. However, since the 1990s, commercial interests, particularly the resort, plantation and quarry lobbies, dominated the scene.

In the past two decades, the high range regions have witnessed a tourism boom, a flurry of infrastructure development, and mushrooming of resorts. This has led to serious illegalities, irregularities, land grab by forging documents, the encroachment of the forest and the government revenue land, and environmental destruction and degradation.

Much of this happened in connivance with some corrupt officials of the revenue and the forest departments.

For instance, 10 revenue and forest officials, including a former district collector were suspended in 2002 after an inquiry by a state government committee found them guilty of "serious lapses" in the encroachment of Mathikettan Shola forest in Udumbanchola taluk by a few private parties. The report prepared by the state additional chief secretary observed that organised encroachment in Mathikettan forests 40 Suicidal resistance: Understanding the opposition against the Western Ghats conservation in Karunapuram, Idukki, Kerala had started way back in 1966. However, large-scale encroachments were reported starting from 1996. In the 2001 incident, about 500 acres were encroached by some individuals with illegal title deeds.

Major Finding in Kartaka during Sabatical Visit

- **Increased number of festivals near forest areas**
- **Increased human movement inside the forest areas**
- **Exploitation of resources by Politicians**
- **Torusim**
- **All these factors exploit forest ecosystem resulting in climate chance and monsoon**
- **Traditional agricultural system reduced**
- **Became a marketing valued place by Corporate**
- **Agriculture based on water**

Western Ghats A modest effort towards a significant impact

The Terrain

The 1600 km long Western Ghats trespasses six states to form a natural fort, parallel to the western seashore from the south Kanyakumari to the northTapti River on the Gujarat-Maharashtra border. The 30 km long "Palakkad Gap in Kerala's Western Ghats, serves as an opening to both the gushing monsoon winds and to the scorching summer breezes. The Western Ghats play a significant role in determining our seasons. We experience a comparatively lengthy monsoon, a prolonged summer, and a reasonable winter. The western ghats serve as a natural barrier, catalyses the humid breezes from the sea resulting in frequent rains.

The researchers date back 50 to 90 million years of ancestry to the western ghats. The Anamudi hills situated in kerala with 2695 meters height is one among the illustrious peaks of western ghats. Kerala owes the Western Ghats for its prosperity - prolific gifted rain, sumptuous rivers, natural greenery, vegetation, fertility, etc. Further the neighboring states of kerala also benefit from the originating rivers of Western Ghats as numerous tributary channels and watercourses enriches these rivers, providing rich greenery, vegetation, livelihood for the beloved neighbors.

Importance of watercourses in the Western Ghats

Numerous watercourses in the Western Ghats have naturally evolved over thousands of years. These watercourse networks embrace the superfluous water from the copious rain and securely channelizes it to the plains. Nevertheless, a good number of these streams have been obstructed for a multiplicity of reasons, which eventually bunged the smooth flow of water. The interruption to the conventional flow of water is the critical reason for the frequent mudslides, and landslides in the highlands. Normally the rain water falling in an area will get precipitated to the soil and the remaining superfluous water will be channelized to the streams and then to the rivers. But once the surface runoff is interrupted it will increase the precipitation level, and unable to mount the pressure of water, the soil will rupture its bonding with the rocks. Depending on the slope and soil structure of the area, it can result in minor mudslides to tumultuous landslides.

If the precipitation level of rain water to soil is optimum if the superfluous water channelized through the streams are uninterrupted, Then the mudslides/landslides will be minimal.

Floods and torrential rains are no longer far-flung.

The torrential rains and disastrous floods of 2018 are deemed then as the great flood of the century until it becomes consecutive in 2019. Kerala reluctantly accepted that the state is vulnerable to natural disasters and are susceptible to imminent tragedies. The 2022 world climate conference has categorically forecasted India as a vulnerable destination of unprecedented extreme rains having catastrophic consequences. Unfortunately, the western ghats regions too fall within the purview of this climatic digression. As tragedies are impending, scientific and collective interventions are indispensable to prevent and minimize calamities.

What about the solution?

It is unanimous that global warming and climate digression are to be blamed for all natural disasters. The mighty interventions/discoveries so far made are incompetent to impede these natural disasters, but can only minimize its impact. Here too a scientific, concerted and collective endeavor is envisaged which can minimize the mudslides and landslides in the Western Ghats region and thereby reduce their outcomes. Systematically tracing and reclaiming the whole watercourse networks of the Western Ghats, and channelizing the superfluous rain water uninterruptedly through these streams is pertinent at this point of time.

Let's retrieve the stalled watercourses
Let's ensure smooth flow of water through channels
Let's restore, reclaim & revitalize the entire watercourse system
No matter how much rain falls, let the excessive rainwater flow uninterruptedly through the chain of natural watercourses and eventually end up in the river.

Let the rivers carry the water to the plains and valleys; endow prosperity-natural greenery, vegetation and fertility. With due diligence, the State is committed to reclaim the whole watercourse networks of the Western Ghats. The Harita Kerala Mission, after the successful implementation of the two phases of 'Ini njan ozhukatte' (let me flow now) by revitalizing and ensuring water affluence in the state's rivers and streams, now in the third phase seeks the rejuvenation of the watercourse's networks in the Western Ghats region.

Let's secure Western Ghats Together, let's make it happen

Mode of execution

A widespread notion prevails that the Western Ghats and its inhabitants are facing risk on behalf of the cry for environmental preservation and sustainable development. This skepticism has gained momentum owing to the recent natural disasters and climate

digressions. It is in this context, the Campaign- "Let's Secure Western Ghats" becomes relevant. The concept of this campaign is to create a milieu in which those born and raised there can continue to live securely there itself and perform their livelihood activities routinely.

"Let's Secure Western Ghats" aims to refurbish the water networks by retrieving the impediments in the water courses, spanning across 230 Grama Panchayats having 46531.63 km long canal networks. Those born and raised here can continue to live here securely and perform their livelihood activities consistently or where else where should the fifty lakh inhabitants in these 230 Grama Panchayats be evacuated and repatriated, paradoxical in a densely populated state with inadequate land availability.

Methodology

The Haritha Kerala Mission and the State IT Mission have developed a methodology to systematically trace and locate the watercourse networks in a region. The first step is to physically identify and locate the hindered and vanished watercourses already snapped on the satellite imagery map. This process of mapping is done by utilizing a mobile application and computer software made for the purpose. The mapping is done by physically moving along the waterway and marking the current plight of the stream in the software. The evaluation done physically will facilitate the identification of the damaged, interrupted, direction altered and vanished watercourses.

The next step is the reclamation and revitalization of watercourses, envisaged by mobilizing the masses on a large scale through the participatory campaigns and through coordination of the Local Self-Government Institutions, various departments the Mahatma Gandhi National Rural Employment Guarantee Scheme, NGO and other volunteers.

As a part of the Nava Keralam karma padhathi, under the auspices of the Haritha Kerala Mission, the local self-government bodies are taking the lead in making this mission a reality. After ensuring a smooth flow of water through the watercourses, no matter how heavy the rain pours, the superfluous water will uninterruptedly gush through the scheduled channels and then to the rivers. As the rain water is channelized uninterruptedly through the streams the precipitation level of rain water to soil will be optimum and the chances of mudslides and landslides will be minimal.

WE WILL LIVE HERE & WILL MOVE FORWARD

We owe the responsibility of protecting the biodiversity of the Western Ghats and simultaneously the welfare of the local residents. We are indebted to preserve our wealth- the ecosystem and biodiversity of Western Ghats.

Any destruction to the Western Ghats would be suicidal and are beyond imagination. We should ensure caution in our actions. We need perpetual smooth flowing rivers; simultaneously adequate groundwater level is to be ensured. Hence, it is high time to protect the watercourse networks of western Ghats. The recurring natural calamities definitely will cripple the tourism sector of the state. Desolate and sterile nature, dried rivers, austere climate if subsist here, will tarnish the tourism prospects and associated tourism-based livelihoods of the state. Prospective planning is indispensable to counter the adverse effects of climate change, and global warming. Let's secure the western ghats is a leap towards it. This endeavor is also to safeguard the livelihood and ensure the wellbeing of the residents. Building a Nava Keralam capable of evading and preventing calamities.

Progress of Mapathon

As the first phase of "Mapathon", scientific mapping of watercourses has been completed in the targeted 230 Gram Panchayats. These 230 grama panchayaths belonging to the9 districts of the state, share borders with the western ghats. It is identified that 46531.63 km long canal networks are available in this region. Maps of the entire 230 Gram Panchayats had been prepared and handed over to the field division for physical verification and updation. It took 11160-man days to finish the entire mapping process.

The next phase of reclamation activities is currently underway in 44 Gram Panchayats pertaining to 6 districts. In the panchayats where the Mapathon has been completed, activities such as reclamation of drains to facilitate water flow have been initiated. An action plan has been prepared in these panchayats for the second phase of activities. Public awareness activities, formation of public committees, Participatory campaigns, general cleaning campaign to remove garbage from streams, cleaning of streams that are clogged with weeds, mud and other garbage, providing soak pits to houses in the vicinity of streams, measures to reclaim illegal encroachment, data collection of streams without protection wall. inspection of heavily polluted streams, list of silted watercourses, listing and identification of the damaged, interrupted, direction altered and vanished watercourses its reclamation measures etc are the main course of action in the second phase.

Threats To Western Ghats of India

Crucial Insights:

The draft aims to reach an agreement among the six states involved: **Maharashtra, Tamil Nadu, Goa, Kerala, Karnataka, and Gujarat.** This issue has been under discussion since 2011.

Proposal inclusion:

Area: Over 56,000 square kilometres across six states will be covered.
It Includes 13 villages in Wayanad, Kerala, which recently experienced severe landslides.

Restrictions: Mining, quarrying, and sand mining will be banned. Large construction projects will also be limited.

Exceptions: Existing homes can be repaired or expanded, or renovation of existing residential houses in the Eco-sensitive Area but new big buildings are not allowed.
The notification also proposes to **phase out the existing mines within five years** "from the date of issue of the final notification or on the expiry of the existing mining lease, whichever is earlier".

Background of the Draft: The first draft was issued in March 2014 on the recommendation of the **High-Level Working Group (HLWG) formed by the Centre in 2012.**

Re-examination of Suggestions: In April 2022, the centre established another panel to check the recommendations from six states.

This panel considered both conservation concerns and developmental aspirations of the region.

Previous Draft: This draft was issued on July 6, 2022. It expired without a consensus between centre and six states on the extent of ESA.

About Western Ghats

Older than the Himalaya mountains, the mountain chain of the Western Ghats represents geomorphic features of **immense importance with unique biophysical and ecological processes.**

Location: Stretches 1,600 km (990 mi) along the western coast of the Indian peninsula.

Coverage: 160,000 km² (62,000 sq mi) across six states: **Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu.**

Local Names:

Sahyadri: In Maharashtra
Nilgiri Hills: In Karnataka and Tamil Nadu
Anaimalai Hills and Cardamom Hills: In Kerala

Formation and Geology:

Formation: Created during the break-up of the supercontinent Gondwana in the late Jurassic and early Cretaceous periods.

Geological Evidence: The mountains were formed when India separated from Africa and rose along the west coast.

Composition: The Deccan Plateau is made of basalt rocks, influencing the rise of the Western Ghats.

Topographical Variation: Higher in elevation (average elevation about 1,500 m) and more continuous compared to the Eastern Ghats, with height increasing from north to south.
Protected Areas in the Western Ghats: Protected Areas Includes two biosphere reserves, 13 National Parks, several wildlife sanctuaries, and many Reserve Forests.

Major Protected Areas include Nilgiri Biosphere Reserve and Silent Valley National Park

Passes in Western Ghats:

Thal Ghat Pass: Connects Mumbai to Nashik

Bhor Ghat Pass: Connects Mumbai to Pune via Khopoli

Palakkad Gap (Pal Ghat): Connects Coimbatore, Tamil Nadu to Palakkad, Kerala

Amba Ghat Pass: Connects Ratnagiri to Kolhapur

Naneghat Pass: Connects Pune with Junnar City

Amboli Ghat Pass: Connects Sawantwadi of Maharashtra to Belgaum of Karnataka

Recognition: Western Ghats was declared as **a world heritage site in 2012** by the United Nations Education, Scientific and Cultural Organisation (UNESCO).
It is one of the eight **'hottest hotspots'** of biological diversity in the world.

Significance of the Western Ghats

The Western Ghats are internationally recognized as a region of **immense global importance for the conservation of biological diversity, besides containing areas of high geological, cultural and aesthetic values.**

Hydrological Functions: The Western Ghats perform important hydrological and watershed functions.

It feeds a large number of perennial rivers of peninsular India including the three major eastward-flowing rivers **Godavari, Krishna, and Kaveri.**

The peninsular Indian states that receive most of their **water supply** from rivers originating in the Western Ghats.

Climatic Role: The mountains of the Western Ghats and their characteristic montane forest ecosystems **influence the Indian monsoon weather patterns** that mediate the warm tropical climate of the region, presenting one of the best examples of the tropical monsoon system on the planet.

The Ghats act as **a key barrier,** intercepting the rain-laden monsoon winds that sweep in from the south-west during late summer.

The Western Ghats include **a diversity of ecosystems ranging from tropical wet evergreen forests to montane grasslands**. They also include the **unique shola ecosystem** which consists of montane grasslands interspersed with evergreen forest patches.

The Western Ghats play a significant and important ecological function in **sequestration of atmospheric carbon dioxide**. It is estimated that they **neutralise around 4 million tonnes of carbon every year**– around 10% of emissions neutralised by all Indian forests.

Hottest Hotspots: The Western Ghats boast exceptionally high biological diversity and endemism, making it one of the world's eight 'hottest hotspots' of biodiversity.

High Biodiversity and Endemicity: Western Ghats along with its geographical extension in the wet zone of Sri Lanka are now also considered one of the eight hottest hotspots of biodiversity.

The forests of the site include some of the best representatives of non-equatorial tropical evergreen forests anywhere and are **home to at least 325 globally threatened flora, fauna, bird, amphibian, reptile and fish species.**

Western Ghats has a high degree of **endemism**, meaning that **species composition** from the very north of the mountains to 1,600km south **varies greatly**.

A number of flagship mammals occur in the property, including parts of the **single largest population of globally threatened 'landscape' species** such as the Asian Elephant, Gaur and Tiger.

Endangered species such as the lion-tailed Macaque, Nilgiri Tahr and Nilgiri Langur are unique to the area.

Economic Significance: The Western Ghats are rich in **iron, manganese and bauxite ores.** Its forests are an important **source of timber** and support a large number of forest-based industries such as paper, plywood, poly-fibres and matchwood.

In parts of their ranges **Pepper and cardamom,** native to the evergreen forests of the Western Ghats have been taken up as **plantation crops on a large scale.**

Other large-scale plantations include **tea, coffee, oil palm and rubber.**

There are a number of **tourist centres** also such as Ooty, Thekkady Wildlife Sanctuary etc. There have been **important pilgrimage centres** such as Sabarimala in Kerala, Mahabaleshwar in Maharashtra, etc.

Home to Indigenous Tribes: The indigenous people of the Western Ghats, including the Particularly Vulnerable Tribal Groups, constitute **44.2% of the tribal population of 6.95% of Karnataka.**

Examples: Gowlis, Kunbis, Halakki Vakkala, Kare Vakkala, Kunbi, and Kulvadi Marathi.

Threats to Western Ghats

The Western Ghats contain exceptional levels of plant and animal diversity and endemicity for a continental area. However, following various threats have been faced by the Western Ghats.

Susceptibility to Landslides: The unique physiographic-climatic-geological conditions make the western slopes of Western Ghats highly susceptible for the occurrence of frequent and widespread landslides.

Mining: Mining activities have grown rapidly especially in Goa and often in violation of all laws, resulting in serious **environmental damage and social disruption.**

Unsustainable mining has increased vulnerability to landslides, damaged water sources and agriculture, and affected the livelihoods of the people living there.

Sand mining has emerged as a major **threat in Kerala.**

Livestock Grazing: High livestock grazing within and bordering protected areas is a serious problem causing **habitat degradation** across the Western Ghats.

Human-wildlife Conflict: Western Ghats exists within an intensely human-dominated landscape, human-wildlife conflicts are a common phenomenon.

Example: Villagers living close to Bhadra Wildlife Sanctuary in Karnataka, **lose approximately 11%** of their annual grain production to raiding elephants annually.

Extraction of Forest Produce: Human communities living within and adjacent to protected areas in the Western Ghats are often dependent on forest produce to meet their subsistence and commercial needs.

With **rising population and changing consumption patterns,** it is becoming a critical issue.
Plantations: Over the years, plantations of cash crops have displaced extensive patches of natural forests throughout the Western Ghats and are frequently associated with **encroachment of surrounding forest areas.**

Plantations owned by private individuals and the corporate sector continue to grow in the Western Ghats, resulting in fragmentation of natural habitat.

Encroachment by Human Settlements: With rise in population, human settlements both within and outside protected areas represent a significant threat.

Pollution and Climate Change: The unrestricted use of agrochemicals is causing serious damage to aquatic and forest ecosystems.

The changes in land use and deforestation have led to changes in climatic patterns and been considered as a cause of floods in many regions in the recent past.

Conversion of forest land into agricultural land or for commercial purposes like tourism, illegal logging for timber has **significant effects on Western Ghats.**

Development of Hydropower Projects and Large Dams: Large dam projects in Western Ghats have an adverse impact on the environment and cause social disruption too.

Conservation Efforts for Western Ghats

Government has taken various measures to conserve biodiversity with the establishment of **Protected Area network, tiger reserves and biosphere reserves. Nearly 10%** of the total area of Western Ghats is currently covered under protected areas.

The government has also taken initiative to **demarcate Ecologically Sensitive Areas (ESA)** for promotion of environment-friendly and socially inclusive development.

Madhav Gadgil Committee (2011):

Classification of Ecologically Sensitive Zones (ESZs): The report proposed classifying 64 percent of the Western Ghats, spread over six states, into three categories – ESZ 1, ESZ 2, and ESZ 3.

Ecologically Sensitive Area (ESA): The entire Western Ghats region was recommended to be designated as an Ecologically Sensitive Area.

Developmental Activities: The report called for a halt to almost all developmental activities like mining, construction of thermal power plants, and dams in ESZ 1.

Bans and Restrictions: Genetically modified crops, plastic bags, Special Economic Zones, new hill stations, and changes in land use from farmland to non-farm land were to be prohibited.

The diversion of rivers to protect the ecology of the region and conversion of public lands into private lands were also discouraged.

Bottom-to-Top Governance: The report suggested a decentralized approach to governance with more power given to local authorities.

It recommended the establishment of a Western Ghats Ecology Authority under the Environment (Protection) Act, 1986, to manage the region's ecology and ensure sustainable development.

Ban on Single Commercial Crops: The report called for a ban on growing single commercial crops like tea, coffee, cardamom, rubber, banana, and pineapple in the Western Ghats, as they had negative environmental impacts.

Dr. K Kasturirangan Committee (2013):

Reduced Ecologically Sensitive Area: It has designated only 37% of the Western Ghats as ecologically sensitive, which was significantly lower than the 64% suggested by the Gadgil panel.

Categorization of Regions: The panel split the Western Ghats into two categories – cultural regions (human settlements) and natural regions (non-human settlements).
It proposed designating cultural lands as an Ecologically Sensitive Area.

Categorization of Activities: The report introduced a classification of activities into three categories – red, orange, and green.

Red Category: Activities, such as mining, stone quarrying, were recommended to be banned.

Orange Category: Activities would be regulated and allowed with appropriate permissions.

Green Category: All agricultural, horticultural, and certain commercial activities were allowed.

Way Forward

Following measures have been suggested to protect the Western Ghats from the facing threats:

Integrated Management Plans: The Government should develop and implement integrated management plans that **balance ecological conservation with the developmental needs** of the region.

Enhanced Monitoring: There is a need to **strengthen the regulatory framework** by enhancing monitoring mechanisms and enforcing existing environmental laws more stringently.

Improvement of Understanding: There is a need for better understanding of the role of biodiversity in ecosystem functions and related ecosystem services to conserve the Western Ghats.

There is also a need to improve the understanding of how human-modified landscapes need to be managed in order to sustain and improve biodiversity conservation.

Need for Appropriate Policy: Such policy changes need to be promoted that can better manage human-wildlife conflict, can provide financial incentives to further encourage biodiversity-friendly practices and other incentive schemes such as payments for ecosystem services.

Ban on Illegal Practices: There is a need to ensure that illegal deforestation should be banned, actions need to take care to tackle animal-human conflict and other human actions that impact biodiversity should be kept in check.

A Collaborative Approach: To maintain the biodiversity of the Western Ghats, a collaborative approach of various stakeholders is required.

A balance between conservation efforts and development should be sought and concerned state governments should come to a consensus for implementation of ESA in Western Ghats.About Eco-Sensitive Zones (ESZs)

ESZs or EFAs are areas designated around Protected Areas, National Parks, and Wildlife Sanctuaries in India.

It is also known **as Ecologically Fragile Areas (EFAs),**

Purpose

Buffer Zones: ESZs help protect critical habitats by reducing the impact of human activities.
Shock Absorbers: They manage and control activities around protected areas to minimise harm.

Function: Serve as a transition zone from high protection areas to areas with lesser protection.

Regulation

Authority: Regulated by the Ministry of Environment, Forests and Climate Change (MoEFCC) of the Indian government.

Extent

10 km Rule: Typically, land within 10 kilometres of national parks and wildlife sanctuaries is designated as ESZs.

