

INDIA HIGH RANGE MOUNTAIN LANDSCAPE PROJECT - GEF MUNNAR LANDSCAPE PROJECT - (2018-2021)

FINAL PROJECT REPORT



UNITED NATIONS DEVELOPMENT PROGRAMME
KERALA STATE BIODIVERSITY BOARD
KERALA

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LANDSCAPE PROJECT
(GEF MUNNAR LANDSCAPE PROJECT)
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TECHNICAL DETAILS

- 1 **Project Title** : a) Documentation and compilation of existing information on various taxa (Flora and Fauna), and identification of critical gaps in knowledge in the GEF-Munnar landscape project area.
b) Review of ecological and development history of various sectors and changes in selected ecological units in GEF Munnar landscape project area
- 2 **Project duration:** : 12 months
- 3 **Total Budget** : Rs. 39,99,600/-
- 4 **Project No. and Date of Sanction** : Project No. 87493; Agreement dated:06/12/2018
- 5 **Name and Designation of Principal Investigator (PI):** : **Chairman, KSBB**
- 6 **Name and Designation of Co-Investigators (Co-PIs)** : **Member secretary, KSBB**
- 7 **Name of Staff:** : **Dr. N. Preetha**, KSBB (Technical Associate)
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- 10 **Study Area:** : Adimali, Munnar, Devikulam, Marayoor, Kanthalloor, Vattavada, Chinnakanal, Mankulam, Edamalakudy, Kuttampuzha, Athirapally

EXECUTIVE SUMMARY

The UNDP funded 'High Range Mountain Landscape Project' was implemented by Kerala State Biodiversity Board in 11 selected Grama Panchayats in three Districts of Kerala- Idukki, Ernakulum and Thrissur. The project was initially sanctioned for one year but was extended till March 2021.

Project 1: Documentation and Compilation of Existing Information on Various Taxa (Flora and Fauna):

Project 2: Review of ecological and development history of various sectors and changes in selected ecological units in GEF- Munnar Landscape Project Area

A. Key activities and results

- a) Classes, awareness programmes and interactive sessions were conducted for Panchayath officials and BMCs in 10 Panchayaths. PRA, RRA and Focal Discussions with different user groups and stakeholders conducted.
- b) Two state level workshops and three consultative meetings with experts/ consultants held for developing a PBR updation methodology.
- c) Prepared a complete list of floral and faunal taxa (Birds, Reptiles, Odonates, Butterflies, Moths and Mammals) in the study area, including current IUCN status, WPA status and Endemism. All the data were handed over to respective BMCs for PBR updation.
- d) Documented Traditional knowledge associated with bioresources of major tribal communities in the study area.
- e) Identified major gaps in the existing PBR through extensive Consultative workshops for PBR data gathering; Analyzed the applicability of mobile applications for PBR updation and Conducted field trials at a pilot scale based on new methodology.
- f) Prepared the methodology manual for updating and bridging existing gap areas in PBR (ePBR) after the field level implementation in a Panchayath which was peer reviewed by experts in the respective field.
- g) A list of bio-resources traded / accessed from different Panchayaths has been prepared based on the threat status, demand, availability of resource and its value in the market as well as importance for ecological functioning

- h) Data of 15 NTFPs traded in large quantities during the last two years documented. Detailed supply chain analysis of *Kattukurumulaku, Karikurinji, Pinari, Marotti, Pachottitholi* was done.
- i) The Movement of '*Kattupadavalam*' from collection point to pharmaceutical companies were identified. Analysed the dynamics/trends on: landuse, vegetation covers and its nature (forests and agriculture practices), build-up areas, hydrological parameters, geological criteria, soil characteristics etc. During different periods (2006, 2016 and 2020) to identify reasons for biodiversity change (degradation) in Munnar landscape.
- j) Studied the impact of production sectors and major drivers that led to landuse change. The impact on different communities and social institutions were analyzed through PRA tools
- k) Studied the impact of production sectors and major drivers that led to land use change through GIS tools. The key findings are: Area under agricultural land in the study area had registered a marked increase from 26581 to 43710 hectares. The other land use / landcover classes that had registered an increase in area is built-up, which increased from 399 hectares to 1584 hectares. Area under forest, waterbody, wastelands, and grass/grazing had registered a decreasing trend. The area under forest decreased from 151131 hectares to 141474 hectares. The total decrease of forest area within the stipulated years as per the data is 9657 hectares, which comes about 6.3 per cent of the total forest area. This loss of forest cover is mainly registered in the five Panchayaths of the study area, i.e., Chinnakanal, Devikulam, Kanthalloor, Munnar, and Vattavada.
- l) Local perceptions regarding major drivers of change in the landscape were collected from different resource user groups. Socio-economic and perceptions of climatic change at Mankulam Panchayath analyzed among local people, tribal communities and Biodiversity Management Communities separately for resource mapping and resource use change.
- m) Policy recommendations to mainstream biodiversity concerns in Production sectors developed after extensive consultations.
- n) The paper presented in Webinar on 'Best Practices for Biodiversity Conservation' held on July 17, 2020 by Indian Institute of management, Bengaluru entitled "Experiences of biodiversity documentation in People's Biodiversity Register - Munnar landscape area". Received **BEST PAPER AWARD**.