Variations: ESZs can extend beyond 10 km if the area is ecologically important.
Statutory Backing

Environment (Protection) Act, 1986: Does not explicitly mention ESZs, but allows restrictions on industries and operations in sensitive areas.

Section 3(2)(v): Permits the Central Government to restrict or regulate industries and processes in certain areas.

Rule 5(1) of the Environment (Protection) Rules, 1986: Allows the government to restrict industrial activities based on biodiversity, pollution limits, and proximity to protected areas.
Constitutional Provisions on Environment Conservation

Article 48A: It states that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country. It was added by the **42nd Amendment, 1976** and places an obligation on the State to protect the environment and wildlife.

Article 51-A (g): It states that it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.

Article 21 and Article 14 are important sources of the right to a clean environment and the right against the adverse effects of climate change.

Without a clean environment, which is stable and non impacted by the impacts of climate change, the right to life is not fully realised.

Article 21 recognises the right to life and personal liberty and the right to health is its important part.

Article 14 indicates that all persons shall have equality before law and the equal protection of laws.

Understanding the opposition against the Western Ghats conservation:

The conservation of the Western Ghats is of great importance, especially in the age of global warming and climate change. The 1600-km long mountain range, also known as Sahyadri, runs parallel to the west coast of India. The chain starts from south of Tapi river in Gujarat and passes through five states-Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala and ends near the southern tip of the country. Geological evidence suggests that the mountain range is approximately 150 million years old and has stood the test of time. This ancient range is, in fact, older than the Himalayas. The Western Ghats is one of the most significant mountainous landscapes in the world, with seven types of vegetation; it is a treasure trove of biodiversity. The forests of the Western Ghats are some of the best representatives of the non-equatorial tropical evergreen rain forests in the world. It is recognised as one of the 34 Global Biodiversity Hotspots and one of the World's Eight Hottest Biodiversity Hotspots with a high level of endemism.

The Western Ghats, having just 4.8 per cent of India's total land area, contains more than 30 per cent of the country's plant, fish, bird and mammal species; many of which are found only here and nowhere else on the earth. Considering the global significance of the Western Ghats, the United Nations in 2012 declared 39 sites on the Western Ghats as World Heritage; of that 20 are in Kerala. This range also mediates the rainfall regime of Peninsular India by intercepting the southwest monsoon winds. The Western Ghats modulate the climate, the river flow and groundwater recharge of the entire region. It is the catchment area for river systems that drain almost 40 per cent of India. Many major rivers of south India such as the Godavari, Krishna and Kaveri, and all the 44 rivers of the state of Kerala, originate from the Western Ghats. Over 45 million people depend directly on the Western Ghats for livelihoods; around 245 million people living in peninsular India receive most of their water from the rivers originating in the Western Ghats.

As for Kerala, the conservation of the Western Ghats is of utmost importance. With 20,000 sq.km, Kerala has the highest proportion of its territory in the Western Ghats; about half of the total area of the state is in the Ghats. The state's water security, food security, cash crops in the high ranges, paddy fields and coconut farms in the midland, industries, and even the coastal fisheries, depend on the rivers that originate in the Western Ghats. Without the Western Ghats, the state's economy will collapse. In a nutshell, the survival of the state depends on the Western Ghats.

However, in all five Western Ghats states, the forests and the fragile mountain ecosystems are being destroyed in the name of development, urbanisation, mining, irrigation and hydroelectric projects, encroachment, timber smuggling, monoculture plantations, chemical farming, tourism resorts and infrastructure development. We are intrigued by the fact that the stiff resistance against the Gadgil and the Kasturirangan reports happened even when farmers in the high ranges face economic issues because of loss of crop productivity and danger to livelihood due to climate change. Further, the resistance came from the most literate state; a state which is often hyped to have an efficient and active decentralised three-tier Panchayati raj System under the 73rd and 74th Constitution amendments.

The irony of this turn of events is that it was in Kerala in the late 1970s and early 80s, that conservation activists, and members of the scientific community, media and non-governmental organisations came together with the determination to save the evergreen forests of the Silent Valley in Palakkad district, a part of the Nilgiris Biosphere in the southern Western Ghats, from being destroyed for a proposed hydroelectric project. Perhaps for the first time in the history of the nation, a major hydroelectric project which was once given a green signal was abandoned for the sake of forest conservation. Silent Valley was declared a National Park in 1984 by the Central government. The success of the Silent Valley movement inspired many environmental movements within the state and in other parts of the country, built around the paradigm development without destruction. It is in this same state that from 2013 onwards we witnessed stiff opposition to the conservation of the western ghat proposed by the reports. The protests, combined with the aggressive stance of the Kerala government against the panel reports, reinforced the negative position taken by governments in the other Western Ghats states. As a result, even after a decade of initiating conservation efforts under legal compulsion, the Centre has not yet issued its final notification on the Western Ghats. This gridlock, we thought, was severe, considering the urgent need for conservation of the Western Ghats. This problem drove us to ask the following questions:

1. What discourse informed farmers' protest against the Gadgil and Kasturirangan committee?

2. What are the views of indigenous communities regarding conservation? Why did they take different stand from farmers during the protests

3. What are the views and stances of the local bodies when it comes to conservation?

4. Are they in agreement with farmers idea of conservation? Do they have their own plans for conservation?

5. What are the views and stands of the Bio-Diversity Management Committees and the Kerala State Biodiversity Board on the issue of conservation?

6. What were/are roles played by the people's representatives from the high ranges?

7. What are the important policies and actions taken by the state government for/against conservation of the Western Ghats? What is the state government's stance on development and environment?

8. What is the popular discourse on the Gadgil and Kasturirangan committee reports and the Western Ghats conservation?

9. Who benefits from the discourse around the organised resistance against the Gadgil and Kasturirangan committee reports?

The reason we sort to answer this question in the field site of Karunapuram village, Udumbanchola Taluk in Idukki District is because, the district, taluk and the village, once with dense evergreen rain forest, bamboo, reed, grasslandand wetland, have undergone tremendous changes in demography, landscape and land use, ecology and climate.

Over the years, the village, which used to get rain throughout the years, has become a water-starved region. Udumbanchola constitutes a significant part of the Cardamom Hill Reserve (CHR) forest. Scientific data reveal that rainfall is dwindling, the temperature is going up, and pest attacks are increasing in the CHR. Our study points towards a possible economic collapse and consequent social unrest in the region unless the government and people take urgent concerted efforts towards conserving the Ghats.

When we started our fieldwork in August 2018, the state was devastated by a severe flood. There were many massive landslides and loss of lives; mostly in the Western Ghats regions. Idukki was ravaged. Exactly one year later, another flood hit the state.

A significant reason for this was the destruction of the forests in the hilly regions. Conservation of the Western Ghats and the Gadgil report once again emerged as a hot topic of discussion. Our study assumed more importance in the context of the floods and severe droughts that followed. Can Kerala, or any other Western Ghats state, afford to make further delays in taking efforts towards conserving the Western Ghats? A large section of environmentalists thinks that the recommendations of the Gadgil committee are the answer to address the disasters happening in Kerala. Should efforts begin again to revive the Gadgil report recommendations that were rejected by the Centre and the states as well? More importantly, can the Gadgil report address the fundamental issues of conservation rather than just the symptoms? We have attempted to look into these issues.

Older than the Himalayas:

I arrived in Karunapuram a couple of days ago. 17 The panchayat is located at about 950 meters above sea level in Udumbanchola taluk. The taluk, with undulating hills and valleys, is a major part of the Cardamom Hills, a plateau right below the Kannan Devan Hills, the real High Ranges. The entire plateau is drained by the Periyar, the state's longest river. The Cardamom Hill Reserve (CHR) is the capital of Indian small cardamom with 70 percent of the total production in the country. Karunapuram lies on the extreme east of the plateau.

My visit is an attempt to understand the impacts of climate change on the lives and livelihoods of people living in CHR. Idukki is often called the rooftop of Kerala. In the upper region, the Ghats rises steeply to 2695 meters forming Anamudi, the highest peak in south India. Formed in 1972, Idukki, the second-largest district in the state, grows mainly tea, cardamom, pepper, coffee in the high ranges, and rubber in the low ranges. All these cash crops are sensitive to climate change. I'm also keen to understand why the residents of Idukki, mostly settlers, along with those living in other parts of the Western Ghats, fought fiercely against the two committees appointed by the Ministry of Environment, Forests, and Climate Change (MoEF & CC) to make recommendations for the conservation of the Western Ghats.

The first one, the Western Ghats Ecology Expert Panel (WGEEP), chaired by eminent ecologist Madhav Gadgil, was appointed in 2010; the second one, the High-Level Working Group (HLWG), headed by renowned space scientist K Kasturirangan, was set up in 2012. The high range regions in Idukki, Wayanad, and Kozhikode districts were burning with protests over the recommendations by these committees.

Isn't it suicidal to resist the conservation of the Western Ghats, the very source of our lives, and the base of our existence? Doesn't conservation assume renewed importance in these difficult times of climate change? It's this mountain range that determines monsoons, climate, weather patterns, ecology, freshwater availability, food production, and the economy of Peninsular India. It provides a cool climate for the cash crops, water for the midland farming, and the nutrients for the coastal fisheries. It's the backbone of Kerala's economy. The Western Ghats Forest is a part of the remaining few tropical rainforests in the world that make just six percent of the global forest area. Being big carbon sink, the forests keep our planet healthy. This mountain range is extraordinarily rich with plants and animals. In 2012, 39 sites in the Western Ghats were declared as World Natural Heritage by UNESCO (the United Nations Educational, Scientific, and Cultural Organisation). Out of these 20 are in Kerala. Then what makes the residents bitter about the conservation?

The Western Ghats or the Sahyadri is a mountain range on the western side of India. The range runs north to south along the western edge of the Deccan Plateau and separates the plateau from the narrow coastal plain along the Arabian Sea. The range starts near the border of Gujarat and Maharashtra, south of the Tapti River, and runs about 1500 km through the states of Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala ending at Kanyakumari, at the southern tip of India.

The exact boundaries of the Ghats are yet to be defined. According to the WGEEP, the mountains cover an area of approximately 1,60,000 sq.km. The history of large-scale migration to the Western Ghats is not even a century old. But this magnificent mountain range has millions of years of evolutionary history that goes back to the formation of continents. They kept on coming together and drifting apart. Long, long back, about 250-million years ago, all the continents were a giant single landmass called Pangaea. This supercontinent broke up about 200-million years ago to form two minor supercontinents, Gondwana and Laurasia. Gondwana comprised what is now South America, Australia, Antarctica, Africa, and India.

The Indian subcontinent was a part of the east coast of Africa. It broke off about 150-million years ago and moved north. During its long journey, the Indian subcontinent passed over a deep-seated volcanic hotspot. The heat generated caused basaltic magma resulting in a crustal arching forming the Deccan plateau. Geological evidence indicates the Western Ghats are the faulted and eroded edge of the plateau. The Indian subcontinent then collided with Asian landmass creating a mountain range- the great Himalayas. The Western Ghats is much older than the Himalayas. The mountain range is almost perpendicular to the Arabian sea and intercepts the monsoon winds making high rainfall, particularly on the much steeper western side.

The annual rainfall varies from 2000-7600 mm on the western side to less than 600 mm on the eastern side with gentle slopes. The range is the headwaters of all the major rivers such as the Kaveri, the Krishna, the Godavari, the Tungabhadra, and many smaller rivers of South India. All the 44 rivers in Kerala originate from this range or its foothills. These rivers drain almost 40 percent of the country's land. They, along with their diverse ecosystems such as flow zones, flood plains, mangroves, wetlands, and deltas, play a major role in maintaining the ecological balance. These rivers provide water and food security to about 500 million people. Around 50 million people live in the Ghats regions. It's home to 40 indigenous communities who depend on the forests for their water, food, fuel, fodder, and livelihood. The dense tropical forests also make rains by creating clouds through the process of transpiration. Rainforests store water, and during the dry season, trees draw water from the forest floor and release it back to the atmosphere as clouds and mist. This helps the forest streams maintain their healthy flow throughout the year. Without rainforests continuously recycling large amounts of water, feeding the streams, rivers, lakes, and irrigation systems, droughts would become common, leading to widespread food shortage and diseases.

A 2018 study published by the scientific journal of Geophysical Research Letters reveals that the transpiration from the thick vegetation over the Western Ghats accounts for one-quarter of the rainfall over Peninsular India. The wide range of rainfall and extremely varying microclimatic and topographic conditions in the Western Ghats have resulted in the development of diverse forest ecosystems like dense evergreen rainforests, semi-evergreen forests, the high-altitude shola forests, grassland, dry forests, and thorny shrubs. These forests have exceptional levels of biological diversity. The mountain range, having just 4.8 percent of India's total land area, contains more than 30 percent of the country's total plant, fish, bird, and mammal species; many of which are found only here and nowhere else on the earth. It has been recognized as one of the Eight Hottest Biodiversity Hotspots in the world. The International Union for Conservation of Nature (IUCN) has identified at least 325 globally threatened plant and animal species in the Western Ghats.

The southern Western Ghats, the mountain stretch in Karnataka, Kerala and Tamil Nadu is higher than the northern part, and much richer in biodiversity than the northern part. The southern part extends from the Nilgiri Biosphere Reserve, the first biosphere in the country, in the north to the Agasthya Biosphere Reserve in the south. It's one of the five major breeding grounds for the endangered tigers, leopards, and black panthers. Endangered mammals such as lion-tailed macaque, Nilgiri Tahr, Nilgiri Langur, and Malabar-large spotted civet live only in this part of the world. The Nilgiris Biosphere Reserve supports about 10000 elephants, the largest population of Asian elephants in the country. The recorded species data include 4500 plants, 650 trees, 179 amphibians, 157 reptiles, 219 fish, and 334 species of butterflies. Many of these species are seen only in the Western Ghats. The region is also internationally known as an endemic bird area with 508 species. New species are added to the list every year.

The central government has set up protected areas including the two biosphere reserves, 13 national parks to restrict human access, several wildlife sanctuaries to protect specific endangered species and many reserve forests, which are all managed by the state forest departments to preserve some of the important, undisturbed ecoregions. As for Kerala, conservation of the Western Ghats is extremely important. Except for three regions, the rest of the state lies on the western side of the mountains. The state has 450 km (28.12 percent) of the Western Ghats within its territories. Barring Alappuzha on the coast, all other 13 districts have a portion of the Ghats in their boundaries. About half (48 percent) of the state's total land area (38863 sq.km) is malanadu or the High Land. The midland, idanadu, with smaller foothills and valleys, constitutes about 40 percent, and the coastal area is12 percent. Without the Ghats, Kerala will perish. It's the source of water security for the state's 33 million people.

The plantation economy of the state depends on the Western Ghats. Cultivation of rice, the staple food, depends on the water from the rivers originating from the Ghats. Kerala has a thickly- populated 580 km coast. Around a million people directly or indirectly depend on the fisheries. The marine wealth depends on the water flow and the nutrients discharged into the sea by the rivers. Imagine what happens if a single river, the Periyar, dies. The 244 kmlong river originating from the forests of the Southernmost part of the Cardamom Hills. The river basin occupies nearly 60 percent of Idukki and 47 percent of Ernakulam districts. A majority of the hydropower projects of Kerala including the giant 780MW Idukki Project are built across the Periyar. They contribute about 80 percent of the state's total power. Several villages and towns in Central Kerala heavily depend on this river for their irrigation, industrial and drinking water requirements. If the Periyar dries up, one million people in the metro city of Kochi, located close to the river mouth, will not get drinking water.

The Eloor industrial estate near the Kochi city houses a quarter of the state's manufacturing units. All these units use water from the river (and discharge hazardous effluents to the river killing it).

Kerala's forest scenario is precarious. As per the 2018 forests statistics, the state has 11521 sq.km forest area; 29.65 percent of the total geographical area of the state. Due to large-scale destruction, the Western Ghats forests have been reduced to nine fragments. According to the 2017 Forest Survey of India Report, the state has 20321 sq.km of forest cover; a six percent increase from 2015. However, dense forest is only 1663 sq.km; just four percent of the state's total area. The rest is highly degraded and can't perform their natural ecological functions. Of the total forest area, 1557 sq.km are plantations, mostly teak. 21 During 2016-2018, Idukkki lost 18285 acres (74 sq.km) of forest cover. (Wayanad's loss was much ahead with 29653 acres). Over the years, desertification has been happening in many parts of the Western Ghats. Being the wettest region in south India, Idukki used to get about 5000 mm of rain in a year, much higher than the state's average of 3000 mm. But now several parts of the district, including Karunapuram, are water-stressed.

Conservation and controversies Despite being a critically important mountain landscape, the Western Ghats in all the five states have historically been one of the most human-impacted and threatened ecologically sensitive areas in the country. The fragile forest ecosystems have suffered huge destruction and degradation starting with large monoculture plantations and timber extraction by the British since the middle of the 19th century, and then dams for hydel projects and irrigation, thermal power plants, windmills, increase in human population, fast-pace urbanisation, construction of houses, roads, rail, and other infrastructure facilities, industries, indiscriminate mining, quarrying, forest plantations such as teak and eucalyptus, mass pilgrimage, tourism, mushrooming resorts, chemically- intensive and highly polluting farming. Wildfire is also causing huge destruction to the Western Ghats forests.

An analysis by the Indian Space Organisation's remote sensing centre shows that a shocking 35 percent of the original Western Ghats forests has been destroyed in 93 years between 1920-2013. The Gadgil committee estimates that of the 1,60,000 sq.km area of the Ghats, hardly one-third remains under forest cover, and that too is highly fragmented and facing high levels of degradation. Even the protected areas are under tremendous pressure from the surrounding humandominated areas. Human encroachment into forests has resulted in rising human-wildlife conflicts. The Central Water Commission's National Register of Large Dams (2011) shows 2258 dams have been built in the Western Ghats region. Many more are there in the pipeline including the proposed Athirappilly Hydro Electric Project in Kerala.

The state has 60 large dams constructed mainly on the Bharathapuzha (all irrigation projects), the Periyar, Chalakudy, and Pampa and Kuttiyadi (mostly hydropower projects).

Most of the Western Ghats rivers have lost their natural flow pattern and water quality and are dying. The deforestation and change in land-use patterns in the Western Ghats have resulted in large-scale soil erosion, siltation of tanks and reservoirs. The Central government had launched a multi-sectoral programme, the Western Ghats Development Programme, in 1974-75, during the Fifth 22 Suicidal resistance: Understanding the opposition against the Western Ghats conservation in Karunapuram, Idukki, Kerala Five Year Plan of India. From the Sixth Plan onwards, Special Central Assistance (SCA) for the Hill Area Development (HADP) was distributed between WGDP and HADP.

The focus was the economic well-being of the population in the hill areas, ecological restoration, conservation, and watershed development. The programmes failed to make much progress due to faulty planning, implementation, and inadequate funds. In 2008, the centre formulated the National Action Plan for Climate Change; the conservation of the Himalayas was included as one of the eight national missions while the Western Ghats left out. Forest destruction and illegalities continued even after passing many legislations, rules and policies including the Wildlife Protection Act (1972). the Water (Prevention & Control of Pollution) Act (1974), the Forest Conservation Act (1980), the Air (Prevention & Control of Pollution) Act (1981), the Environment Protection Act (1986) Protection Act (1986), the Environment Impact Assessment Act (1994,2006), the National Biological Diversity Act (2002), and the National Climate Change Action Plan (2008). The states have their own climate change action plans. Environmental activists have been taking up the Western Ghats destruction issues since the late 1970s engaging in campaigns and legal battles.

The Central government was forced to appoint the Madhav Gadgil and the Kasturirangan committees after a prolonged legal battle fought by Goa Foundation, a non-profit organization, against the indiscriminate iron ore mining in the state that resulted in huge forest destruction. The activists moved the National Green Tribunal (NGT) and the court directed the Centre to take immediate action for the conservation of the Ghats. Activists were fighting similar cases in various courts in all the five states against the inaction of the central and the state governments.

First, MoEF appointed WGEEP in August 2010 under the Environment Protection Act (EPA), 1986, and asked it to assess the status of the Western Ghats and submit a plan within a year for its protection. When this was done in mid-2011, the ministry sat on the document

for nine months, refusing to release it even for public debates. The Greens, highlighting an unholy nexus between the mining lobby and the governments, again approached the NGT. The tribunal directed the Centre to take immediate action on the recommendations. The High-Level Working Group (Kasturirangan Committee) was then set up in April 2012 to advise the government on how the recommendations of WGEEP should be implemented.

In April 2013, the Kasturirangan Committee submitted its report. 23 Instead of making suggestions for implementing the recommendations of the Gadgil Committee, the second panel came up with yet another set of recommendations going beyond what it was asked to do. However, in October the ministry accepted the report in principle rejecting the Gadgil report. This evoked angry reactions. Most of the ecologists and environmental activists blamed it as a dilution of the Gadgil report. On the other hand, people living on the Western Ghats, except some groups of Scheduled Tribes and Scheduled Castes, strongly opposed both the reports. Protests were the strongest in Kerala. There were strikes, shutdowns, and road-blockades for days against the "anti-people" and "anti-farmers" reportsIn Idukki, residents locked their homes, took to the streets, cooking and sleeping on the roads. Even school children were made a part of the agitations. In the northern districts of Kozhikode, Wayanad, and Kannur, the protests turned violent. An office of the Forest Department was gutted in Thamarassery in Kozhikode; forest department's staff and police personnel were attacked; angry mobs vandalised the department's vehicles. 24 Suicidal resistances: Understanding the opposition against the Western Ghats conservation in Karunapuram, Idukki, Kerala in Idukki, the agitations were led by the High Range Protection Council under the leadership of a few priests of Syro-Malabar Catholic Church, the largest and strongest denomination of the Catholic Church in the country. A pastoral letter by the Bishop Idukki Diocese condemning the Gadgil report was read out in all its parishes appealing people to take to streets against it. The Left Democratic Front (LDF) led by the Communist Party of India-Marxist (CPI-M), the then opposition in the state legislature, joined hands with the church. The ruling United Democratic Front (UDF) led by the Indian National Congress also joined the agitations.

The debates on the two reports have been messy and uninformed. There are three key differences between the Gadgil and the Kasturirangan reports. First is on the extent of the area that should be awarded protection as an eco-sensitive zone (ESZ). The Gadgil panel identified the entire Ghats as ESZ. But it created three categories of protection regimes and listed activities that would be allowed in each based on the level of ecological richness and land use. The Kasturirangan panel used a different method. It removed cash crop plantation, farmland and human settlements from the Ecologically Sensitive Areas (ESA). It also made the distinction between what is called cultural

landscape and natural landscape. The purpose was to remove already modified areas under private control from protection to avoid unnecessary conflict. The Kasturirangan report's area of ESA is 37 percent of the Western Ghats— 60,000 sq.km-much less than 137,000 sq.km proposed by the Gadgil committee. The second difference is over the list of activities permissible in the protection regime. The Gadgil committee's recommendations on this are comprehensive, from banning mining, red-category industries, genetically modified crops in agricultural areas, new hydroelectric projects, and a gradual shift from chemicals to organic farming, and decommissioning of old dams, and a gradual shift from plantations to natural forests. It is perhaps exactly the right formula for this region.

The Kasturirangan panel had already removed substantial areas of humanly modified lands from protection, so it decided to impose restrictions on what it called highly interventionist and environmentally damaging activities in the ESA areas. All mining, including quarrying; red-category industry, including thermal power, and buildings over 20,000 sq m area would be banned. In the case of hydropower projects, the panel set tough conditions to ensure adequate flow in rivers and distance between projects. 25 The third difference concerns the governance framework. The Gadgil panel suggested that the final demarcation of each zone (ESZ1, ESZ2, ESZ3) must be based on extensive inputs from local communities and rural and urban local self-government institutes under the overall supervision of a national-level authority, with counterparts at the state and district levels. The Kasturirangan panel argued for strengthening the existing framework of environmental clearances and setting up of a state-of-the-art monitoring agency.

The Kerala government after rejecting the Gadgil report, appointed a state panel headed by Oommen V Oommen, the then chairperson of the Kerala State Biodiversity Board (KSBB), to study the Kasturirangan report. The panel came up with suggestions of exempting all plantations, human habitations, and agriculture farms from the list of ecologically sensitive areas, and marking the already protected areas under the Forest Department as ESA. The irony of this turn of events is that it was in Kerala in the late 1970s and early 80s, that conservation activists and members of the scientific community, media and non-governmental organisations came together with the determination to save the undisturbed evergreen rainforests of Silent Valley from being destroyed for a proposed hydroelectric project of the Kerala State Electricity Board (KSEB). The 89- sq.km untouched forest is a part of Nilgiri Biosphere Reserve. Perhaps for the first time in the history of the nation, a major hydropower project that was once given a green signal was abandoned for the sake of forest conservation. Silent Valley was declared a National Park in 1984 by the Central government led by Indira Gandhi.

The success of the Silent Valley movement inspired many environmental movements within the state and in other parts of the country, built around the paradigm development without destruction. However, thirty years after Silent Valley, people living on the highland regions were up in arms against the conservation committees. While rejecting the Gadgil Committee report, Oommen Chandy, the then chief minister of Kerala had stated in the legislative assembly that the state could protect its environment and the Western Ghats within the provisions of the existing laws.

Kerala flooded Five years down the line, Kerala was devastated by floods. The worst ever floods in its history since 1924. Media term it "Flood of the Century". Thirteen of Kerala's 14 districts were affected; 483 people lost lives; more than five million people were relocated to relief camps.

26 Suicidal resistances: Understanding the opposition against the Western Ghats conservation in Karunapuram, Idukki, Kerala Torrential rains continued for two months. India Meteorological Department data indicated from June 1 to August 19 Kerala received 2346.6 mm rainfall as against the expected 1649.5 mm; 42 percent above normal. Between August 1 and August 19, the state recorded abnormally high rainfall; 164 percent above normal. By the second week of August, most of the 60 major dams were full. Unabated rains forced the authorities to open the floodgates of 37 dams, including that of Cheruthoni (a historic event since this happened after 26 years). This was done to regulate the water level in the Idukki dam. The arch dam, built across a narrow gorge between two granite hills is one of the highest in Asia. Owned by KSEB, it started operation in 1975. The dam had submerged vast stretches of pristine evergreen rainforest.

When the dams were opened many rivers including the Periyar, the Pampa, the Chalakkudi, the Manimala, and the Achankovil rivers, swelled. Lowland regions in the central districts of Ernakulam, Thrissur, and Pathanamthitta flooded the most; cities and towns in the floodplains of the rivers submerged. Fishers, coast guard, border security force police, army, navy, and air force, youth, civil society organisations, all jumped in to the rescue and relief operations. The government put the initial loss is Rs 40000 crore. The torrential rains caused 5191 landslides in Kerala's Western Ghats, estimated Hyderabad-based National Remote Sensing Centre (NRSC), a wing of the Indian Space Research Organisation.

Idukki was ravaged by 143 massive landslides and hundreds of smaller ones. Hillslopes came crashing down with roaring water and huge landmass; houses disappeared without a trace in a split second; roads, shops, and vehicles were washed away. With 59 deaths, the toll was the highest Idukki. More than 33,000 people took refuge in temporary

relief camps. Cash crops in 11000 acres got destroyed. The spice capital is in a deep depression. The disaster was washing away lives and livelihoods in a massive way; washing away numerous ecosystems; washing away biological diversity in huge quantities. What could be the cost of such losses that cannot be estimated? The flood has brought back debates on the urgent need for conserving the ecologically fragile and disaster-prone Western Ghats, the midland, and the coasts.

The Gadgil report, a report that doesn't exist officially, has once again become a hot topic. The media are abuzz with debates and discussions, for and against the report. The flood has forced more people to join the Gadgil bandwagon, it seems. "The Gadgil committee had warned categorically about the precarious state of the Western Ghats. These disasters are not sudden. They were 27 predicted five years ago. Many of the ravaged areas were marked as ecologically sensitive and fragile by our committee," says V S Vijayan, a member of the WGEEP and former chairperson of the Kerala State Biodiversity Board.

Environmentalists in the plains are busy organising meetings making Madhav Gadgil address the audience. Reporters queue up for a face to face with him. "This is partially a man-made disaster," Madhav Gadgil told us when we met him soon after the flood at the Government Guest House, Ernakulam (Cochin), a city that might submerge if the Arabian Sea rises one meter. "If the state government, the local bodies, and the public had taken the conservation of the Western Ghats and the climate change issues seriously, we could have reduced the magnitude of the present calamity. Forget about my report. Start doing something NOW. It's already late." Too late, perhaps? Could the five years and a devastating disaster have changed the mindset of the people living in the upland regions? Could they be pondering over their survival and sustainability at least now? Better to talk to them face to face. I set out from the ravaged plains to the bleeding mountains. *** The bus traversed along the badly-damaged NeriamangalamCheruthoni forest road. The road was winding up the ripped slopes with bleeding gashes. Roots of the not-yet-fallen wild trees protruded through the large red cuts like broken veins.

At Cheruthoni, people were yet to recover from the shock of watching massive landslides and swelling of the river. The town is in the floodplain of the Cheruthoni river, a minor tributary of the Periyar. When the shutters opened, the dry river swelled and flowed madly, washing away a bus stand, a parking place that could house 200 vehicles, a four-story shopping complex, ten small shops, and a few farm patches; all were built right on the riverbed when the shutters of the dam remained closed for two decades. Just across the bridge, a house sits right at the top of a broken slope; it may fall at any time.

At Painavu, the district headquarters, a couple of kilometers from Cheruthoni, the scenes are heart-breaking. All three relief camps are packed with grieving humans who lost their dear ones, houses, crops, 28 Suicidal resistances: Understanding the opposition against the Western Ghats conservation in Karunapuram, Idukki, Kerala and cattle. A crowd is a mixed group of the marginalised tribal and dalit communities and settlers. "I now feel what Gadgil said was true," Raju Krishnan, a 32-year-old Urali adivasi youth laments. His family and some others were living in Kallemadu settlement, growing pepper and cardamom in eight acres. None of them has any land ownership document to claim compensation for their loss. "Once the relief camps get closed, where shall we go and live?" asks Raju adding that they were not a part of the protests against the Gadgil-Kasturirangan reports. Some others like Vinu P Thomas, president of a traders' association in Cheruthoni insisted on constructing whatever they lost to the river exactly in the same old locations. "The government says we encroached the floodplains and constructed the buildings illegally. If so, then why did the panchayat and KSEB give us the required permissions for the construction of the buildings and provided us the electricity connections? We have title deeds. Come what may, we shall not relocate from this place," he said. Through the spider web Cheruthoni is a gateway to the high ranges. The bus climbs for an hour, passing the Idukki dam, to reach Kattappana. Located 900 meters above sea level, Kattappana is a valley surrounded by hills. It was a dense forest a few decades ago inhabited only by the indigenous tribes of Mannan and Urali.

Over the years, the town has flourished to have about 42000 residents, large houses, vast stretches of cardamom plantations, two bus stations, wholesale and retail spice shops, hotels, and restaurants. A panchayat, Kattappana was upgraded to a municipality in 2015- the first municipality in the high ranges of Idukki. Karunapuram village panchayat is located 18 km from Kattappana, on the right side of the State Highway connecting the tourist hotspots of the Periyar Tiger Reserve (Thekkady) and Munnar (the Kannan Devan Hills). The panchayat with 17 wards was formed in 1976 bifurcating the neighboring Pampadumpara panchayat to the west. Out of the 30473 residents, a majority are small planters with less than five acres of landholding. Karunapuram shares its southern border with Vandanmedu village panchayat with huge cardamom estates. Nedumkandam, the taluk headquarters, is about 10 km to the north. Beyond the eastern border, it's Tamil Nadu; the eastern slope of the Western Ghats.

Every nook and corner of Karunapuram is well-connected by roads; mostly tarred. As Tomi Plavuvachathil, president of the panchayat, puts it, "The village has a network of roads like a spider web." He sees it as a sign of development. "Our panchayat pays a lot of attention to 29 development and infrastructure building," says he leaning on to his car parked on the side of a road in Moshappara, rocky terrain in his ward (No:9).

Moshappara overlooks the farmlands far below in Kambam and Komba valleys across the border. The view is enchanting. I strain a little to hear what he says. The wind is howling. A drive through the "spider web" is a bit shocking. Was this region once a part of a magnificent rainforest? Hard to believe! Not a single patch of wilderness remains anywhere in the village. Homesteads with pepper, coffee, jackfruit, banana, cocoa, nutmeg, turmeric, and ginger along with cardamom farms are spread right up to the edge of the Ghats. The sky is dotted with coconut and areca nut palms as it would be in the lowland. Schools, government offices, banks, churches, temples, mosques, markets, and hospitals…Not so far, I can see a hillslope blasted by a granite quarry. I dropped in to see K Unnikrishnan Nair, 48, headmaster of the Kallar Higher Secondary School that celebrated its Golden Jubilee in 2015. He says, being migrants, the settlers have brought along them the habits, culture, and agriculture of their native places. Unnikrishnan lives not far from Mariamma's house in Thookkupalam, an emerging town with a few hotels, restaurants, textiles, spices and medical shops, a market, and a bus stand. It's a meeting point of three village panchayats: Karunapuram, Pampadumpara, and Nedumkandam. The junction, located on the banks of the Kallar, a small river, is noisy with autorickshaws, jeeps and buses, private and government, plying between Nedumkantam and Kattappana, Kottayam, Kumily, and Munnar. Thookkupalam means hanging bridge. There was a narrow bamboo bridge across the Kallar. A sturdy concrete bridge replaced it. The Kallar and its minor tributaries, Koottar and Amayar streams, are choked by new buildings coming up encroaching the floodplains. With all the solid waste and sewage from the hotels and shops, the river has turned a drain of dirt. The Kallar has a small dam across it seven kilometres from the junction. Unnikrishnan's father also came to Kallar Pattom Colony under the HRC scheme. "The river was perennial in my childhood. We used to swim and fish for hours," he recalls the good old time- of his and that of the river. He and his friends would run to school, holding a banana leaf over their heads, partly drenched in Noolamazha, splashing the puddles on the narrow, slippery mud road. The five acre-land allotted to his father got divided among Unnikrishnan and his three brothers. They all built separate houses in their plots. 30 Suicidal resistances: Understanding the opposition against the Western Ghats conservation in Karunapuram, Idukki, Kerala An ironic sigh of relief Karunapuram heaved a sigh of relief when the relentless rain was wreaking havoc in the rest of the state. "You know why? We're lucky to get sufficient water to fill our rainwater harvesting tanks," laughs C N Sujatha, the teacher at the Anganwadi, a rural child-care centre under the Integrated Child Development Scheme of the Central government, in Ward No.7. She takes me to a 10000-liter big tank in the backyard of the building. "See, it's full now. Enough for us to pull on for a few months." The village panchayat has been facing severe water scarcity for the past two decades.

The residents tell me about dwindling rainfall and rising temperature. "Noolmazha now rains only in our memories," says T V Jose, 55, a former panchayat member." It has gone away from the skies of the entire CHR." Jose relocated to the high ranges at the age of three along with his father from the plains of Kanjirappally in Kottayam district. "We now have a long dry season. I don't know how the plantations in the high ranges will survive." Unlike others, Jose has no memories of a thick forest at Kambamedu, the location he lives. The government had gone for a large -scale clear-felling in the late 1950s and auctioned timber, says he.

An agent was roaming around showing the settlers the areas that could be encroached upon. He pocketed Rs 100 from each migrant family as a fee for this service. Jose's father took over 10 acres of forest which later got divided among him and his 13 siblings. A few of his siblings bought more land later expanding their property. Karunapuram, like other villages in the Western Ghats, had several small natural ponds, locally known as oli, on the hillslopes. These ponds would get filled up by the runoff from higher elevation during monsoon. When they are full, water would overflow to ponds further down by gravity. This is a traditional water harvesting system that would recharge the groundwater continuously. "Whenever we needed water, we would just go and fill our pots from oli," Thankamani, a 47-year-old resident of Ward No 9, says. She is an Accredited Social Health Activist (ASHA). Most of the small natural tanks have dried up. The dry tanks were filled up with soil permanently for planting cardamom and other cash crops.

The Ghats and the Humans

Ask the residents the reasons for erratic rainfall, rising temperatures, and the alarmingly depleting groundwater table, you would get an array of answers.

"Global warming and climate change. The whole world experiences that."

"Forests along the Tamil Nadu-Kerala border have been destroyed. The dry climate of Tamil Nadu is spreading to Kerala."

"A lot of trees have been cut for setting up plantations."

"Earlier we're growing the traditional varieties of cardamom. New hybrid varieties need many more rounds of irrigation."

"Coir factories in Kambam and Theni in Tamil Nadu used to burn huge quantities of waste till recently. That could be a reason for this area becoming drier."

"Granite quarrying and sand mining."

Put all these answers together with a bit of history, a clearer picture will emerge.

Researchers have found strong evidence for human presence since the Stone Age in many locations of the Western Ghats. Tools, pottery, burial urns, umbrella stones, hood stones, and menhirs have been found from different parts of Idukki. But we still don't know much about the rise, progression, and the collapse of those societies.

The ancient and medieval history of the region is closely linked to the trade of spices in the world market. The monsoon- soaked rain forests were home to wild varieties of many spices like cardamom, pepper, cinnamon, and nutmeg.

Spices were a main source of income to the exchequers of the rulers. In the ancient, medieval, and modern period of history, different dynasties—Chera, Chola, Pandya, Vembolinadu Keezhmalinadu, Thekkumkoor, Vadakkumkoor, Poonjaar, and Travancore--had tried to establish domination over the high range region during different centuries.

Ancient Kerala (Chera Nadu) was a prime destination for traders from the Mediterranean countries, Rome, Egypt, Portugal. The region had direct contact across the Arabian Sea with all the major ports of the Mediterranean, Red Sea, and those of the Far East. Ancient ports such as Muzris, Alappuzha and Vizhinjam were bustling with the spice trade.

About three hundred years ago, tribal communities such as Muthuvan, Mannan, Urali, Ulladan, Malavedan, Mala Pandaram, Malapulayan, Paliyan, and Mala Arayar, were the only inhabitants in the densely forested region. They are believed to have migrated to this region at different points of time in the thirteenth and fourteenth centuries. A few of the communities have their roots in the eastern side of the Western Ghats and some others migrated from the western side. They were engaged in hunting, food gathering, shifting cultivation, and collecting forest produce including honey, wax, and wild varieties of pepper, cardamom, and other spices for the rulers. They are considered to be the indigenous communities of the Western Ghats.

Then came a group of Tamil speaking people in the second half of the 18th century from the eastern side. They settled in the Anjanadan villages in the north-east part of the present Idukki district. They were also engaged in farming clearing forests in a small way.

Large-scale destruction of the Western Ghats forests started in the last decades of the 19th century with the Europeans setting up plantations in Peerumed and Munnar. In 1877-79, the Royal Family of Poonjar, a principality in the central Travancore, leased a large tract of land of 588 sq. km in Munnar in the Kannan Devan Hills to John Daniel Munro, the British Resident of Travancore.

The land, called the Kannan Devan Concession Land, was covered with thick forests and grassland. The grandeur of the Western Ghats, the thick evergreen forests with wildlife is well documented in J D Munro's account of the High Ranges.

The landscape of the Idukki par of the Western Ghats started changing drastically with the members of the North Travancore Land Planting and Agricultural Society, an association founded by Munro and H. G. Turner of the Madras Civil Service, started buying several more plots developing their estates. They cleared vast stretches of forests, tilled the hillslopes, and tried growing coffee, sisal, cinchona, before switching over to tea that suited for the high-altitude climate. A lot of Tamil labourers were brought in for the plantation work. Roads were built to transport tea and timber. Ropeways were set up. The British planters even established a railway station and a steam engine railway line in Munnar in 1902. This railway line was washed away in a devastating flood in 1924. The Old Munnar railway station is now being used as the head office of the Kannan Devan Hills Plantation.

Almost around the same period, significant changes were taking place in the Cardamom Hills too. In August 1897, through a historic proclamation, Sri Mulam Thirunnal, the then Maharaja of Travancore, declared about 870 sq.km (87000 hectares) of forests as Cardamom Hill Reserve Forest (CHR) for promoting cardamom. The Maharaja started giving land on lease for growing cardamom into more areas. The proclamation changed the status of cardamom and the destiny of Cardamom Hills as well. Cardamom changed from a natural forest plant to a cultivated plant.

After the proclamation, the CHR land was brought under the revenue department while the Forest Department in charge of the trees, a sort of dual administrative system. Cutting of trees was strictly prohibited, cardamom being a shade-loving tree that grew under four layers of the rainforest canopy.

This dual system of administration was continued even after Independence paving the way for legal complications and confusions regarding land, trees, and title deeds.

Along with leasing out land for cardamom cultivation, Travancore Maharajas also opened up vast stretches of ecologically fragile grassland, wetland, and rocky land for growing rice and pepper. These lands located within CHR were not suitable for cardamom.

With this, small streams of Tamil-speaking cultivators and labourers from the eastern plains climbed up the hills through forest paths. The influx gained momentum when the first commercial cardamom estate in India was set up in Pampadumpara in 1922 by John Joseph Murphy (1872-1957, a young Irish planter, after securing land from the Travancore rulers. From this large estate of 1200 acres, loads and loads of cardamom were taken to Madras port by headload workers.

With the success of this plantation, many more cardamom estates came up strengthening the stream of Tamil migrants. It was easier to reach the High Ranges through the gentler slopes on the eastern side than the steep and rugged Western side.

There had been some trickling in of Malayali settlers since 1910, it became a large influx during the Grow More Food Programme followed by the High Range Reclamation Scheme and the High Range Colonisation Scheme. These were initiated and organized by the governments.

The Grow More Food programme was launched when a severe famine struck British India in the early 1940s. It was the time of the Second World War (1939-45). Most of the grains produced in the country were diverted to the war front. Besides, a severe cyclone hit the eastern coast of India destroying vast stretches of rice fields in Bengal and Orissa. The acute food shortage led to the starvation death of about three million people in Bengal alone.

Travancore was badly hit too by the famine. In Cherthala and Ambalappuzha 21000 people died. The poor and the landless peasants took up the cudgels against the rulers. Subsequently, Travancore leased out 24000 acres of wetland and grassland in the Western Ghats for growing food crops, mainly rice and tapioca. Each lease, (kuthakappattam) was for five acres. It was called off in 1954.

By then the process for reorganising the states based on spoken language had started. The highlands of Idukki being dominated by Tamil-speaking people, the demand for merging this region with Tamil Nadu became strong. Protests led by Travancore Tamil Congress turned violent in many places such as Marthanadam killing civilians and the police.

The government was not ready to let a region rich with natural resources go from its boundaries. To make a dominance of Malayalis here, the Thiru-Kochi government formulated the High Range Colonisation Scheme encouraging the landless to migrate to the High Ranges for growing food. Under the HRC scheme too, the government offered a block of five acres of forest to the landless. Financial aid of Rs 1000 to build a house and buy farm tools was also offered to each family.