B. Key Deliverables

1. Two interim reports and a consolidated project report.
2. Brochure on “Access and Benefit Sharing” in Malayalam.
3. Guidelines for Range Forest Officers to enforce regulatory provisions of Biological Diversity Act 2002 of Kerala.
4. Booklet of species notified under Section 38 of Biological Diversity.
5. Methodology Manual “Biodiversity Documentation and Monitoring-ePBR”.
6. Policy document on mainstreaming biodiversity in agriculture and fisheries sector for health and nutrition
7. Nineteen species are reported to be transported through check posts of which seven species such as *Grevilla robusta* and *Oaklandra travancore*, *Santalum album*, *Macaranga peltata*, *Artocarpus hirsutus*, *Swietenia mahogani*, *Erythrina variegata* are not mentioned in the list of NTC by the MoEF&CC.
8. “Tradable Bio-resources’ Documentation (Database) and Identification of its ABS potential with Supply Chain: A Manual”
9. Four scientific paper published in Webinar on ‘Best Practices for Biodiversity Conservation’ held by UNDP on July 17, 2020.
 - i. “Experiences of biodiversity documentation in People’s Biodiversity Register. Munnar landscape area”. (Best Paper Award). A. Bindya, K.F. Shahnas, A.L. Aneesh Kumar, R.S. Reshnu Raj, M.K. Justin, Anand Zacharias, N. Preetha, S.C. Joshi.
 - ii. A Comparative analysis of Agriculture Practices among Communities of Idukki for Mainstreaming Biodiversity in Agriculture Sector R.S. Reshnu Raj, M.K. Justin, K.F. Shahnas, A.L. Aneesh Kumar, A. Bindya, Anand Zacharias, N. Preetha, S.C. Joshi.
 - iii. Spatio - Temporal Drought Assessment of Mankulam Panchayath in Idukki using Geospatial Techniques. Anand Zacharias, R.S. Reshnu Raj, M.K. Justin, A.L. Aneesh Kumar, A. Bindya, K.F. Shahnas, N. Preetha, S.C. Joshi.
 - iv. Status of Plant Bioresources Utilised in Herbal Industries and The Need for Conservation - Kerala. Shahnas K.F., Reshnu Raj R.S., Dr. Preetha N., 4th Global Ayurveda Festival 12-19 March 2021

C. KEY CHALLENGES, LESSONS LEARNED AND RECOMMENDATIONS

- Major gaps in knowledge identified in the lower group of plants and fauna and biodiversity of forest areas in PBR.
- Lack of standardized methodology for data collection both among scientific community and citizen science projects is a major issue identified, hence change in resource availability or population loss of species over the years is difficult to monitor.
- Biodiversity concerns are not mainstreamed into production sectors and lack of awareness among various stakeholders is a major issue identified
- The driving force of land use change varies from one location to another. Hence further studies should be conducted in a local scale to identify the driving force behind the land use change in specific locations.
- Since spatial planning is purely based on data, accuracy of data is especially important. Major issues identified in GIS data sets are Issues related to the geometry and topology of the spatial dataset, Positional error in the spatial data, Issues related to the reliability of the spatial data itself. A better way to ensure spatial data accuracy is to make meta data standards obligatory for data being used in future studies.
- A location specific action plan should be devised to prevent the degradation of forest and forest resources. The dense forests of the Western Ghats of Kerala are the real lifeline of the state. A community driven mapping programme of forest areas at small scale should be carried out in all Panchayaths which have considerable area under forest cover. The programme must ensure people's participation at all levels.
- A State level programme should be devised for the ecological restoration of degraded forest under the MGNREGS. This would ensure not only employment for the people who depend on forest products for their livelihood but at the same time prevent the degradation of the environment.