Religious and caste organisations were given the responsibility of the land distribution process. Applications were called for; thousands of people applied; lots were taken to decide who should be given land; 8000 acres of thick forest were demarcated for this; surveys were conducted in four areas- Kallar in Udumbanchola taluk and Kanthallur, Marayur and Deviyar in Devikulam.; plans were prepared; locations for houses and

places of worship were decided. The biggest was the Kallar Pattom Colony with 1397 housing plots in 6860 acres; each of five acres.

"During the Grow More Food Campaign, the government encouraged people to migrate to the High Ranges, clear forests, and grow food. Whereas the HRC scheme was completely organized, designed and engineered by the government," points out T Rajesh, an employee with the Nedumkandam village office. He is the author of Idukki Charithrarekhakal, a book in Malayalam on the land issues in Idukki. His grandfather migrated to the High Ranges in 1950 from Meenachil in Kottayam. Rajesh perused old land documents for two years. Labelling all the people living in the High ranges as "encroachers" is painful for us, the third generation born and brought up in Idukki, says he.

But he confesses that along with each wave of mass migration, largescale encroachment and destruction of fragile ecosystems had also taken place.

It was the policies of the government, before and after independence, that led to migration, encroachment, destruction of the forests, and messing up of the title deed issues. The arrangement of dual administration of CHR- land under the revenue department and trees under the forest department continued even after the formation of Kerala. This created a lot of confusion between the two departments.

The large-scale encroachment of forests in the 1940s and the1950s during the Grow More Food and other schemes, had created concerns at the government level by the end of the 1950s itself. The state government had even formed two commissions to assess the encroachment issues. The state also came out with the legislation, the Kerala Forest Conservation Act, in 1961. But encroachment continued.

In fact, after the formation of the state, forest encroachment has been regularised four times changing the cutoff dates for eviction: 4 January 1957, 1 January 1960, 1 January 1968, and the final cut-off date was fixed as 1 January 1977.

However, the government could not implement its policies. In 1980, when the Forest Conservation Act was enacted by the Centre, CHR again became a reserved forest under the definition in the new legislation. This led to a lot of legal complications. The law made it 39 mandatory to get the Centre's approval for diverting the forest land for non-forest purposes. In CHR, the land was under the revenue department. By then people had made huge investments in CHR converting forest land for all sorts of infrastructure development activities. The Congress-led government at the Centre yielded to the persistent requests from the Congress-led state government for diverting "forest land" to give title deeds to the pre-1977 "encroachers".

In 1993, the state government formulated a set of new rules "Kerala Land Assignment (Regulation of Occupation of Forest Land before 1.1.1977" and started to distribute title deeds. This paved way for a long-drawn legal battle between the environmentalists and the state government. The Supreme Court issued its verdict on this case in 2009 favouring the state government.

"The period from 1993 to 2009 was a period of fear and uncertainty for thousands of families, the legal occupants as well as the encroachers," points out Rajesh. They could not buy, sell land, or get loans from banks. The Gadgil committee was appointed close to the heels of the Supreme Court verdict. "Naturally many people thought it was a scheme for evicting them from the occupied land."

Construction of dams, starting with the Mullaperiyar in 1887, has also contributed to the destruction of forests. With 18 dams, Idukki tops the districts in Kerala as for the number of dams. Most of those who came to Idukki as construction labourers stayed back while townships like Cheruthoni emerged in forest land.

The initial encroachments were in search of better livelihood opportunities by the poor. However, since the 1990s, commercial interests, particularly the resort, plantation and quarry lobbies, dominated the scene.

In the past two decades, the high range regions have witnessed a tourism boom, a flurry of infrastructure development, and mushrooming of resorts. This has led to serious illegalities, irregularities, land grab by forging documents, the encroachment of the forest and the government revenue land, and environmental destruction and degradation. Much of this happened in connivance with some corrupt officials of the revenue and the forest departments.

For instance, 10 revenue and forest officials, including a former district collector were suspended in 2002 after an inquiry by a state government committee found them guilty of "serious lapses" in the encroachment of Mathikettan Shola forest in Udumbanchola taluk by a few private parties. The report prepared by the state additional chief secretary observed that organised encroachment in Mathikettan forests 40 Suicidal resistance: Understanding the opposition against the Western Ghats conservation in Karunapuram, Idukki, Kerala had started way back in 1966. However, large-scale encroachments were reported starting from 1996. In the 2001 incident, about 500 acres were encroached by some individuals with illegal title deeds.

THE WESTERN GHATS & SAVE THE WESTERN GHATS MOVEMENT

The Western Ghats & Save the Western Ghats Movement

The Western Ghats, a mountainous ridge running parallel to the west coast of India's ancient peninsula, has a rich and intriguing history. They boast an age of 150 million years, and have seen variations of climate that have helped shape the soils and geology of the hills. The escarpment of the Western Ghats probably formed during the Gondwana supercontinent break-up and is the faulted edge of the Deccan Plateau.The mountain chain called Western Ghats, covers 51 districts in six states, is one of the 34 global biodiversity hotspots and is home to many indigenous communities. These mountains are under tremendous pressure and the ecology and environment is at stake.

Western Ghats passing through six states, from Gujarat to Tamil Nadu, for the fact that it neutralizes no less than 4 million tonnes of carbon, equivalent to 14 million tonnes of carbon dioxide annually. The diverse forests ecosystems in the region neutralize 10 per cent of total greenhouse gas emissions neutralized by the country's forests. It had also put on record that the region has been one of the important global biodiversity hotspots that harbours 1,741 species of flowing plants and 403 species of birds among a vast variety of reptiles and large The Western Ghats, older than the Himalayas, are among 34 Global Hotspots of Biodiversity in terms of flora, fauna, landscape and ethnicity.

They are full of bewitching locations that are home to known 4,050 types of plants, 121 species of frogs, 508 bird species, six types of turtles and terrapins, 87 species of snakes, 63 types of lizards and a wide variety of large mammals.

Save the Western Ghats Movement

Peaceful Society, a Gandhian voluntary organization convened a 3 days consultation in October 1996 of prominent environmental activists from South India, mostly from the 6 states of the Western Ghats to discuss and develop common programme. The discussions brought out the important role played by Western Ghats in India's environment, cultural life and economic development. The consultation decided to organize a foot march to understand the state of the Western Ghats and highlight ongoing degradations. The consultation entrusted Peaceful Society to take all necessary step towards organising the dream environmental March in 1987.

The Save the Western Ghats Movement was a landmark event in environmental activism in India since its beginning in 1986. And foot march was organised in 1987-88 with the participation of people from every section and active involvement of more than 150 organisations.

Organizational Structure;

:- **Central Organisation Committee (COC),**
:- National Advisory Committee (NAC),
:- Regional Coordination Committee (RAC),
:- State Coordination Committee (SCC),
:- State Advisory Committee (SAC)
:- Route Committee,
:- Resource Materials Committee,

Kumar Kalanand Mani was Central Coordinator of the COC which had overall responsibility of organising Save the Western Ghats March. Others coordinators and members were Jagdish Godbole (Pune), Pandurang Hegde (Sirsi-Karnataka), A Mohan Kumar (Trichur-Kerala), Dinananth Manohar (Nandurbar –Maharashtra), S. Venkatachalam (Arcot-Tamil nadu) , SR Hiremath (Hubali – Karnataka), Claude Alvares (Mapusa-Goa), Archana Sadhale (Pune-Maharashtra), Vijay Paranpye (Pune-Maharashtra), Jay Samant (Kolhapur-Maharashtra), Subramanya Hegde (Sirsi-Maharashtra), Satish Chandra Nair (Trivandrum –Kerala), Sugatha Kumari (Trivandrum – Kerala), Civic Chandran (Trichur – Kerala), N Baddusha (Waynad-Kerala), Ulhas Rane (Mumbai), Dinkar Gangal (Mumbai), Ajit Patil (Sangli- Maharashtra), Sudhakar Khomne (Ahmednagar – Maharashtra), Anant Hegde (Sagar –Karnataka) .

National Advisory Committee was led by Prof. Kailash Chandra Malhotra, Indian Statistical Institute, Calcutta and noted environmentalist, anthropologists, as its chairman. Other distinguished members were Dr. Anil Agrawal, CSE, Delhi, Darryl D'monte, Mumbai, Thomas Mathew, WWF, New Delhi, Vijay Tendulkar, noted script writer, S.R. Ramaswamy, Prof. Madhav Gadgil, Indian Institute of Environmental Science, Bangalore, Erich Bharucha, Anupam Mishra and LT Sharma were the members of the national advisory committee.

The key objectives of the March.

I. To generate awareness among the people about ecology and related issues like denudation of forests, afforestation, preservation of wildlife, natural resources etc.
II. To learn more facts about the nature and extent of ecological destruction of the Western Ghats.
III. To expose young research scholars to the filed situations so that they could view the problems in a wider perspective.
IV. To bring together all voluntary organisations working in the region, to formulate some long –term common ecological programmes.
V. To encourage academic institutions, involvement of schools in the area to take up afforestation and other ecologically relevant programmes.

The foot march along the Western Ghats was divided into 2 parts up to Goa border which was further divided into 4 groups in Goa. The March started simultaneously from two extreme ends of the Western Ghats on Nov. 1st, 1987 and moved towards Goa. The Northern March was started from Navapur in Dhule District of Maharashtra whereas Southern March started from Kanyakaumari in Tamilnadu. The Northern March was flagged-off by noted environment campaigner and one of the founder leaders of Chipko Movement Shri Chandi Prasad Bhatt. The Southern March was flagged-off by noted Gandhian and historian Shri Dharmpal. 76 years old Mr. Fadake was the oldest marchers of northern team whereas 6 years old Gautam was the youngest marchers of southern team. In average 50 marchers were always with the both teams. Total 169 men and women from 11 states and 4 countries were in the March. The March finally reached Goa on January 27th and converged into huge Save Western Ghats Conference at Ramnathi. The March concluded in a public meeting at Panaji on Feb 3rd, 1988.

The activities like public meetings, village level meetings, filed observations, survey, seminars, rallies, orientation camps etc were organised during the March.

The Marchers surveyed 55 villages in Maharashtra, 2 in Goa, 52 in Karnataka, and 7 in Kerala during the March to Panaji, Goa. The finding of survey was drawn by a competent team from Indian Statistical Institute, Kolkata. The main findings were;

- Decrease in rainfall, late onset of the monsoon, its shorter duration, increased incidence of thunderstorms and rise in temperature.
- Scarcity of drinking water for human and animal consummation during summer. Only 16.7 % villages in the north and 8.5 % villages in the south had availability of drinking water throughout summer.
- Reduction of groundwater table and availability of water for agriculture and horticulture.
- Reduction of forest resources such as fodder, fuel, food, timber and medicinal plants etc.
- Siltation of tanks, drying up of rivers and springs, invasion of eupatorium.
- Increase in monoculture plantations of teak, rubber, eucalyptus,
- Changes in agriculture practices and crops pattern.
- 9 types of animals or birds were in domestication by the hills people.
- In addition to organic manure like Leaves, cow dung, compost, chemical fertilisers were also in use in agricultures.
- Waterfalls, rivers, wells, canals, springs, tanks, tube-wells were the sources of irrigation.
- Coconut, areca nut, pepper, cardamom, cocoa, coffee, cotton, cashew, tea, rubber, tobacco, sugarcane, banana, betel leaf, pineapple, lemon, and eucalyptus were grown as commercial crops
- Deforestation led to damaging crops by wildlife species such as the Indian elephant, wild boar and monkeys.
- Deforestation led to the appearance of new human, animal and plant diseases.
- Forest-fire and destruction of sacred groves.
- Encroachment in the forest areas and illicit tree felling.
- 6 types of domestic fuel were in use in surveyed villages. These included firewood, agricultural waste, cow dung, biogas, kerosene, and electricity.
- Increase in displacement, migration and food crisis,
- All types of pollution,
- Damming rivers, establishment of medium and large-scale industries, mining, tourism and putting atomic plants were big concerns among the public in general and in particular among the activists and environmentalist.

The March converged into Save the Western Ghats Conference where they shared their experiences. Prof. Madhav Gadgil, chairman of the technical committee presented post march follow up plan which led to the discussion about the direction of saving the Western Ghats. The Conference took following decisions;

1) Support & strengthen people's movement in Kodgu, Karnataka against Galebeedue Tea Estate due to which 5000 acres of forest land was threatened.
2) Support & strengthen people's movement against Nylon 6,6 of Thapar group in Goa
3) Support & strengthen people's movement against Narmada Sagar and Sardar Sarovar project.
4) Firm demands were made to scrap the river projects like upper Bhadre project in Chikmaglur, Sharawati Tailrace project in Uttara Kanara, Haggnur dam in Mysore, Pullingam Dam in Kerala, Naiya dam in south Kanara.

5) Requesting Maharashtra govt. not to allow Dahanu Thermal Power Plant that would threaten the ecological fragile zone.
6) Requesting Maharashtra govt not to venture to displace 50 villages in Shirpur taluka of Dhule dist.
7) Requesting Kerala govt to organise public debate on energy crisis in the state.

8) Opposing the move of central and state government of distributing surplus degraded forests, grazing lands to the industries and institutions in the name of social forestry. The conference urged that instead such land / forests must be given to the land less and poor for their subsistence.

9) The government should inform public about each development plan and seek their consent.
10) Urged Tamil Nadu govt not to convert virgin Janmam forests of Gudlur for another commercial plantation.
11) To undertake afforestation activities at mass scale to ensure more green cover.

12) It was decided to continue with existing structure of the March in the name of Save the Western Ghats Movement but it should not be registered. This arrangement was proposed till Nov 1988.

Slow but steady progress of SWGM

The SWGM was a landmark event in the environmental sector, on par with other key movements like the Chipko Movement and later on the Narmada Bachao Andolan.

Due to defunctness of 2nd committee, situation compelled Peaceful Society to continue with the role of maintaining contacts, communications with all stake holders. A vehicle Yatra was organised in 1998 on completion of 10 years covering northern part of the Western Ghats up to Goa. At the end of vehicle Yatra, 2nd conference of SWGM held on 1-3 November 1998 at Peaceful Society, Goa. The conference took stock of ongoing work by various groups on various issues pertaining to ecology and environment of the Western Ghats. Thereafter SWGM was registered under Society's Registration Act 1860 in Goa under the chairmanship of Kumar Kalanand Mani.

The real boost emerged in 2008 when Mr. Pandurang Hegde of Prakruti, Sirsi, Karnataka along with Dr. Sudhirendar Sharma, Ecological Society of India, New Delhi approached Peaceful Society to rejuvenate the movement and to convene 3rd Save the Western Ghats Conference. Both took pain and re-established contact and communications with existing environmental organisations and individuals working on various issues of the Western Ghats. The 3rd conference was organised on 08-10 February 2009 in Peaceful Society campus. The conference demanded in one voice for the formation of a Western Ghats Authority to ensure that all developmental work must be governed under one roof. The follow-up meeting came with the proposal of requesting Government of India for constituting a study team to bring out present status of the Western Ghats, recommends for its sustainable and comprehensive conservation measures and mechanism of governance. Accordingly, Mr. Jayram Ramesh, minister of Environment and Forest, Govt. Of India was invited to inaugurate 4th conference of Save the Western Ghats Movement held on 18-20 February 2012 at Keystone, Kotagiri in Nilgirti Hills, Tamil Nadu. The minister responded the demand for a panel to study the Western Ghats and recommend about conservation and governance mechanism positively which resulted into formation of Western Ghats Ecology Expert Panel (WGEEP) headed by Dr. Madhav Gadgil, environmental scientist. Dr. Gadgil was one of the members of Advisory Committee of Save the Western Ghats March in 1987-88 and had presented a follow-up plan in post march conference held at Ramnathi, Goa.

The development after the submission of report by WGEEP to the Govt. Of India was quite negative. The government refused to accept the report whereas prior this the SWGM was divided into two fractions at 5th conference held at Moodbidri in 28-30 January 2011.

Hereinafter some anti forces succeeded in spreading negative propaganda against the recommendation / report of the WGEEP. This also provided needed ammunition to the state governments for adopting anti stands. The two fractions failed to do mass mobilisation in favour of the report. Again, Peaceful Society came forward and organised 6th conference of SWGM in its campus on 17-18 November 2012. It was commemoration conference on completion of 25 years of SWGM. One key objective of conference was to the WGEEP report and recommendations and to create positive propaganda in its favour. This was followed by a planning consultation at Wildernest in association with Sahayadri Research Centre, Prakruti and Peaceful Society. The fraction group did organise another conclave at Mahabaleswar as mark of 25 years of the Save the Western Ghats Movement. Meanwhile Goa Foundation, an associate of SWGM moved a joint petition before the National Green Tribunal (NGT), New Delhi requesting implementation of the WGEEP recommendations. In between the govt. appointed another commission as Western Ghats High Level Working Group (WGHLWG) headed by Dr. Kasturi Rangan. Almost after 2 & ½ years, the union government did express before the NGT to implement the recommendations of HLWG. The SWGM continued propagating in favour of WGEEP but at the same time also propagated the HLWG because it was accepted the government. PS did organise series of consultations in every state of the Western Ghats. Sarvanan, Aranya, Aurovile and core marchers of SWGM took lead in organising 30 Years of SWGM at Kanyakumari on 1 Nov 2017. 7th Conference which was organised by Peaceful Society on 1-3 February 2018 as mark to 30 years of SWGM. An ad-hoc committee was formed in this conference with three advisors, three Coordinators as Coordinators collective and two representatives from each state as SWGM Presidium. The mandate of this committee was to organise state level conferences, formation of state level committees and to organise 8th Conference where presidium shall be constituted formally. The conference resolved to pursue the governments in Western Ghats to expedite implementation of recommendations of HLWG and to mobilised people of WG. The progress is that the union government have issued notification for Sensitive Ecological Zone as per the recommendation of HLWG. Peaceful Society took initiative to convene consultation of SWGM to understand the notification and suggestions are submitted by the associates accordingly for a better, comprehensive notification. The consultation held on 1-2 February 2018 at Peaceful Society had decided to organise a national level conference as Ecological Festival of Western Ghats in October 2018. Osai, Tamil Nadu 8th conference of SWGM on 1-3 February 2019 at Coimbatore as Ecological Festival of the Western Ghats at Shrikrishna College campus, Coimbatore. More than 1300 participants from the states of the Western Ghats and other parts of India attended.

Water Resources and Western Ghats

Quick Facts about Western Ghats

The Western Ghats perform important hydrological and watershed functions. Approximately 245 million people live in the peninsular Indian states that receive most of their water supply from rivers originating in the Western Ghats. Thus, the soil and water of this region sustain the livelihoods of millions of people. With the possible exception of the Indo-Malayan region, no other biodiversity hotspot impacts the lives of such a large population.

Water Tower: Western Ghats is also called the "Water Tower "of peninsular India and form the catchment area for complex riverine drainage systems that drain almost 40% of India

Length: 1600 km parallel to the West Coast of India from river Tapi in the north to Kanyakumari in the south.

Area of the Ghats: 160,000 sq km

Species Diversity: Nearly 4000 species of flowering plants or about 27% of the Country's total species are known from the Ghats. . About 63% of India's woody evergreen taxa are endemic to the Western Ghats. Of 645 species of evergreen trees, about 56% is endemic to the Ghats. Among the lower plant groups, the diversity of bryophytes is impressive with 850–--1000 species; of these 682 species are mosses with 28% endemics and 280 species are liverworts with 43% endemics

Details

Area: The Ghats descend steeply to the coastal plains on the west, but merge rather gently through a series of hills with the Deccan plateau. Geologically the Ghats fall into two sections. North of the river Kali is the Deccan trap country of relatively fragile rocks and flat hill tops. The hills do not rise much beyond 1500 m in this tract. South of Kali is the region of Precambrian archean crystalline rocks which are much harder. The hills tend to be rounded and rise to 2000 m or more.

Bringing monsoon: The Western Ghats force the moisture laden winds coming off the Arabian Sea to rise and receive in consequence heavy precipitation of 2000 mm or more a year. The east of the Ghats is a region of rain shadow and is much drier than the Western face. The rainfall is heavier to the south and extends over 8 to9 months a year. The rainfall is lower in the northern parts of the Western Ghats and is restricted to 4 months of.

Water Tower of Peninsular India: The Western Ghats block rainfall to the Deccan Plateau. Important rivers include the Godavari, Krishna and Kaveri. These rivers flow to the east and drain out into the Bay of Bengal. The west flowing rivers, that drain into the Arabian Sea and the Laccadive Sea, are fast-moving, owing to the short distance travelled and steeper gradient. Important rivers include the Periyar, Bharathappuzha, Netravati, Sharavathi, Mandovi and Zuari. Many of these rivers feed the backwaters of Kerala and Maharashtra. Rivers that flow eastwards of the Ghats drain into the Bay of Bengal. These are comparatively slower moving and eventually merge into larger rivers such as the Kaveri and Krishna. The larger tributaries include the Tunga River, Bhadra river, Bhima River, Malaprabha River, Ghataprabha River, Hemavathi River, Kabini River. In addition, there are several smaller rivers such as the Chittar River, Manimuthar River, Kallayi River, Kundali River and the Pachaiyar River.

Biodiversity: The western slopes of the Ghats have a natural cover of evergreen forest, which changes to moist and then dry deciduous types as one comes to the eastern slopes in proportion with the rainfall pattern that is higher on the western slopes compared to the eastern rain shadow regions. The vegetation reaches its highest diversity towards the southern tip in Kerala with its high statured, rich tropical rain forests. Tropical rainforests represent primary centres of species richness and endemism within the Western Ghats and cover approximately 20,000 km². Dry moist deciduous and scrub forests cover another 20,000 km². A unique mosaic of stunted montane evergreen forests, called sholas, and rolling grasslands can be found above 1,500 m.

Western Ghats in Kerala: Tropical moist forest areas of potential conservation value in Kerala are scattered over more than 20,000 Sq Km. natural topographic features such as mountain ridges and valleys divide it into a number of sub-units.

The importance of the Western Ghats

The Western Ghats are monsoon mountains. Their rugged heights and cold, lofty peaks turn the humid air currents of the southwest monsoon to rain, and determine where the water falls during the summer months. Where natural vegetation is intact, the hills provide perennial sources of water to the lower, more densely populated areas. Millions of farmers, industries and urban dwellers in the peninsula get their water sourced in the upper heights of the Western Ghats. All of peninsular India's major rivers, the Godavari, Krishna and Cauvery, have their origins in the cool height of the Western Ghats. Large metros such as Mumbai and Bangalore are indebted to forested catchments that receive and store water for their teeming populations. Local residents, who retain some of the ancient wisdom passed down by their ancestors, know the importance of these sources in the mountains, which is why they are often points of spiritual veneration.

A unique geographic entity:

A controversial issue that has been highlighted in the last year has been the precise delineation of the Western Ghats. For a long time, the idea of the Western Ghats has been a convenient geographic name tag to identify the long belt of mountains that separate the wet western coast of peninsular India from the drier interiors. Yet, there are a wide variety of heterogeneous geological formations that make up the 1,600 km.-long stretch of mountains. They also run through six different states, each with different elected governments and varying priorities that have affected the use and abuse of the hill areas.

The Western Ghats start at Kanyakumari and rise to 2,695 m. in the southern ghats at Anai Mudi, the highest mountain in peninsular India south of the Himalaya. The only significant break in the veritable wall of mountains is found at the Palghat Gap. The southern portion is made up of several 'horsts', or uplifted mountains. These pre-Cambrian ranges, including the Ashambu Hills, Cardamom Hills, High Range, Anaimalai, Palani and Nilgiri Hills, host the greatest concentrations of diversity. At the Nilgiri hills, where three states are joined and the ghats meet the Mysore plateau, an arm of the ghats stretches eastwards. These ranges (the Biligirirangans, for instance) share biological and geological origins with the ghats and conservationists have lumped them into the Western Ghats boundary. In the mid-section that lies along Karnataka's and Goa's coastal belt, the Western Ghats host vast evergreen, deciduous and mixed forests with edges that have been used for plantation agriculture and mining. Finally, north of the Goa-Maharashtra border, the Sahyadris make up the rugged, volcanic, northern-most ranges of the Western Ghats. This area, with the Deccan Traps has recently been highlighted in connection to theories regarding the extinction of dinosaurs. Forests are fragmented here but significant stretches are highly biodiverse, and are home to the apex predator, the tiger. The northern border of the Western Ghats is generally agreed to be the Tapi river in Gujarat. Several ecologists have also highlighted the importance of not just protecting the ghats but the coastal plains and rain shadows that fall next to them. Obviously, they are part of a greater range of biomes in the peninsula.

What is Western Ghats?

- Entire tract of hills from the Tapi to Kanyakumari is called Western Ghats.
- Length =approx. 1500km and Area= approx. 1.6 lakh sq.kms
- About 30% of the area of the Western Ghats Region is under forests.

SIX States	Three (important) Passes
1. Gujarat (portions of Dang Forests). 2. Maharashtra 3. Karnataka 4. Goa 5. Kerala 6. Tamilnadu	1. Thalghat 2. Bhorghat 3. Palghat

Administrative Region

(no need to mugup table, but if you're from any of these districts, be more prepared for "profile based" interview questions on Western Ghats).

Gujarat	Maharashtra	Karnataka	Kerala	TN
The Dangs	Ahmednagar	Belgaum	Idukki	Coimbatore
Navsari	Kolhapur	Chamrajnagar	Kannur	Dindugal
Valsad	Nandurbar	Chikmagalur	Kasaragod	Erode
	Nashik	Dakshin Kannad	Kollam	Kanyakumari
	Pune	Davanagere	Kottayam	Nilgiris
	Raigarh	Hassan	Kozhikode	Tirunelveli
	Ratnagiri	Kodagu	Malappuram	Tiruppur
	Satara	Mysore	Palakkad	Theni
	Sindhudurg	Shimoga	Pattanamtitta	Virudunagar
	Thane	Udupi	Thiruvananthapuram	
		Uttar Kannada	Thrissur	
			Wayanad	

+ UT- Diu Daman (Silvassa region)

Western vs Eastern Ghats

Western	Eastern
Almost Continuous hills	Discontinuous hills (thanks to River deltas)
Avg. height: 1500 to 2000 m	lower: 500-700 m
Highest peak: Anai Mudi (Kerala)	Dewodi Munda (Odisha) (as per Majid Hussein). Update: Highest peak in Eastern ghat is Jindhagada peak Andhra- it is few meters taller than Dewodi Munda.
Fast flowing rivers, donot form delta	Long broad rivers, form delta.
Narmada-Tapi	Krishna, Kaveri, Godawai (these origin from Western Ghats though) and Mahanadi
Flow into Arabian sea.	Into Bay of Bengal.

- Land between Western and Eastern Ghats=Deccan plateau.
- Nilgiri hills connect Western and Eastern Ghats.

Western Ghat: Forest

Western Slope	Eastern Slope
Rainfall: 200cm	70-200cm
Tropical Evergreen+ Semi Evergreen.	Moist Deciduous (also known as Monsoon Forest)
There is no definite time for trees to shade leaves. Hence the jungle appears green throughout the year.	Trees shed leaves during dry season.
1. Rosewood, 2. Mahogony 3. Ebony 4. Aini 5. Cedar 6. Hollywood ock 7. Kail	1. Teak 2. Sal 3. Shisham 4. Mahua 5. Sandalwood 6. Mahua

Western Ghats: Rivers

- Three main rivers of South India= Krishna, Godavari and Kaveri. They originate from Western Ghats.
- Traditionally these water resources were used to irrigate the valleys for paddy and arecanut cultivation.
- But later, construction of major river valley projects =irrigation + power generation.
- The steep slopes to the western Ghats = ideal for constructing dams and hydel power generation.
- In recent years construction of resorts and hill stations started around lakes and rivers. E.g. Amba Valley, Lavasa.
- Rivers flowing from the Western Ghats drain almost 40% of land in India.
- Roughly 250 million people depend on these rivers.
- From Western Ghats, rivers originate and flow in both directions: West and East.

West Flowing Rivers

	Narmada	Tapi
Origin (both MP)	Amarkantak hills	Satpura Ranges.
Length	Longer	Shorter
States covered	Guj, MP	Guj, MP, Mah.
Other names	Reva	Handmaid of Narmada.

- Coastal plains between Western Ghats and the Arabian sea are very narrow. Hence, these coastal rivers are short (compared to East flowing rivers)

East Flowing rivers- they drain in Bay of Bengal

	Godavari	Krishna	Kaveri
Origin	Nasik, Mah.	Mahabaleshwar	Brahmagiri Range
Length (km)	1500	1400	750
Water Basin covers	Mah, MP, Odi, AP*	Mah, Karn, AP	Karn, Ker, TN
Other names	Dakshin Ganga/Vridha Ganga		Ganga of South
Misc.notes			Sivasamudram water falls.
Tributaries	1. Manjra 2. Wainganga 3. Penganga	1. Tungabhadra 2. Koyana 3. Ghatprabha 4. Musi 5. Bhima	1. Amravati, 2. Bhavani, 3. Hemavati 4. Kabini.
Type of Delta?	Lobate	Arcuate	Quadrilateral

- ***NCERT Class 9 Geography: Chapter 3 page 21.**
- **Every once in a while, UPSC has a nasty habit of asking MCQ question from "delta-type" (Lobate, Arculate etc.) so do mug it up hahaha.**
- **Mahanadi also drains in Bay of Bengal but it comes from Chattisgarh=not part of Western Ghats.**

Western Ghats- Other names

1. Maharashtra	Sahyadri
2. Karnataka	Nilgiri hills
3. Tamil Nadu	Same as above
4. Kerala	Anaimalai + Cardamom hills.

Geologically, the Western Ghats is subdivided into three parts

1. Surat to Goa
2. Goa to Nilgiris
3. South of Palghat Gap

AGRICULTURE IN WESTERN GHATS

Region	Cultivation of
Valleys	• Paddy
Hill slops	• Earlier slash and burn type agriculture. Nowadays Terrace farming. • Millets and legumes. • arecanut
Coastal areas	• coconut, mango, jackfruit

Plantation crops

Introduced by Europeans in Western Ghats	Native to Western Ghats
1. Tea 2. Coffee 3. Rubber 4. Tapioca 5. Potato	1. Pepper 2. Cardamom

Forest produce

- **Pepper, Cardamom, Honey, Wax, Myrobalan (Small Fruit),**
- **Bamboos + Reeds = For Basket Weaving**
- **1980 onwards = explosion of forest-based industries such as paper, plywood, polyfibres, matchwood, tanning etc.**

My Observations in Gujarat and Goa Western Ghats Region:

01 Reduction of large areas of forest
02. No water resources
03. Need to protect the forest areas
04. Corporate invasion
05. Huge tourism coverage
06. Extension of settlements in forest area
07. Became a place of entertaining for rich people


WELCOME TO
MALAI MAHADESHWARA
WILDLIFE SANCTUA

Westrern Ghats: Biodiversity

- The Western Ghats is one of the biodiversity hotspots of the country.
- The wild relatives pepper, cardamom, mango, jackfruit and plantain=found here.
- Thousands of **endemics*** species of flowering plants, insects, trees, fishes, butterflies, dragonflies, mollusks (land snails) present.

*What is Endemic Species?

- Any species which is exclusively confined to a particular geographical area and it is found nowhere else in the world.

Nasikabactrachus sahyadrensis

- Recently discovered frog species in Western Ghats.
- It proves that Western Ghat was once part of ancient Gondwana region.

Western Ghat: Notable wildlife

1. **Tiger**
2. **Elephant**
3. **The Indian Bison**
4. **Lion-Tailed Macaque**
5. **Wynad Laughing Thrush (Songbirds)**
6. **Travancore Tortoise**
7. **Uropeltid Snakes**
8. **Several Species of Legless Amphibians.**

In the next article, we'll see the threats to this rich biodiversity of Western Ghats.

The Western Ghats are known as *Sahyadri* in northern Maharashtra, Sahya Parvatam in Kerala and Nilagiri Malai in Tamil Nadu.

States and Union Territories under the Western Ghats

Six states—Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu, and Kerala—as well as two Union Territories—Dadra & Nagar Haveli and Pondicherry—are home to the mountain region.

The range begins near the Gujarati border, south of the Tapti River, where the eastern part of Dadra and Silvassa in D&N is occupied by the foothills of the mountains. It ends at Kerala's Anamudi peak, almost 1600 kilometres south of where it began.

Mahe in Pondicherry is situated on the Malabar coast on the Western Ghats surrounded by Kerala.

Mountains in the Western Ghats

- Numerous hill towns, including Matheran, Lonavala-Khandala, Mahabaleshwar, Panchgani, Amboli Ghat, Kudremukh, and Kodagu, may be found in the mountain region.
- The extreme northern parts of Western Ghats fall in the Dangs district of Gujarat, known for the Dang (Bamboo) forests.
- The Eastern and Western Ghats converge in Karnataka near Biligirirangan Hills. The highest peak in the mountain region is Anamudi, which is 2,695 metres high. The highest peak in Karnataka is Mullayanagiri, which rises 1,950 metres.
- They conjoin the Anaimalai Hills to the northwest, the Palni Hills to the northeast and the Agasthyamalai Hills to the south as far as the Ariankavu pass.

- There are many important passes in the Western Ghats such as Tamhini Ghat, Palakkad Gap, Naneghat, Kasara ghat etc.
- The short coastal plain between the mountain region and the Arabian Sea is divided into three parts: the northern part, known as the Konkan Coast, the centre part, known as Kanara, and the southern part, known as the Malabar area or the Malabar Coast.
- The foothill region east of the Ghats in Maharashtra is known as Desh, while the eastern foothills of the central Karnataka state are known as Malenadu.

Rivers in the Western Ghats

- Peninsular India is home to 245 million people, most of whom depend on rivers coming from the mountain region for their water supply.
- The rivers that originate in the Western Ghats and flow towards the west are Periyar, Bharathappuzha, Netravati, Sharavathi, Mandovi etc.
- The Western Ghats' westward-flowing rivers move quickly because of their short travel distance and greater grade. Because of this, the Western Ghats are more advantageous for producing hydroelectricity than the Eastern Ghats.
- The steep gradient makes the Jog Falls on the Shravasthi River in Karnataka one of the most spectacular waterfalls in India. Narmada and Tapti although don't rise from the Western Ghats but flow westwards.
- The rivers that originate in the mountain region and flow towards the east include three major rivers viz. The Godavari, Krishna and Kaveri, and many smaller / tributary rivers such as Tunga, Bhadra, Bhima, Malaprabha, Ghataprabha, Hemavathi, and Kabini.
- These east-flowing rivers are comparatively slower moving and eventually merge into larger rivers such as the Kaveri and Krishna.

Also read: Hills of Peninsular India

Climate of Western Ghats

- Due to the mountains' ability to obstruct rain-bringing westerly monsoon winds, the western side of the Western Ghats receives more rainfall than its eastern side. It, therefore, has a significant impact on the pattern and intensity of India's monsoonal rainfall.
- The dense forests also contribute to high orographic precipitation. The climate is humid and tropical in the lower reaches tempered by the proximity to the sea. Elevations of 1,500 m and above in the north and 2,000 m and above in the south have a more temperate climate.
- Here, the yearly average temperature is close to 15 °C. Some regions frequently get frost, and the winter months have temperatures below freezing. 20 °C in the south to 24 °C in the north are the average temperatures. Additionally, it has been shown that the South Western Ghats' coldest and wettest seasons are related.

- During the monsoon season between June and September, the unbroken Western Ghats chain acts as a barrier to the moisture-laden clouds. The heavy, eastward-moving rain-bearing clouds are forced to rise and in the process deposit most of their rain on the windward side. Rainfall in this region averages 3,000–4,000 mm.
- The eastern region of the mountain region which lies in the rain shadow receives far less rainfall averaging about 1,000 mm bringing the average rainfall figure to 2,500 mm.

Vegetation of Western Ghats

- The vegetation on high hills differs from that on low slopes as well. As a result, the Western Ghats are home to a wide variety of plants.
- The western slopes have tropical and subtropical moist broadleaf forests marked predominantly by Rosewood, Mahogany, Cedar etc. These slopes appear green in almost all parts of the year. No time is fixed when these trees would shade their leaves.
- The eastern slopes of the mountain region have dry as well as moist deciduous forests marked predominantly by Teak, Sal, Shisham, Sandalwood etc. trees.
- Further, on the northern side of the Wayanad forests; we find dry deciduous forests while on the southern side there are wet deciduous forests. The evergreen Wayanad forests of Kerala mark the transition zone between the northern and southern ecoregions of the mountain regions.
- The southern ecoregions are generally wetter and more species-rich. South Western Ghats Montane rain forests are the most species-rich ecoregions in peninsular India. 80% of the flowering plant species of the entire Western Ghats range are found in this ecoregion.
- The areas which are high in elevation are cooler and wetter in the north and so the forests there are called North Western Ghats Montane rain forests. There are montane grasslands as well as stunted forests also in the Western Ghats.

Protected Areas in the Western Ghats

The Western Ghats is home to India's two biosphere reserves, 13 National parks, several wildlife sanctuaries and many Reserve Forests.

1. The Nilgiri Biosphere Reserve comprises 5500 km² of the evergreen forests of

- Nagarahole
- Deciduous forests of Bandipur National Park
- Nugu in Karnataka
- Wayanad
- Mudumalai National Park in the states of Kerala and Tamil Nadu forms the largest contiguous protected area in the Western Ghats.

2. The Silent Valley National Park in Kerala is among the last tracts of virgin tropical evergreen forest in India.

Biological diversity

Numerous types of flora and wildlife, including hundreds of species that are threatened with extinction globally, may be found in the Western Ghats. Many of these species are also endemic to the region. Covering an area of 180,000 sq. km, or just under 6 per cent of the land area of India,

The Western Ghats are home to over 5000 species of flowering plants, 139 mammal species, 508 bird species 179 amphibian species, and many undiscovered species.

It contains more than 30 per cent of all the plant, fish, herpeto-fauna, bird, and mammal species found in India.

The mountain region includes a diversity of medicinal plants and important genetic resources such as the wild relatives of grains, fruit and spices.

Some endemic species of the mountain region include the Malabar large-spotted Civet, Lion-tailed Macaque, Nilgiri Tahr and Brown Palm Civet

Biodiversity Crisis

The Western Ghats are under rising population and development pressure, according to the International Union for Conservation of Nature 2020.

This requires intensive and targeted management efforts to conserve the existing values and also remediate past damages.

Madhav Gadgil's committee reiterated that human interference and unscientific land use had worsened the already damaged ecosystem of the mountain region.

Climate change and Global warming have led to big variations in the duration and intensity of rainfalls in the region.

Endemic Herbs of Western Ghats:

India is one among the 18 Mega Biodiversity countries of the world holding 3 of the 25 identified hot spots (Meyers, 2000), concurring geographical area of ca.329 million hectors and over 6000 kms of coastline, is the 7th largest country in the world and 2nd largest in Asia. The variations in climate, topography, altitude and monsoon patterns coupled with various ecological habitats have contributed immensely to the floristic richness of India from coastal mangroves to tropical and evergreen temperate forests. With only 2.4% of the world's total landmass, India harbors ca.45,000 plant species representing as much as 11% of the known world flora. Singh and Hajra reported that

5,400 species are endemic out of 17,500 angiospermic species in India (Singh and Hajra, 1996). Western Ghats region is considered as one of the most important biographic zones of India (Nayar, 1982) since it is one of the richest centres of endemism holding 56 genera and 2,000 endemic species. The richness is currently decreasing at an alarming rate as the forests remain unprotected. Approximately ca.654 plant species (mostly flowering plants) are recorded as extinct (WCMC, 1992). This compels a detailed botanical account of several regions. Adequate knowledge about the plants is necessary for planning sustainable development of any region. Conservation and preservation of floral diversity is an important social, moral and economic issue where documentation of plants is the basic step in such program. Therefore, the current research focus on the documentation of herbal diversity at the Tropical Gene-Pool Garden, a part of The Nilgiri Biosphere of Western Ghats, India.