Member Secretary

Chairman

Thiruvananthapuram
31.03.2021

ACRONYMS

1. ‘ Minutes
2. “ Seconds
3. ABS Access and Benefit-Sharing
4. ANP Anamudi Shola National Park
5. BMC Biodiversity Management Committee
6. CHR Cardamom Hill Reserve
7. CITES The Convention on International Trade in Endangered Species of Wild Fauna and Flora
8. COVID Coronavirus Disease
9. CWS Chinnar Wildlife Sanctuary
10. D Simpson's Index
11. E East
12. EIA Environment Impact Assessment
13. ENP Eravikulam National Park
14. ENS Effective Number of species
15. ePBR Electronic Database of People's Biodiversity Register
16. FGDs Focus Group Discussion
17. FRA Farmers’ Right Authority
18. GEF Global Environment Facility
19. GIS Geographic information systems
20. GP Grama Panchayath
21. H Shannon - Weiner Index
22. H1N1 Hemagglutinin Type 1 and Neuraminidase Type 1
23. HF Holstein Friesians
24. HOPS High Range Organic Producer’s Society
25. HRML High range Mountain Landscape
26. HWC Human wildlife Conflict
27. IMD Indian Meteorological Division
28. IUCN International Union for Conservation of Nature
29. KADS Kerala Agricultural Development Society
30. KDHP Kannan Devan Hills Plantation
31. KFD Kerala Forest Department
32. Kg Kilogram
33. Km kilometer
34. KSBB Kerala State Biodiversity Board
35. KSBC Kerala State Bamboo Cooperation
36. LC Least Concern

37. LSG Local Self Government
38. LULC Land Use Land cover
39. m Meter
40. MFP Minor Forest Produce
41. MGNREGA Mahatma Gandhi National Rural Employment Guarantee Act
42. MoEF&CC Ministry of Environment, Forest and Climate Change
43. MSSRF M.S. Swaminathan Research Foundation
44. N North
45. NASA National Aeronautics and Space Administration
46. NBA National Biodiversity Authority
47. NGO Non-governmental organization
48. NH National Highway
49. NP National Park
50. NSS National Service Scheme
51. NTFP Non-Timber Forest Product
52. ° Degrees
53. OSM Open Street Map
54. PBR People's Biodiversity Register
55. PG Post-Graduates
56. PHC Primary Health Center
57. PNP Pampadum Shola National Park
58. PPV Protection and Plant Varieties
59. PRA Participatory Rural Appraisal
60. R&D Research and Development
61. RRA Rapid Rural Appraisal
62. Rs Rupee - Rupee
63. SBB State Biodiversity Board
64. SLR Single-Lens Reflex
65. SOI Survey of India
66. TB Tuberculosis
67. TSG Technical Support Group
68. UNDP United Nation Development Project
69. USGS U.S. Geological Survey
70. VSS Vana Samrakshana Samithy
71. WPA Wild Life (Protection) Act
72. WS Wildlife Sanctuary

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INTRODUCTION

Kerala is situated on the south west corner of the peninsula between latitudes 8° 04" and 12° 44" N and longitudes 74° 54' and 77° 12 E. It is one of the smallest Indian states with a total area of 38,863 sq. km. comprising about 1.8% of the total area of the country. On the north it is bounded by Karnataka, south by Tamil Nadu, east by the Western Ghats and on west lies Arabian Sea. Physiographically the state can be divided in to 3 zones, namely, the Highlands (Mountainous zone), the Midlands, the Lowlands (Coastal zone).

The Western Ghats is one of the most important natural heritage sites of the world. Recently, UNESCO has expressed concern over the conservation of the biodiversity in the Ghats. The assessment report was prepared by the International Union for Conservation of Nature (IUCN). They pointed out that the Western Ghats the lifeline of six states including Kerala in a dangerous condition. Climate change, intense rain and summer, water and air pollution, tourist activities, deforestation, hunting, road and rail projects inside the forest, dam, mine and quarry industries, wildfires and similar other activities destroy the mountain range.