Plant species from the survey of Topical Gene-Pool Garden, Nadugani. S. **No. SPECIES FAMILY STATUS LOCAL USE** **1. Aerides crispum Orchidaceae Endemic Decoration 2. Aerides ringens Orchidaceae - Decoration 3. Allotropis cimicina Poaceae - Medicinal 4. Alternanthra sessilis Amaranthaceae - Medicinal 5. Amischophacelus axillaris Commelinaceae - Fodder 6. Ammania baccifera Lythraceae - Medicinal 7. Anisomeles indica Lamiaceae - Medicinal 8. Aristolochia ringens Aristolochiaceae - Medicinal 9. Artemisia japonica Asteraceae - Medicinal, Fodder 10. Arundinella ciliata Poaceae Endemic Fodder 11. Arundinella purpuria Poaceae Endemic Fodder 12. Blumea membranacea Asteraceae Endemic Medicinal 13. Brachiaria reptans Poaceae - Fodder 14. Bupleurum distichiophyllum Apiaceae Endemic Medicinal 15. Canna indica Cannaceae - Medicinal Int. J. Adv. Res. Biol. Sci. (2021). 8(4): 90-99 93 16. Capillipedium assimile Poaceae - Fodder 17. Caraxhebe carpa Cyperaceae - - 18. Cardiospermum halicacabum Sapindaceae - Medicinal 19. Cenchrus biflorus Poaceae - Forage, Fodder 20. Cenchrus ciliaris Poaceae - Fodder 21. Centella asiatica Apiaceae - Medicinal 22. Chrysopogon asper Poaceae Endemic - 23. Commelina clavata Commelinaceae Endemic - 24. Commelina longifolia Commelinaceae - - 25. Costus speciosus Zingiberaceae - Medicinal 26. Crotalaria acicularis Papilioniaceae - - 27. Crotalaria bifaria Papilioniaceae - - 28. Crotalaria clarkei Papilioniaceae Endemic - 29. Crotalaria umbellate Papilioniaceae - - 30. Curculigo orchioides Hypoxidaceae - Medicinal 31. Cyperus stoloniferus Cyperaceae - Medicine, fodder 32. Cyperus difformis Cyperaceae - Fodder 33. Cyperus iria Cyperaceae - Fodder 34. Cyperus nutans Cyperaceae - Fodder 35. Cyperus rotundus Cyperaceae - Medicinal 36. Cyprerus tenuispica Cyperaceae - Fodder 37. Dactyloctenium aegyptium Poaceae - Fodder 38. Dendrobium nanum Orchidaceae Endemic - 39. Desmodium alysicarpoides Papilioniaceae - - 40. Desmodium pulchellum Papilioniaceae - Medicinal 41. Desmodium triflorum Papilioniaceae - Medicinal 42. Desmodium triquetrum Papilioniaceae - Medicinal 43. Dichrocephala integrifolia Asteraceae - Medicinal 44. Didyplos andralurida Acanthaceae Endemic - 45. Digitaria setigera Poaceae - Fodder 46. Dioscorea bulbifera Dioscoreaceae Endemic Medicinal 47. Drymaria cordata Caryophyllaceae - Fodder 48. Dumasia villosa Papilioniaceae - - 49. Elephantopus scaber Asteraceae - Medicinal 50. Eleusine indica Poaceae - Fodder 51. Emilia sonchifolia Asteraceae Endemic Medicinal 52. Eragrostis gangetica Poaceae - Fodder 53. Eragrostis reparia Poaceae Endemic Fodder 54. Eragrostis tremula Poaceae Endemic Fodder 55. Eragrostis unioloides Poaceae Endemic Fodder 56. Eria reticosa Orchidaceae - - 57. Eriocaulon truncatum**

Eriocaulaceae - - 58. Eryngium foeticlum Apiaceae - Medicinal 59. Exacumtetregonum Gentianaceae Endemic - 60. Fimbristylis aestivalis Cyperaceae - - 61. Fimbristylis bisumbellata Cyperaceae Endemic - 62. Fimbristylis complanata Cyperaceae 63. Fimbristylis dichotoma Cyperaceae - - 64. Fimbristylis tenera Cyperaceae - - 65. Galactia tenuiflora Papilioniaceae - - 66. Galinsoga parviflora Asteraceae - Medicinal 67. Gnaphaluim polycaulon Asteraceae - - 68. Hedychium coronarium Zingiberaceae - Medicinal 69. Heteropogon contortus Poaceae - - 70. Hydrocotyle javanica Apiaceae - Medicinal 71. Impatiens chinensis Balsaminaceae - - 72. Iphigenia indica Liliaceae - Medicinal 73. Ipomea hederifolia Convolvulaceae - - 74. Ipomoea indica Convolvulaceae - Decoration 75. Isachne miliacea Poaceae - - 76. Jasmanium flexile Oleaceaae - Decoration 77. Leucas aspera Lamiaceae - Medicinal 78. Lindernia anagallis Scrophulariaceae - Medicinal 79. Lindernia antipoda Scrophulariaceae - Medicinal 80. Lindernia oppositifolia Scrophulariaceae Endemic Medicinal 81. Lindernia parviflora Scrophulariaceae - - 82. Lindernia tenuifolia Scrophulariaceae Endemic - 83. Lipocarphas phacelata Cyperaceae - - 84. Ludwigia perannis Onagraceae - Medicinal 85. Lycinathes laevis Solanaceaae - Medicinal 86. Mariscus dubius Cyperaceae - - 87. Mariscus squarrosus Cyperaceae - - 88. Mariscus sumatrensis Cyperaceae - - 89. Melastoma malabathricum Melastomataceae - Medicinal 90. Micrococca mercurialis Euphorbiaceae - Edible 91. Mimosa polyancistia Mimosaceae - - 92. Mukia leiosperma Cucurbitaceae - Medicinal 93. Murdania dimorpha Commelinaceae Endemic - 94. Murdania semiteres Commelinaceae Endemic - 95. Ocimum gratissimum Lamiaceae - Medicinal 96. Oldenlandia biflora Rubiaceae - Medicinal 97. Oldenlandia herbacea Rubiaceae - Medicinal 98. Ophiorrhiza mungos Rubiaceae - Medicinal 99. Orthosiphon pallidus Lamiaceae - Medicinal 100. Osbeckia leschenaultiana Melastomataceae Endemic - 101. Oxalis corniculata Oxalidaceae - Medicinal 102. Panicum miliaceum Poaceae - Millet 103. Paspalidium geminatum Poaceae - - 104. Pavonia odorata Malvaceae - Medicinal 105. Pennisitum purpureum Poaceae - Fodder 106. Persicaria chinensis Polygonaceae - - 107. Physalis minima Solanaceaae - Edible, Medicina 108. Phytoloca octandra Phytolochiaceae - Dye 109. Pilea melastomoides Urticaceae - Medicinal 110. Plumbago zeylanica Plumbaginaceae - Medicinal 111. Polygonum glabrum Polygonaceae - Medicinal 112. Polygonum hydropiper Polygonaceae - - 113. Polygonum plebcium Polygonaceae - - 114. Pothos scandens Araceae - Medicinal 115. Pycreus flavidis Cyperaceae - - 116. Pycreus pumilus Cyperaceae - - 117. Satyrium nepalens Orchidaceae - Medicinal 118. Scoparia dulcis Scrophulariaceae Endemic Medicinal 119. Setaria pumila Poaceae - - 120. Sida schimperiana Malvaceae - - 121. Smithia blanda Papilioniaceae - - 122. Solanum torvum Solanaceaae - Medicinal, Edible 123. Spermacoce pussilla Rubiaceae - - 124. Sphaeranthus indicus Asteraceae - Medicinal 125. Spilanthes calva Asteraceae - Medicinal 126. Sporobolous coromendelianus Poaceae - - 127. Sporobolus wallichia Poaceae - Craft 128. Tephrosia purpurea Papilioniaceae - Medicinal 129. Teramnus labialis Papilioniaceae - Medicinal 130. Thmbergia fragrans Acanthaceae - - 131. Thumbergia mysorenses Acanthaceae Endemic Decoration 132. Tinospora cordifolia Menispermaceae Endemic Medicinal 133. Torenia bicolor Scrophulariaceae Endemic Decoration 134. Torenia lindernioides Scrophulariaceae - - 135. Trichosanthes cucumerina Cucurbitaceae - Edible 136. Utricularica scandens Lentibulariaceae - - 137. Vernonia conyzoides Asteraceae Endemic Medicinal 138. Wedelia chinensis Asteraceae - Medicinal 139. Zehneria maysorenses Cucurbitaceae - Medicinal 140. Zingiber zerumbet Zingiberaceae – Medicinal

Tribal Communities Western Ghats: An Overview

The Western Ghats is a hotspot for biodiversity and home to diverse **tribal groups**. These communities have thrived in harmony with nature for centuries. They have developed unique knowledge systems.

Major Tribal Groups

The Western Ghats are home to many tribal communities, each with their own traditions. **The Kadar, Muthuvar, Paliar, Malaiyali, Kattunayakkar, Malai Malasar, Irulas, Kurumbas, and Badagas are some of the main groups.** They have long relied on trade networks to exchange goods and services.

Historical Background: Originally, many tribes in the Western Ghats were hunter-gatherers. Over time, they adapted to settled lifestyles while keeping their cultural roots. This change has brought about big shifts in their social structures and ways of living.

Cultural Significance

The **tribal groups** in the Western Ghats hold a lot of cultural importance. Their unique languages, customs, and knowledge systems are key parts of India's **cultural diversity**. In recent decades, their population has grown by 180%, and literacy rates have risen.

Aspect	Data
Population Growth	180% increase in past three decades
Overall Literacy Rate	52%
Female Literacy Rate	42%
Male Literacy Rate	63%

The tribal communities in the Western Ghats are key to preserving the region's ecological balance and cultural diversity. Their knowledge and sustainable practices are valuable for conservation efforts in this unique area.

The Kadar Tribe: Guardians of the Forest

The **Kadar tribe** shines as a symbol of deep forest knowledge in the Western Ghats. They live in the Anamalai hills, connecting deeply with their forest. Their lifestyle shows how to protect the forest, making them its true protectors.

Kadar people know the local ecosystem well. They spot many plant species and know how to use them safely. This knowledge helps keep their forest healthy.

"Our ancestors taught us to take only what we need from the forest. It gives us life, so we must protect it," shares a Kadar elder.

Even with modern changes, the Kadar keep their forest values strong. Many work with the Forest Department, using their knowledge to help protect the forest. This shows how native wisdom and science can work together.

The Kadar teach us about living sustainably. They gather forest products in a way that helps the forest grow back. By learning from them, we can find better ways to protect our forests.

Muthuvar: Preserving Ancient Traditions

The **Muthuvar tribe** is a symbol of cultural strength in the Western Ghats. They have kept their rich culture alive despite modern changes.

Unique Customs and Rituals

The **Muthuvar tribe** has special customs that show their bond with nature. Their weddings include rituals tied to the forest. At harvest festivals, they dance to thank nature for its gifts.

Traditional Knowledge Systems

Muthuvar elders know a lot about plants and animals. They use plants for medicine and understand the forest well. This knowledge is shared from one generation to the next.

Traditional Knowledge	Application
Herbal Medicine	Treating common ailments

Forest Navigation	Sustainable resource gathering
Weather Prediction	Agricultural planning

Challenges in Modern Times

The **Muthuvar tribe** faces big challenges in keeping their culture alive. Their land is being taken over, and economic changes threaten their way of life. Young ones often leave for school and jobs, taking their traditions with them.

Even with these problems, the Muthuvar tribe is dedicated to saving their culture. They're working with local groups to record their traditions and spread the word about their customs. By changing with the times but keeping their values, the Muthuvar aim to keep their old ways alive today.

Malai Malasar: Experts in Ethnomycology

The **Malai Malasar** tribe in the Western Ghats is known for their deep knowledge of wild mushrooms. They have learned about these mushrooms from their ancestors. This knowledge has been passed down for many years.

They have found many edible mushroom species. Their knowledge covers different types of fungi. This includes:

- Identification of at least 19 distinct edible mushroom species
- Recognition of mushrooms from 12 different genera
- Classification across 9 families and 4 orders

The tribe lives closely with the forest. This has given them a deep understanding of where mushrooms grow and when they are ready to eat. They know how to harvest mushrooms in a way that doesn't harm the environment.

They also know how to keep mushrooms fresh for a long time. This helps them have a steady food supply during hard times.

The Malai Malasar's knowledge about mushrooms is very useful for many things. It could help with:

- Enhancing nutritional studies
- Developing new medicinal applications
- Informing conservation efforts in the Western Ghats

Learning about the Malai Malasar and their relationship with the forest teaches us a lot. It shows us the importance of **traditional knowledge** in protecting nature.

Tribal Livelihoods and Resource Use

The Western Ghats' tribal communities live in harmony with nature. They depend on the area's rich biodiversity. This shows a strong bond with the environment.

Traditional Occupations

Tribal groups have activities that go back to their ancestors. They gather forest products, farm on a small scale, and make crafts. Many grow crops like millet and vegetables for food, keeping their culture alive.

Sustainable Practices

For generations, tribes in the Western Ghats have used sustainable ways to manage resources. This helps protect the environment and meet their needs. For instance, they harvest forest products in a way that lets nature heal itself.

Adapting to Change

As the world changes, tribal communities are changing too. Some are starting to grow cash crops, like cardamom. This shows they can adapt and use new ways to make money while keeping their old knowledge.

Traditional Livelihood	Modern Adaptation	Impact on Community
Forest gathering	Sustainable harvesting cooperatives	Improved market access, fair prices
Subsistence farming	Cash crop cultivation (e.g., cardamom)	Increased income, economic stability
Artisanal crafts	Eco-tourism initiatives	**Cultural preservation**, new revenue streams

Despite the challenges, tribal communities are changing their ways. They keep their culture while adapting to new practices. This shows how they can use resources wisely and stay strong as a community.

Cultural Heritage and Ethnobotanical Knowledge

The Western Ghats' tribal communities have a deep **cultural heritage**. Their **ethnobotanical knowledge** is passed down through generations. It shapes their identity and life.

Tribal elders are like living encyclopedias of **traditional medicine**. They know hundreds of plant species and their uses. This knowledge helps them treat illnesses and keep healthy every day.

*"Our forests are our pharmacies. Every leaf, bark, and root have a purpose," says Muthamma, a respected healer from the **Kadar tribe**.*

The tribes' knowledge goes beyond medicine. It includes sustainable farming, food preservation, and managing natural resources. These methods keep the Western Ghats' ecosystem balanced for centuries.

- Medicinal plants used for various ailments
- Traditional cultivation methods
- Sustainable harvesting techniques
- Natural conservation practices

This mix of culture and **ethnobotanical knowledge** is valuable for today's science. Researchers work with tribes to find new uses in pharmaceuticals, farming, and saving biodiversity.

With environmental issues growing, saving this knowledge is crucial. It's not just about keeping culture alive. It's about protecting wisdom that could help all of humanity.

Conservation Efforts and Tribal Involvement

The Western Ghats' conservation efforts now include tribal communities as key partners. This change recognizes the deep bond between indigenous people and their environment. It leads to better ways to protect biodiversity.

Community-based Conservation Initiatives

Tribal groups are now part of conservation efforts on their ancestral lands. They use both modern science and traditional practices. This mix creates a complete way to manage ecosystems.

Traditional Ecological Knowledge in Conservation

Knowledge passed down through generations is vital for conservation. Tribal communities use their **traditional knowledge** to find rare species, understand animal behavior, and keep the ecosystem balanced.

Traditional Knowledge	Conservation Application
Medicinal plant use	Sustainable harvesting practices
Wildlife tracking	Population monitoring
Fire management	Controlled burning for habitat renewal

Challenges and Opportunities

Tribal involvement in conservation has many benefits but also faces challenges. Finding a balance between traditional ways of living and modern conservation goals is hard. Yet, these partnerships offer chances for **sustainable development** and protecting biodiversity in the Western Ghats.

"Our ancestors taught us to live in harmony with nature. Now, we work with scientists to protect our forests for future generations," says Ravi, a Kadar tribe elder.

As conservation efforts grow, combining tribal knowledge with modern science leads to better ways to protect the Western Ghats' biodiversity.

Impact of Modernization on Tribal Communities

The Western Ghats' tribal communities are at a turning point as modern life moves in. This change brings both good and bad, affecting their identity and traditional life.

Education and better infrastructure are bringing new life to these distant places. More people can read, and healthcare is getting better. But this progress has its downsides.

Many tribes are leaving their nomadic ways for a settled life. This change is affecting their old customs and ways.

It's hard for these communities to keep their identity as they modernize. Young ones often feel caught between keeping their heritage and new chances. This creates a world where old knowledge meets new tech.

"Our children learn about smartphones and computers, but we fear they might forget the wisdom of our ancestors," says a Kadar tribe elder.

New jobs are coming to tribal lands, offering stability. But they also threaten the old ways of making a living. Finding a balance between growth and keeping culture is tough for these groups.

- Increased access to education and healthcare
- Shift from nomadic to settled lifestyles
- Introduction of new economic opportunities
- Erosion of **traditional knowledge** systems

As these communities' face change, they must blend new tech with their deep culture. This will be key to their future.

Collection of Palm Leaf Manuscripts

Palm-leaf manuscripts are ancient written records made on dried palm leaves, primarily used in South and Southeast Asia before the widespread adoption of paper. They were a major source for writing and painting, preserving texts on a variety of topics including religious scriptures, literature, history, and medicine. Palm leaves were chosen for their durability and availability, with some surviving for centuries.

Here's a more detailed look:

Origins and Materials: The practice of writing on palm leaves dates back centuries, with some evidence suggesting use as early as the 5th century BCE. Palm leaves were prepared by drying, smoking, and polishing to create a writing surface.

Scope and Content: These manuscripts were used for a wide range of texts, including religious texts (like Buddhist scriptures and Hindu Puranas), poetry, philosophy, medicine, science, mathematics, and astrology.

Preservation and Distribution: Palm leaf manuscripts were often arranged in bundles and stored in temples, monasteries, libraries, and even private collections. They were copied and recopied manually over centuries, and their preservation was a significant undertaking.

Current Status: While palm leaf manuscripts were gradually replaced by paper and printing presses, they remain an important part of South and Southeast Asian cultural heritage. Many ancient manuscripts are still preserved, with some dating back to the 11th to 14th centuries.

Digitization and Preservation Efforts: Efforts are being made to digitize and preserve these valuable texts, making them accessible to researchers and the public. For example, the Tamil Nadu State Department of Archaeology is digitizing manuscripts and making them available online.

Palm leaf manuscripts are prevalent in the Western Ghats region, particularly in states like Kerala and Tamil Nadu, and are often found in temples, libraries, and private collections. These manuscripts, written on prepared palm leaves, contain a wealth of historical, cultural, and religious information, including texts on various subjects like religious rituals, royal history, natural medicines and literature.

Key Features and Significance: Historical and Cultural Value: Palm leaf manuscripts provide valuable insights into the history, culture, and traditions of the region.

Content: The manuscripts contain a wide range of information, including religious texts, historical records, literary works, and administrative documents.

Material and Writing: They are written on prepared palm leaves, often with a specific script or language (e.g., Malayalam, Tamil, Kannada).

Preservation: Many manuscripts are ancient and have been preserved over time, often in temples or libraries.

Digitization Efforts: There are ongoing efforts to digitize these manuscripts to preserve them for future generations and make them accessible to researchers and the public.

Unique Script Styles: Some manuscripts employ ancient scripts like Vattezhuthu and Kolezhuthu, which can be challenging to decipher.

Preservation Challenges: These manuscripts are susceptible to damage from environmental factors, pests, and improper handling, necessitating conservation efforts.

Indigenous Preservation Methods: Traditional methods of preserving palm leaf manuscripts, such as using herbs and spices, are still practiced in some areas.

Collection of Palm Leaf Manuscripts during my journey during the sabbatical visit.

While visiting the Western Ghats in Tamilnadu and Kerala, I had the opportunity to collect volumes of Palm Leaf Manuscript which I got as a invaluable treasure in my life. I will separately take time to go through my collection and work on a special research work from the Palm Leaf Manuscripts.

Examples of Palm Leaf Manuscripts in the Western Ghats:

Kumaranalloor Devaswom: temple in Kerala has a large collection of palm leaf manuscripts, including temple documents, records of rituals, and royal decrees.

A

Sevadhi Museum: Remya Bhaskaran, the manuscript-keeper of the Sevadhi museum, works on restoring the temple's palm leaf scrolls.

Orient Institute (ORI), Mangalore: The ORI is a repository of thousands of palm leaf manuscripts, containing a wide range of subjects.

Thrissur, Kerala: A collection of palm leaf manuscripts is kept at the Vadakke Madham Brahmaswam, a traditional Hindu institution.

Mathilakom Records: A collection of cadjan manuscript rolls, including palm leaf manuscripts, is found at the Sri Padmanabhaswamy Temple.

Western Ghats: Man-Made Disasters Disguised as Natural Calamities Waiting to Happen

In the last of a three-part series on climate change and its impact on various areas, The Secretariat takes a deep dive into how the ecologically sensitive Western Ghats will cope with climate change

Natural disasters are not new to the Western Ghats, nor to Kerala, not even to Wayanad. In 2018, furious floods lashed the south western state fondly referred to as God's own country. In August 2019, Wayanad was one of the several districts to be battered by landslides and floods. In 2020, it was the tea plantation workers in Idukki that bore the brunt of nature's fury. Sporadic events followed suit from 2021 to 2023.

This time in Wayanad, the scale of damage and destruction has been unprecedented. Entire villages have been swept away, bodies have been found as far as 25 km from where they originated, and the death toll has crossed the 350 marks. Such catastrophic landslides are not limited to Kerala. Maharashtra, Goa and Karnataka too have been at the receiving end.

The recent tragedy has given the 13-year-old Gadgil committee its 'I told you so' moment. The Western Ghats Ecology Expert Panel (WGEEP), famously known as the Gadgil committee, had sought to label the entire Western Ghats as an ecologically sensitive area (ESA), divided into three zones with different levels of restriction. The committee also recommended the establishment of a Western Ghats Ecology Authority, a statutory body under the Environment Protection Act, 1986.

The WGEEP report was rejected by the state government for being too environment friendly and not in sync with reality. The chilling repercussions of this decision are now being felt by the helpless villagers residing in the landslide and flood-prone areas of the ghats.

ESA Notification – Long Delayed, Still Awaited

Post the Gadgil committee, a new committee was established under the chairmanship of K. Kasturirangan. It recommended that 37 per cent of the western ghats be labelled as ESA's, a sharp decline from Gadgil committee recommendations. Accordingly, the government released a draft notification in 2014 notifying around 55,000 sq km of land under ESA. However, this too was rejected by the state governments who considered the ESA tag detrimental to the ongoing development projects in their area.

Since 2014, five iterations to the original draft have been released, the latest in July 2022, but all have failed to get the states on board. A new committee was established under the chairmanship of the former Director General of Forests, Mr Sanjay Kumar. The committee has a tough task ahead, for getting the states to come to a consensus on the ESA issue is akin to finding a needle in a haystack.

Professor Manoj R. Borkar, former member of the Goa State Wildlife Advisory Board and a founder member of the Goa State Biodiversity board is of the opinion that "Gadgil Report was based on hardcore science, consultations with stakeholders and a note of precaution. As is always the case, science does not accommodate electoral compulsions and populist leanings".

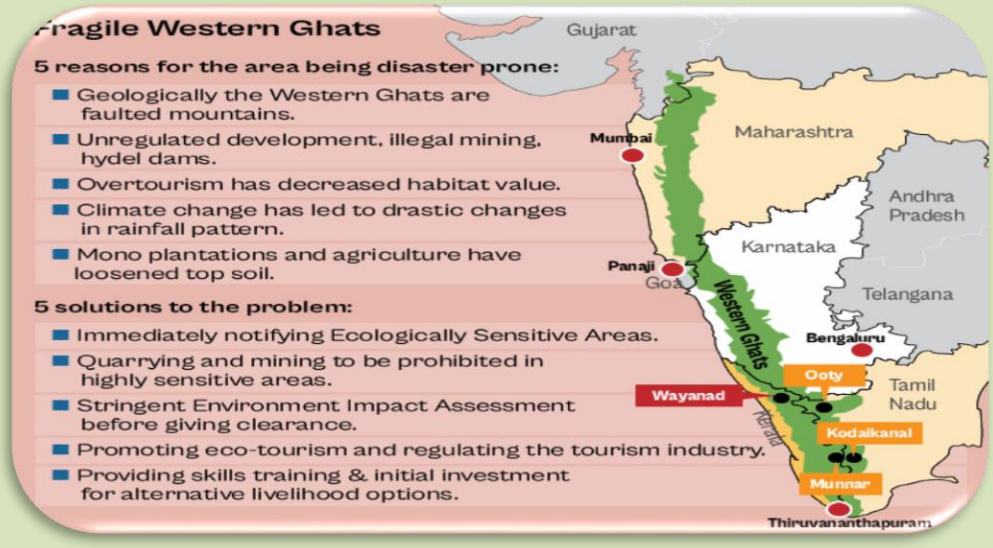
Borkar, who was an expert member in the committee constituted by the government of Goa to identify the causes of the Sattari Landslide in 2021 firmly believes that "the Western Ghats cannot be protected in a piecemeal basis. The ecological continuum cannot be forsaken for economic gains. This mountain range is a last refuge of rich and rare biota and must be preserved not just for posterity but for our present ecological security".

Unregulated Development in the Western Ghats

The absence of an official Ecologically Sensitive Area notification in one of the most biodiverse hotspots of the world has led to unabated quarrying and mining altering the very landscape of the lofty hill range. The Justice MB Shah commission, a contemporary of the Gadgil commission was appointed with the mandate of probing illegal mining across the country. It had in its report revealed of a Rs 35,000 crore iron ore mining scam in the Western Ghats of Goa. The report boldly held both state and central government as parties to the scam.

Exploiting the non-existence of ESA regulations, large tracts of forests have been cleared in the Western Ghats to build luxury resorts and homestays, adventure parks, skywalks, giant swings etc., many of which are operating illegally. This too has added to the woes of the Western Ghats already reeling under the stress of illegal quarrying.

Professor Borkar feels that "The mountain range has been assaulted mercilessly by the mining sector and hydel dams; its rich and diverse forests denuded and homogenised for agriculture and linear infrastructure. This pristine landscape is being subjected to encroachments and urban engineered assets". The tourism sector too is eyeing this area and its riches, further posing a threat to the fragile landscape.



Geologically Susceptible

While all the above-mentioned pressures operate on the surface, geologically the Western Ghats are block mountains and the eroded edge of the Deccan plateau. The meteorology of this region is such that the South Western Monsoons spell can saturate the topsoil and reduce the cohesive forces that bind the soil.

"Along the slopes with steep gradients, the soil saturated with rain water can simply move as large masses of mud and drag more topsoil as it slides. The loss of vegetation cover simply loosens the soil that becomes susceptible to movement. Any development that is a threat to slope stability combined with climate change-driven events of extreme precipitation can trigger landslides", adds Borkar.

The Solution

Frequent disasters have led to calls for Improved long-term weather forecasting. And while better forecasting can only be beneficial, the seriousness of the situation demands that the root cause be fixed in the first place.

Borkar suggests that "the state and Centre must work in tandem to avert such human-catalysed disasters by investing in mitigation measures rather than managing the post-disaster scenario. Mapping Vulnerable Areas of the Western Ghats is critical to averting loss of life and property. Environmental Impact Assessment must be stringent for developmental proposals in the Western Ghats. Ecotourism could be an effective incentive and alternative to destructive economic activity here".

For the ESA notification to be successful, the Sanjay Kumar committee should be given a new mandate to prioritise the health of the Western Ghats over all else. It should be obligatory for the states to adhere to the committee recommendations and not cry hoarse over planned development projects.

Alternative Livelihoods

What about lost livelihoods? There is a plethora of ways in which the locals can sustain their livelihoods and that too in conditions far better than that of mine and tea plantation workers.

For instance, the government can provide skills training and initial investment to the villagers for collective honeybee rearing, mushroom farming, indoor saffron cultivation, etc. Low-cost aquaculture, pearl farming, and seaweed farming in small ponds can also be promoted.

A cooperative should be formed to help the villagers collectively market and sell their produce. The financial investment required to build self-sustaining livelihood options for villagers will be far less than what must be spent in the aftermath of tragedies like in Wayanad. The government should immediately assign a committee to work out alternative livelihood opportunities for villagers and ensure timely and proper implementation.

It is easy to label landslides and flash floods as nature's fury but a deeper analysis reveals that man-made activities have led to nature unfurling its wrath. Livelihoods can most certainly be provided without playing with nature, livelihoods that don't put lives at risk.

WHY I LOVE THE WESTERN GHATS OF INDIA

Ten reasons why you must visit Western Ghats

I have always enjoyed my geography classes during school. And drawing, shading and marking maps has always been a personal favourite. Perhaps that is why I am addicted to adult colouring books rig

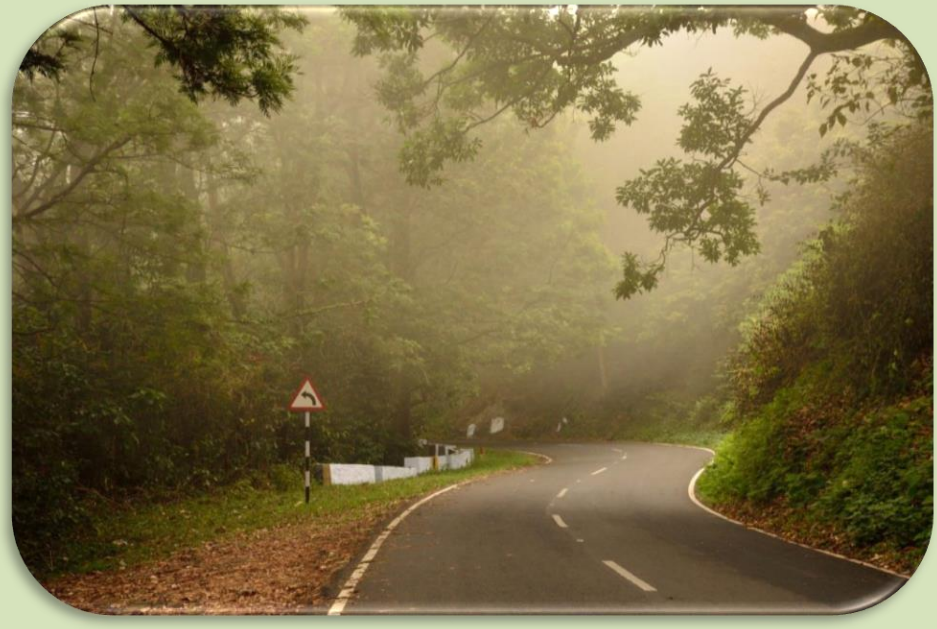
Every time I think of the Western Ghats, I remember my class when we used to mark and colour the western stretch of India on the map, all the way from the tip of Tamil Nadu to Kerala and right up to Goa. And then there was the Eastern Ghats as well.

Manimuthar Dam in KMTR

I used to have two different shades of brown – the darker and bolder one was used to mark the Western Ghats and the lighter shade was for the Eastern

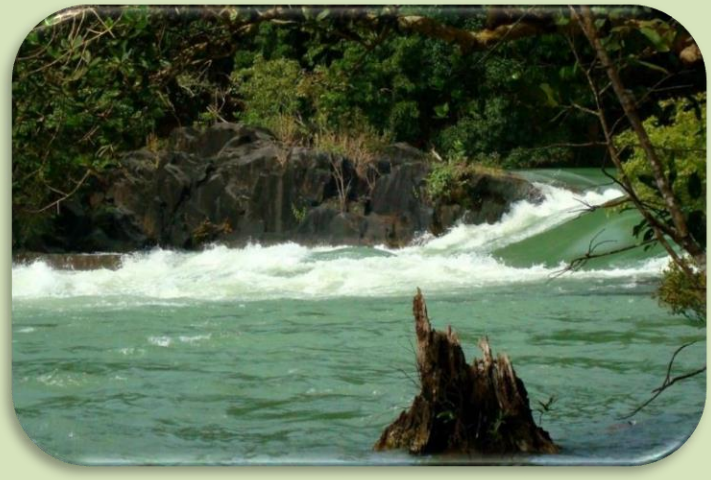
The misty forests of Valparai

I love the Western Ghats. Period. I was introduced to it as a three-year-old when we used to drive from Chennai to visit Sringeri and then we stayed in my grandfather's coffee estates in Chikmagalur. And the fascination stays even today. There is an element of nostalgia every time you think of it irrespective of whether it was a road trip or a train journey



Sculptures in Vidyashankara temple in Sringeri

I have traversed the Western Ghats several times and it has almost become an annual pilgrimage. Some statistics from the Wikipedia – the 1600 kms long unbroken chain of mountains occupies an area of 160000 sq kms. There are about 39 individual sites that make up this World Heritage Site including reserve forests and national parks



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The River Kali in Dandeli

But then there are mountains and mountains and there is the Western Ghats, a UNESCO World Heritage Site. And personally, I think there is more to it as, than just hills stitched together forming ranges, peaks and valleys.

Devils Canyon in Goa in the wilds

Here is a post on why it is so special to me and the reasons you must visit the Western Ghats in India

BR Hills in BRT Sanctuary

BR Hills in BRT Sanctuary

The green cover is all encompassing. From evergreen tropical rain forests to deciduous jungles to shola forests, the dense canopy here can take you to a different world. It is not just about tiger tourism.

A tusker in Kabini

From elephants to big cats, wild dogs to langurs, sloth bears to wild boars, the forests are home to wildlife. And there are several endemics which are found only here.

Looking away – the Nilgiri langur

Snakes and frogs, mongoose and civets, flying squirrels to giant squirrels, this is a wild lifer's paradise.

On a wild reptile trail in Goa

The flora is exotic and endemic. Be it the ferns or the fungi, lose yourself in a world of woods and trees.

Orchids in Valparai

And then there is my personal favourite – birds. The birds of Western Ghats are special – resident, migratory and the endemic. Almost 500 species are found here. I have seen varieties of bulbuls, hornbills. sunbirds, flycatchers, thrushes and melted away like Keats listening to their songs.

Blue capped Rock thrush in Ganeshgudi

There are some exclusive birding destinations as well – one of my favourites being Ganeshgudi on the banks of the River Kali in Karnataka.

Srilankan Frogmouth in Thattekadu

And as for wildlife destinations – my personal recommendations are KMTR – Kalakadu Mundanthurai Tiger Sanctuary and Bandipur and Nagarhole forests separated by the River Kabini. There is BR Hills and Valparai as well, which you must not miss. The forests of Goa are another favourite.

Iconic Mountain Ranges

We have grown up talking about the Himalayas and the Alps, the Atlas and the Andes, but in a very special way, the Western Ghats has its own special iconic ranges too.

The Sahyadris, the Annaimalais and of course, the Nilgiris, where the West and the East meet.

Grasslands of BRT

And then there is the Cardamom Hills and B R Hills and the highest peak is Anaimudi in Kerala. Trek, camp, relax – how can anyone not be beckoned by the mountains? Another reason for you to visit Western Ghats.

Springs and streams

A mountain spring forms into a tiny rivulet murmuring through the woods and becomes a little river. The Western Ghats has given many a river its source. The Cauvery's little birth place in Coorg is called Talacauvery.

Athirapally Falls

The Tungabhadra, the Krishna, the Godavari, the Zuari, the Mandovi and my very own Tambiraparani – all have their origins here and their tributaries run amok in the hills, charting their own courses.

Kudrevatti In Tamil Nadu where the rivers are dammed

They are confined in dams or they gush as cascades. Look anywhere around you and you will find a river nearby. So, if you love the water, you will definitely want to visit Western Ghats.

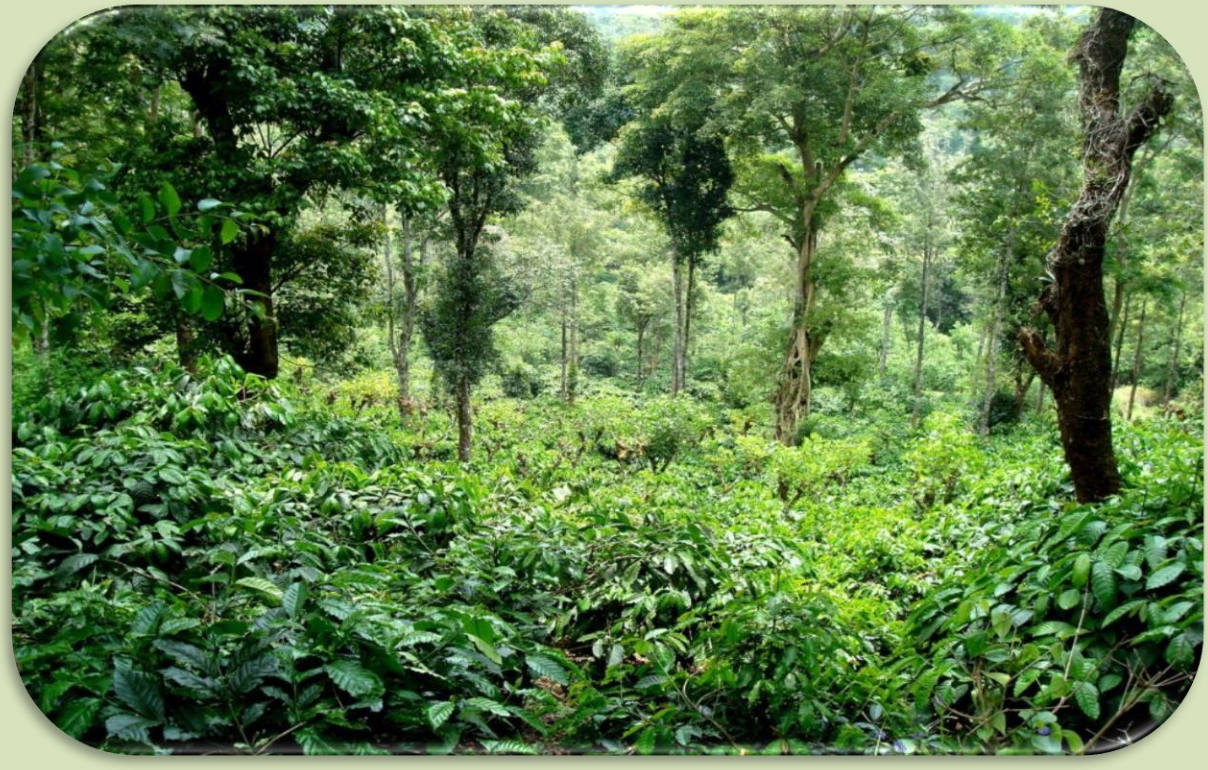
Where oceans meet the mountains

The Western Ghats run parallel along the coastline of India and some of the most virgin beaches meet the mountains here. Karwar in Karnataka is so beautiful, almost oblivious of its own beauty as it stands perched between the oceans and mountains.

The coastal plains along Kanyakumari, located in the Southern most tip of India also comes to my mind. Some coastal towns in Goa, Karnataka and Kerala are my favourite haunts.

Tea or coffee or spices

The British destroyed these forests and created plantations here. And you see the mountains carpeted by tea, coffee and spices. Even today plantation tourism is one of the biggest draws. The coffee plantations of Malnad or the tea estates in Nilgiris with the spice plantations are tourist destinations.



Wake up and smell the coffee in Coorg

Coorg, Chikmagalur, Saklespur, Munnar, Wayanad, Valparai are some of my favourite towns. If you are planning to visit one of them I recommend the beautiful tea plantations of Munnar where you can find a slice of British charm in the estates there.

Tea and mist in Munnar

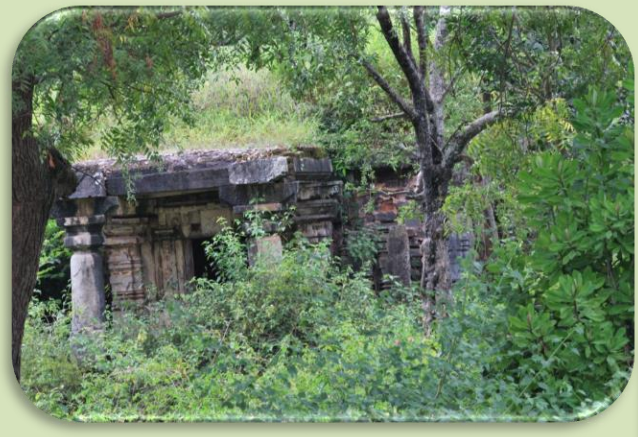
Take an early morning walk – watch the mist play with the mountains and relive the colonial era in some of these towns.

Heritage in the hills

A temple in the forest, a fort atop the hills, ancient ruins and monuments call me here. You wonder who built these shrines in the middle of a dense canopy of trees with crickets murmuring all around you. I am lured to heritage sites in general and all the more reason, when they are built in a pretty setting.

Interiors of the old Nalknad Palace in Coorg

Sringeri in Karnataka is one of my favourite spiritual destinations, where Adi Sankaracharya established his mutt in the South on the banks of the Tunga Bhadra. It was my very introduction to the Western Ghats.There are several temples around like Hornadu set deeper in the forest.



The Hoysalas built several temples along Malenadu and some of them are still in ruins, in dense forests and in coffee estates.

Sculptures in ruins in a coffee plantation

Padmanabhapuram palace in Kerala – Tamil Nadu border talks about the legacy of the Travancore kings.

Set amidst the mountains, Padmanabhapuram palace is an ode to beauty

Ancient Jaina sites, cave temples, monoliths, churches – they are all scattered in the mountains and forests here. There is a spiritual mystique here that can only be experienced.

Cultural experiences Western Ghats may be an unbroken chain but they span different states and each region has its own little culture. Festivals and traditions change from region to region. There are several lores and legends here. Some destinations have their own tribal culture too – Nilgiris, BR Hills, Coorg.

A house of the Todas in Nilgiris

While most tourists are wrapped in the natural beauty of the Western Ghats, very little attention is paid to the myriad cultures in the region – something that has always personally fascinated me.

Flavours of the Western Ghats

When you think of travel, you think of food. And it forms a part of the culture of the region. There is a unique culinary spread across the Western Ghats as every region or state has its flavour. Coorg's speciality is different from Malenadu.

Neeru Dosai – one of my favourites.
Pic Courtesy Prathap Nair

The towns spread across Maharashtra or Goa offer a different cuisine from that of Kerala or Tamil Nadu. You can taste everything from coastal delights to seasonal produce here.

However, being a vegetarian, I am never disappointed as i can relish some of the local preparations here

Tourism for everyone

So, it does not matter if you do not want to hike in the mountains. The Western Ghats beckon every kind of traveller, including lazy ones like me, who are content to meditate upon nature and do absolutely nothing.

Crested serpent eagle in Kabini

The bird watchers and wildlife enthusiasts flock here, there is fishing and angling and there is even water sports and river rafting for the adventurous.

The Kali is a great river for water sports

You can just chill in hill stations, sip coffee or tea, visit temples in the forests or focus on living traditions and tribes living here.

Watching the mist in Kodaikanal

However, I will just go for long walks in the mist or read a book and sip ginger tea.

Destination for all seasons

In the summer you can run to the hills and sing The Sound of Music and look for tigers in the jungles or in winters, you can imagine like Ruskin Bond, that there are ghosts melting away in the cold, brooding mist.

Can you see ghosts here?

But my favourite time of the year is monsoons, or perhaps to be right, precisely just after the monsoons.

The forests are scrubbed well after a refreshing bath and they wear a new coat of green. The birds start beginning to sing. The waterfalls are in full flow and the rivers are smiling, coursing down the valleys.

Gushing waterfalls invite you to Western Ghats

Reimagining the governance of the Western Ghats

The ecological significance of the Western Ghats and its complex governance challenges

Recent interactions between the Ministry of Environment, Forests and Climate Change (MoEFCC) and concerned states regarding the classification of certain parts of the Western Ghats as Ecologically Sensitive Areas (ESA) have once again highlighted the issue of management of this biodiverse region. While the state governments of Karnataka, Kerala, Goa, Gujarat, Maharashtra and Tamil Nadu believe that the region needs to be protected, they have pushed back against the extent of the area to be declared as ESA, and the kinds of activities that can be carried out here.

Maharashtra, for instance, wants 15% of the area classified as ESA to be allowed for mining and industrial activities; Goa wants 30 villages out of the 99 identified as potential ESAs to be excluded and the State Wildlife Board has even discussed the possibility of several projects, including a railway line, a transmission line and a highway expansion proposal that would affect the Bhagwan Mahavir Wildlife Sanctuary and the Mollem National Park – both eco-sensitive areas of the Western Ghats. The National Board for Wildlife and MoEFCC's Expert Appraisal Committee has, in the middle of the nationwide lockdown, given the green light to two of these projects – the transmission line and the expansion of the highway, which would require the felling of trees at a substantial scale (Roads and transmission lines are known to fragment habitats and wildlife corridors). In Karnataka, weeks before the ESA deliberations between the national and state governments, the authorities green signalled a railway project that would clear nearly 1000 hectares of forest land in the north, posing a threat to the survival of several endemic species and increasing the chances of landslides and the diminution of carbon removal capacity caused by the loss of vegetation.

Ecological significance of the Western Ghats

Faced with increased pressure from state governments in declaring portions of the Western Ghats as ecologically fragile, even as evergreen forests are drastically turned into sites for industrial activities and endemic species continue to dwindle, the governance of the Western Ghats needs to be reimagined urgently. Regional governance approaches which have worked in other biodiverse contexts, such as the Great Barrier Reef in Australia could provide useful lessons in this regard.