Idukki district is considered as one of the most forested regions in the State. This district shares the borders of Ernakulam on its North East, Kottayam on its West, Pathanamthitta on its South. The neighbouring state Tamil Nadu is also sharing the North Eastern side, Idukki has numerous hills and treacherous terrains which makes life not that easy for anyone. Idukki is also known as the spice garden of Kerala. This district lies in the Western Ghats of Kerala, and is the second largest district in area with lowest population density. Idukki district consists of 5 Taluks: Thodupuzha, Devikulam, Idukki, Udumbanchola, and Peermedu. The study area comprises of Anjunad and other connecting areas encompassing Munnar, Devikulam, Chinnakanal, Kanthalloor, Vattavada, Edamalakudi, Marayoor, Mankulam, Adimali, Kuttampuzha and Athirappilly Grama Panchayath comprising a total area of 2198.78 km². This district has several discrete terrains

and protected areas which are known for its rich biodiversity. The vegetation is mainly grassland/ shola in the lower region, moist deciduous forest ecosystem from 1200m to 2000m and evergreen forest above this region. Almost all the protected areas (Wildlife sanctuaries and National Parks) are contiguous and have connectivity with one another.

Now-a-day, mountain landscape face a series of threats particularly habitat fragmentation and overexploitation, which leads to extinction of flora and fauna and rising poverty and hunger for the dependent inhabitants. In view of the importance of mountains landscapes The United Nations General Assembly (UNGA) proclaimed 2002 as the International Year of Mountains (IYM) for the sustainable development of mountain regions. Landscape is defined as the natural and physical attributes of land together with air and water which change over time and which is known by people's evolving perceptions and associations such as beliefs, uses, values and relationships. The importance of landscapes is mainly concentrated in three major sectors: economic, socio-cultural and ecological. The vegetation of Munnar Landscape areas chiefly consists of sholas, grasslands, dry mixed deciduous forest, moist deciduous forest, forest plantations (Eucalyptus, wattle, pine, teak, sandal), commercial plantations, agri-horticultural field and mixed farms. The land use pattern in areas such as Munnar, Marayoor, Mankulam, Malayattoor, Kothamangalam other than Protected areas (Eravikulam National Park (NP), Chinnar WLS (Wildlife Sanctuary), Idukki WLS, Kurinjimala WLS, Anaimudi NP, Pampadum shola NP, Mathikettan shola NP, Thattekkad Bird Sanctuary) arise as a result of commercial plantations like tea, cardamom, coffee, mixed cultivation and human dominated home gardens. India's agro-climatic conditions in the Hilly area of Munnar are conducive for the growth of highly diversified floral species which are ecologically and economically vital for the day-to-day livelihoods of natives. The area is phyto-geographically unique with highest mountain peaks, river valleys and shola in the windward side and rain shadow region of vertical cliffs on the backward side with diurnal

temperature variations. The protected areas are in danger due to encroachments and forest fellings leading to biodiversity loss.

The UNDP funded High Range Mountain Landscape Project entitled “Documentation and compilation of existing information on various taxa (Flora and Fauna), and identification of critical gaps in knowledge in the GEF-Munnar landscape project area” was implemented by Kerala State Biodiversity Board in 11 selected Grama Panchayaths in the three Districts of Idukki, Ernakulam and Thrissur. PROTECTED AREAS in the survey site are Eravikulam NP (9700 ha), Anaimudi NP (750 ha), Mathikettan shola NP 1280, Pampadumshola NP 130, Chinnar WLS 9040, Kurinjimala WLS 3200, Thattekkad WLS 2500, Idukki WLS 10500. Total 37100 ha. Also the High Value Biodiversity Areas (HVBA) are under Mankulam Forest Division 9000, Munnar Division 23800, Marayoor Division 5200, Malayattoor Division 37100, Kottayam Division 3500, Revenue areas 2000, Tea estates 4000, Total 84600 ha.