The Western Ghats are of immense ecological significance, not just for any one state, but for large portions of peninsular India. Straddling Gujarat to Kerala, this biodiversity hotspot contains more than 30% of all plant, fish, bird, and mammal species found in India. The Ghats are also the 'water tower' of peninsular India and the source of several perennial rivers including Mandovi, Zuari, Krishna, Cauvery, Netravathi and Tungabhadra. In addition, the critical function of the region in moderating tropical climate along the western peripheries of the Indian peninsula, and more broadly, in influencing the Indian monsoon weather pattern, are ecological services that are availed by millions of citizens residing beyond the evergreen tropical forests. Recognizing the importance of the region, in 2015, UNESCO approved India's proposal for listing the Western Ghats as a World Heritage Site.

Gadgil and Kasturirangan reports – wide disparities

Yet, defining the boundaries of the Ghats, identifying eco-sensitive zones that support faunal diversity, and determining the kind of economic activities that would not diminish its socio-ecological functions – have all been nagging issues which have only delayed the robust governance of the Ghats. The lack of concerted political will to protect the region is perhaps exemplified in prolonged contestations around the recommendations of two expert committee reports of the past decade, as well as the glaring disparities between these two reports.

The Gadgil Commission (Western Ghats Ecology Expert Panel) report of 2011 recommended classifying 137,000 hectares of the Ghats as Eco-Sensitive Areas (ESA) – subdivided into three Eco Sensitive Zones (ESZ) to determine the kind of economic activities that could be carried out. The Kasturirangan Commission (High-level Working Group) report of 2013, however, reduced the area of the ESA to a total of 60,000 hectares and did away with the ESZ classification of areas. The Kasturirangan report also dismissed the need to establish a Western Ghats Ecology Authority (WGEA) – a regional authority recommended by the Gadgil Commission for the management of the Ghats.

Governance challenges – need for a regional authority

Apart from the two widely divergent reports, the governance of a region of the scale of the Ghats is a challenge in itself. Several authorities including the national and state governments and their respective environment ministries, as well as a multitude of government departments and agencies, are responsible for the governance of the Ghats. These include the National Biodiversity Authority, the National Board for Wildlife, the Central Pollution Control Board; state-level Pollution Control Boards, Forest Departments, Biodiversity Authorities, State Wildlife Boards; and local-level authorities such as Gram Sabhas and other institutions like the Gram Panchayat, Block Panchayat and Zilla Parishad which often have devolved powers to legislate on matters concerning agriculture, animal husbandry, fisheries, water management, and social welfare, among others. Since the 42nd Constitutional Amendment of 1976, forests have been brought under the Concurrent List, which means that both the national and state governments can make laws on the subject; in case of a conflict, however, national legislation will prevail.

Caught in this political quagmire, the governance of the Western Ghats has not evolved in the last decade, even as state governments continue to invoke the socio-economic development of remote regions in the Ghats to override the restrictions that will follow when the MoEFCC's ESA notification is implemented. While it may be nothing short of a

herculean task, establishing a regional authority which draws its mandate and powers from a Western Ghats-specific legislation is perhaps the need of the hour.

The Great Barrier Reef Marine Park Authority

In the case of the Great Barrier Reef (GBR), an environmental regime centered around a regional decentralized authority – the Great Barrier Reef Marine Park Authority (GBRMPA) – has been successful in managing this eco-sensitive region. In 1975, the Australian government enacted a national legislation specifically for the GBR, which led to the creation of the GBRMPA as well as a joint ministerial council, comprising ministers from the national and the state governments.

In the 1980s and 1990s, additional state-level land, water and coastal arrangements were added for the protection of the GBR. A national environmental legislation introduced in 1999 further strengthened the institutional protection of the GBR and gave non-governmental organizations the power to act on behalf of affected communities.

Between the late 1990s and early 2000s, the GBR region was divided into eight zone types, which determined allowable activities, such as fishing, within each zone. The rezoning was designed to work in conjunction with a variety of other management tools developed before and after the rezoning, including public participation, traditional-use agreements, species protection and special management areas, management and site plans, impact assessment, permits, monitoring and enforcement measures, public education, and reporting. All these measures, centered around a regional authority and a diversity of state and non-state actors and institutions, led to a relatively stable polycentric regime by the late 2000s, which was only thwarted due to the 2007-2008 global financial crisis when public spending cuts and internal restructuring diluted the effectiveness of the GBRMPA. Subsequently, increased lobbying for environmental deregulation and new political appointees to the GBRMPA board who favored mining interests, shifted the focus of the regime from conservation to sustainable use.

Perhaps the solution here lies in establishing a regional authority for the Western Ghats with oversight over all relevant national and state-level institutions, and subsequently plugging in state-level development and management plans on a case-to-case basis. This is primarily because a straddling ecological region such as the Western Ghats cannot be governed through existing national and state-level institutions which have been devised with particular administrative units in mind. On the flip side, the regional governance of the Western Ghats is not expected to be a silver bullet either. States will continue to pursue socio-economic development – in the process, felling trees for railway lines, dams, factories and mining projects.

What regional governance of the Western Ghats has to offer though, is increased decision-making to local governments and community-based organizations to be able to resist agendas aimed at the exploitation of the Ghats. The creation of a financially-stable and relatively independent regional authority could also help bridge the gap between national and state-level interests, and more importantly, reduce the risk of regulatory capture by vested interests. The presence of multiple state and non-state actors within this framework – the regional authority, national, state and local governments, community-based non-governmental organizations, scientific research committees and institutions, and industry associations – could offer transparency and effective checks and balances, geared towards the protection and fair-use of a biodiverse region which has evolved to its present state through a journey of over a hundred million years.

WESTERN GHATS – DECIDUOUS FORESTS

THE ROAD TO REDEMPTION

In the field of wildlife conservation working closely with the government and providing suitable policy inputs can result in important on-ground changes. Several of our projects are wonderful examples of successful partnerships between governmental and non-governmental agencies.

Connecting the sources

In a densely populated country such as India, the 5% of land set aside as areas protected for wildlife, is often the last refuge for some wildlife species such as the tiger one-horned rhinoceros and others. Conservation efforts need to be supplemented with the availability of larger tracts of forests to support ecologically viable wildlife populations and also to ensure that the protected areas are connected. By working closely with the government, we have been able to secure the addition of ~2,700 km^2 of biodiversity rich forests into the protected area network in Karnataka as well as mitigate some of the threats to these islands of biodiversity.

Our team worked closely with the government to augment the protected area network in the state. Through GIS tools, field understanding of ecologically important sites we identified parcels of forested land that would provide a contiguous protected area network for wildlife. In addition, we attempted to address this using a conservation planning technique that considers ecological, social and political factors. Our efforts also bore fruit with the declaration of a new protected area, Sri Malai Mahadeshwara (MM Hills) Wildlife Sanctuary (906 km^2). We continue to provide scientific inputs on this aspect to ensure that network is further enhanced to ensure that wide-ranging species have a secured land-tenure.

Ensuring wildlife compatible land uses

Implementing wildlife compatible projects in the immediate vicinity of protected areas is a much-needed necessity to ensure that land-use in these areas are in tune with wildlife conservation. Eco-sensitive zones could minimize the detrimental impacts of certain activities on these ecologically fragile areas while incentivizing local people living there. We have provided critical scientific and GIS inputs to the government to identify and delineate eco-sensitive zones, under the existing Environment Protection Act 1986, around 14 protected areas in the Western Ghats of Karnataka. We also work with local leaders to ensure that these inputs had support from democratically elected people's representatives. Bandipur Tiger Reserve was the first tiger reserve in the country to notify the eco-sensitive zone where we played a critical role.

We further suggested and convinced the government to provide additional benefits for communities living within the eco-sensitive zones. Based on these suggestions Karnataka government has now approved to provide additional funding for water conservation activities to communities living within the eco-sensitive zones.

Frontline warriors

Most frontline staff of forest department are local people with a keen understanding of the wildlife in the area, looking to make a livelihood out of protecting their forests. These foot soldiers work in harsh and remote conditions, often far from human habitations or medical help. They are also inadequately equipped to deal with emergency situations.

Through our efforts, a government sponsored personal accident insurance scheme for the frontline staff of all protected areas in Karnataka was initiated in 2013. This scheme is expected to cover the staff against injury or death on duty and has already been implemented in many protected areas in Karnataka. Funds for this insurance scheme is sourced through the revenue generated by tourism in protected areas.

Similarly, we are working on other welfare initiatives that could help the frontline staff. We believe that government sponsored programs are more sustainable in the longer-term on staff welfare aspects, and civil societies can act as pivotal agencies to initiate and facilitate the welfare programs.

Defragmenting wildlife habitats

Mushrooming of certain developmental activities causes untold damage to wildlife habitats in terms of loss and fragmentation leading to several direct and indirect impacts to wildlife. We have supported and worked with the government and other civil societies to reduce impacts of fragmentation in some of the protected areas and ecologically rich multiple use forests. However, we have also ensured that alternative suggestions are provided and implemented so that the solutions are pragmatic and scalable. Closure of highways to vehicular traffic at night within Bandipur and Nagarahole Tiger Reserves and development of alternative roads outside these reserves are some of the examples of such initiatives. Through such efforts, we have been successful in combining biology with action to result in tangible gains for wildlife. These initiatives have now been replicated by other state governments.

CONCLUSION:

Protecting and conserving the Western Ghats involves a multi-pronged approach including designating ecologically sensitive areas, engaging local communities, implementing sustainable practices, and promoting research and monitoring. A balanced approach that safeguards the ecological integrity while allowing for sustainable development is crucial.

I thank all the supporters and Cocoon Initiative when I proposed my desire for the Sabbatical year to explore and take up research at Western Ghats by visiting the places, meeting the indigenous communities, collecting traditional resources about herbals, rare plants, animals, caves and collecting palm leaves (Olai Suvadikal). I worked for the rural development and environment protection for a period of 35 years in the communities through GREEN. I developed a strong desire to explore the richness of the Western Ghats, Identify the reasons and the gaps generated between men and wildlife and the resources of the forest, traditional practices by indigenous people living in the forest, their life style and practice of herbal medicines. During my travel I visited interior mountain hills, identified rare animals and species, discussed with the elders, collected details of medicinal and herbal plants and its use, collected numbers of palm leaves (Olai Suvadikal) As part of my my work, I prepared and completed the book **ECO SYSTEM OF WESTERN GHATS**. I happy to present the following Key Strategies for Conservation efforts to Save Western Ghats:

Designation of **Ecologically Sensitive Areas (ESAs):** The Western Ghats, particularly the areas with high biodiversity, should be designated as ESAs, requiring stricter regulations and monitoring of development activities. Community-Based Conservation: Engaging local communities and incorporating their traditional ecological knowledge is vital for long-term success. This includes empowering local communities with alternative livelihood options and ensuring their participation in conservation efforts. Sustainable Land Management: Implementing sustainable agricultural practices, promoting agroforestry, and managing water resources effectively are crucial for long-term conservation.

Habitat Restoration: Restoring degraded habitats, such as swamps and forests, can enhance biodiversity and support the survival of threatened species. Monitoring and Enforcement: Strengthening regulatory frameworks and enforcing existing environmental laws is essential for effective conservation.

Research and Monitoring: Conducting scientific assessments to determine the minimum area required for ESA designation and monitoring the effectiveness of conservation efforts is crucial. Policy and Advocacy: Advocating for strong environmental policies and promoting awareness among stakeholders are important for long-term conservation. Zero Chemical Farming: Sustainable coffee farming practices minimise the use of synthetic fertilisers, pesticides, and herbicides, reducing chemical pollution and its impact on the environment. This helps maintain water quality in rivers and streams, which are vital components of the Western Ghats' hydrological system. All our produce here grows naturally, without the use of any external nutrition or artificial pest control and with intervention mostly restricted to pruning.

Activities including mulching, composting, and agroforestry also help maintain soil fertility, prevent erosion, and improve water retention in the soil. These practices mitigate the risk of soil degradation and protect water resources in the Western Ghats.

Let's ensure all joined hands and efforts to

SAVE WESTERN GHATS

NEWS PAPER CLIPPINGS:

VIRTUAL TIMES

Conservation of Ecosystem Profile of Western Ghats & Western Ghats P.S.Bose, Secretary - GREEN

The Western Ghats, a mountain range running parallel to the western coast of ancient peninsular India, has a rich and intriguing history. They are 150 million years old, and have witnessed climatic variations that helped shape the soils and geology of the mountains. The Western Ghats formed when the Gondwana supercontinent broke up and formed the faulted margin of the Deccan Plateau. The mountain range known as the Western Ghats covers 51 districts in six states and is one of the 34 global biodiversity hotspots. For many tribal communities. These mountains are under tremendous pressure and ecologically and ecologically at risk.

The Western Ghats pass through six statesfrom Gujarat to Tamil Nadu, neutralizing 4 million tonnes of carbon equivalent to 14 million tons of carbon dioxide per year. The region's diverse forest ecosystems neutralize 10 percent of the country's total forest-neutralized greenhouse gas emissions. It also records that the region is one of the important global biodiversity hotspots with 1,741 species of flowingplants and 403 species ofbirds and various species of reptiles and the great Western Ghats,34 species older than the Himalayas. Global hotspots of biodiversity by flora, fauna, landscape and species.

They are full of enchanting places known to be home to 4,050 species of plants, 121 species of frogs, 508 species of birds, six species of turtles and terrapins, 87 species of snakes, 63 species of lizardsanda variety of large mammals.

The world will know the important role played by the Western Ghats in the environment,cultural lifeand economic development of India. It was decided to save the Ecosystem Profile of the Western Ghats to understand the status of the Western Ghats, highlight the ongoing degradations and conduct a survey.

As a manifestation of this, Mr.P.S. Bose, who is running the GREEN organization, has Sabbatical trip to 6 states in India with the helpof a voluntary organization called Dasra (The Cocoon initiative) to know the ecosystem profile of the Western Ghats and to improve it.

The main objectives of this trip are from November to February.

1)To create awareness among people about conservation of forests, afforestation, conservation of wildlife, ecology and related issues like natural resources.

2)To know more facts about nature and extent of environmental destruction of Western Ghats.

3)Exposing young research scholars to filed situations so that they can see problems from a broader perspective.

4.)Bringing together all the voluntary organizations working in the region and creating some long-termcommon environmental projects.

5.)Promotion of educational institutions, involvement of schools in the area in carrying out afforestation and other environmental related projects. The purpose of the trip is to conduct activities like villagelevel meetings, fieldobservations, survey, orientation camps and implement ancient leaf traces and traditional scientific techniques to prepare a study report on the Western Hills tract.

Conservation and development of the Western Ghats can coexist

Located in central India, the Western Ghats are globally recognized as one of the eight biodiversity hotspots in the world. Spread over several states, this vast area not only has a rich diversity of flora and fauna but also plays a significant role in sustaining biodiversity and ecosystems.

Amidst the natural wealth, the Western Ghats have become home to a thriving coffee growing industry. The undulating terrain and favorable climate create an ideal environment for coffee plantations, contributing to the economic livelihood of local communities.

The Western Ghats, with

their blend of natural beauty and human activity, serve as a microcosm that reflects the broader global challenge of harmonizing progress with environmental conservation. By facing these challenges headon, we aim to foster a sustainable future of the Western Ghats along with sustainable development activities. At BForst Collective in Coorg, we are exploring various ways to balance development with conservation, especially as we protect the areas located in the Shola grasslands of the Western Ghats.

Studies show that a 1% increase in soil carbon content can sequester carbon emissions over the past 40 years and provide 700,000 liters of water per acre per year. Forests act as carbon sinks, which is why reforestation and conservation are at the center of action, promoting the diversity of forest-grown coffee trees and protecting forest-adapted and natural wonders. Such as the Sola grasslands, which are an integral part of the conservation of the Western Ghats as they are the birthplace of South Indian rivers.

Treating coffee estates as layers of a rainforest ecosystem:

Sustainable coffee farming practices, such as shade-grown coffee, mimic natural forest ecosystems, providing habitat for native flora and fauna. It helps conserve biodiversity in the Western Ghats, recognized as one of the world's hottest biodiversity hotspots. Our Boomale 1.0 Collective in Coorg, nestled in the Western Ghats, is a sustainable coffee estate. It reverses the impact of decades of land degradation and deforestation through permaculture farming techniques and biodiversity conservation. We believe that treating coffee estates as layers of the rainforest ecosystem and acting as such helps integrate sustainability into our operations.

Soil Construction, Conservation and Water Management:

Maintaining the health and safety of soil and water management is one of the key factors we have recognized for development and conservation. BForst has taken several soil building initiatives such as introducing biochar into the soil, creating soil reserves like ditches to retain moisture and adding nutrient-rich compounds to the soil to help provide long-term nutrition and build soil strength over the years. Activities including mulching, composting and agroforestry help maintain soil fertility, prevent erosion and improve soil water retention. These practices reduce the risk of soil erosion in the Western Ghats and conserve water resources. So let's build a joint operation to protect the Western Ghats.

The Hindu News

Green revolution in Western Ghats

Beulah Rose
THENI

Twenty years ago, the hill ranges in the Western Ghats looking over Chinnamanur would see frequent forest fires destroying not just age-old trees but also the thick undergrowth.

With the slopes turning brown, this tinderbox needed just a slight provocation for the hills to glow orange in the dark. For villagers living in the foothills it turned into a dangerous scenario as the mountain streams were the only water source for irrigation.

Fast forward to 2024, the rolling hills are turning green and the animals are slowly regaining their lost habitat. All thanks to like-minded people like S. Bose, a native of Erasakkanayakanur, a small village that is about nine kilometres from Chinnamanur in Theni district.

"Trees in the mountains conserve water and they keep the wild streams alive throughout the year bringing in the much needed water for farming activities in the foothills. But after the trees were destroyed in the forest fires, the streams also died. Even the wild animals started moving to Megamalai, which lies on the other side. It is then that I decided to plant 5 lakh trees per year in these forests," says Mr. Bose, who is known by his moniker 'Pachai' Bose.

During monsoon, he along with his eco-warriors trek through the forest dispersing seed balls that are slowly and firmly taking root. His journey as an environmentalist began when he joined Gandhigram University to do his degree in rural development. Here, he came in contact with G. Nammalvar and that he considers as his turning point.

From his farmland in the foothills of Megamalai, he has carved out a five-acre patch where a silent green revolution is in the making for 11 years.

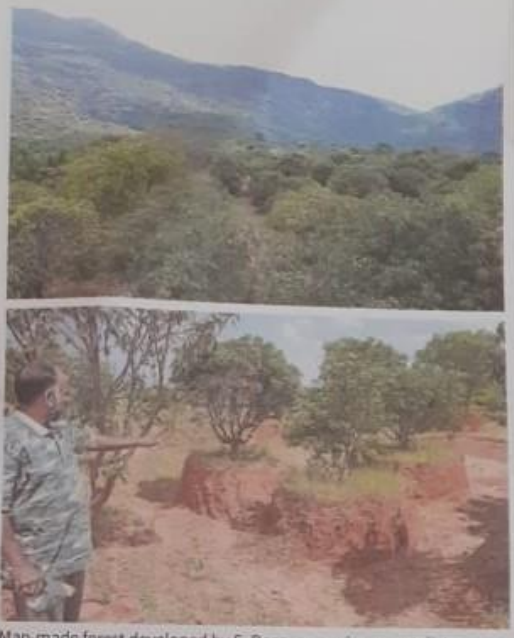
Unlike a Miyawaki grove, this patch is filled with fruit bearing trees. Other than native berry-bearing trees, jackfruits, varieties of mangoes, sapotas, pomegranates and guavas fill the space. Except during the sapling stage, Mr. Bose does not water these plants. Now, these young trees thrive on rainfall and soak in the abundant groundwater which Mr. Bose keeps replenished by having turned a natural hollow in the terrain into a recharge shaft, wherein water flowing from the wild streams are let into.

In another few years, this little dip in the otherwise rugged red soil will turn into a steppe-style forest as about 360 saplings have been planted in it. It is a little experiment being done by his daughters - one is an MBA in agri business management and the other is doing honours in horticulture.

"In order to increase pollination with the help of butterflies and birds, I decided to turn this five-acre into a mini-forest," he adds. The fruit trees provide food for birds and animals and the grassy undergrowth provides a haven for deers to rest at night. A little patch of tapioca grows wild and provides food for the wild boars. "As the tuber is readily available, the boars don't destroy other plants," he points out. Ripening jackfruits also lure elephants and occasionally these pachyderms take the pathway carved by a stream and enter this min-forest to relish a treat. For bears, there are also artificial bee hives to indulge in. Water troughs have been placed where animals slake their thirst.

On any given day, around 16 varieties of birds can be seen feeding on the fruits and some of these winged visitors visit the little strip where millets also grow wild.

Eco-dynamics will later play its role as the droppings of the birds and animals would help in dispersal of seeds in the western ghats. For 'Pachai' Bose, this thriving forest is a small step in the right direction.



Man-made forest developed by S. Bose, an environmentalist, in the foothills of Megamalai at Erasakkanayakanur in Theni district. (above) The trees planted by him for birds and animals.
G. KARTHIKEYAN

Western Ghats – Tamil Nadu and Karnataka region

Palm Leaf Manuscripts (Tamil) (Indigenous Documents), data available with the traditional medical practitioners, agrarian community, indigenous tribal community and ancient literature available in classical Tamil language.

I would like to express my heartfelt gratitude to The Cocoon Initiative and the Dasra for creating this wonderful opportunity.

“Nature never did betray the heart that loved her”

GREEN

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