1. PROJECT OBJECTIVES AND METHODOLOGY

- a. Group wise and Taxa wise documentation and compilation of flora and fauna.
- b. Updation of PBR of the region and development of a digital platform in ePBR.
- c. Documentation of economically important flora/ fauna - tradable bio-resources with ABS potential.
- d. Documentation of the impact of landslides/floods on selected ecosystems and keystone/indicator species.
- e. Identification of the research and management priorities for long term conservation of Munnar landscape.

The HRML study area (spread over 11 Panchayaths in Idukki, Ernakulam and Thrissur districts of the state of Kerala) 4 National Parks (NPs) and 4 Wildlife Sanctuaries (WLS) provide critical ecosystem services for the enhancement of faunal diversity. The diversity of vegetation structure and composition is behind the transformation of the Western Ghats into an ideal habitat for birds, reptiles,

mammals, amphibians and invertebrates. It is very difficult to estimate the biodiversity of the fauna at the respective Panchayath level. Secondary data was collected from forest management plans, journal articles, and study reports from R&D institutes. The objectives of the present studies were categorized in to three divisions (1) Documentation of flora and fauna (2) PBR updation and (3) ABS. Based on the outcomes of both studies management priorities are suggested. The following major activities and methodologies was adopted for the study.

Methodology

A. Objective 1: Group wise and Taxa wise documentation and compilation of flora and fauna

1. Collection and compilation of Secondary data (Group/taxa/subject wise) from University libraries, research institutions, journals, websites etc.
2. Primary data collection (Group/taxa/subject wise). Transect/Pollard walk or multiple quadrat/ plot method or Point count or focal-animal sampling with the participation of subject experts.
3. The documentation of bio-resources with commercial potential with the support of representatives of stakeholders via focus group discussions/survey.
4. Assigning the threat status of bio-resources based on the primary/secondary data and study focused on how this affected the HRML ecosystem (with the support of subject experts).
5. Documentation of best practices related to Traditional knowledge (TK)/ Biodiversity conservation.

B. Objective 2: Updation of PBR of the region and development of a digital platform in ePBR.

1. **Document critical gap areas in the PBR:** based on consultation with BMCs/existing PBR registers/Panchayath committees/local communities etc.
2. Developing a standardised methodology for PBR preparation based on the gaps identified in the existing PBR.

3. Check the present status of bio-resources (assign rank based on the % of loss/gain with respect to the secondary data. Also, the Group/taxa/subject wise updation of PBR and its digitization (e-PBR).
4. Identification of Biodiversity Heritage Sites (BHS) and sites for Eco restoration and Studying the ongoing changes and forces driving changes in Bio-resources/landscapes and its impact in the livelihoods of native people.

C. Objective 3: Data of bio-resources. with commercial potential and Access and Benefit Sharing

1. Compilation of primary and secondary data especially of the economically important bioresources (Group/taxa/subject wise) via Rural Rapid Appraisal (RRA) and Participatory Rural Appraisal (PRA) methods.
2. Assigning an index/Rank (category wise) of biological resources involved in Indigenous use/trading purpose/illegal overexploitation for ABS linking.
3. Analyzing the long-term availability/ IUCN status /trade channels /marketing networks/financial transactions of key bioresources thereby improving native people's life.

3. RESULTS

3.1 Objective 1: Group wise and taxa wise documentation and compilation of flora and fauna

The flora and fauna records of a particular area can give people the ability to assess the biological diversity, conservation value of particular areas or species, preparing management guidelines for natural resources, distribution of species and the environmental factors, developing hypotheses about habitats, understand the impact of land use changes and document the natural heritage.

Estimation of the distribution and abundance of organisms found at the Panchayath level is very important during this period. This is not only for sustainable harvesting or utilization, but also serve as an indirect economic stimulus to the Panchayath through access and benefit sharing.

In order to focus on the above description, in the present study, we attempted to compile a comprehensive checklist based on the primary and secondary data of flora and fauna found within the study area including the endemism, IUCN and WPA status. For this purpose both biodiversity survey and ecological surveys were conducted. The aim of the study is to generate a comprehensive documentation of information on various taxa of Munnar landscape for developing strategies for the conservation of this unique and biodiversity rich landscape of Western Ghats.

For PBR updation and for developing a standardized protocol for the same, a two-day State Level Consultative Workshop was held by KSBB on 21st and 22nd November 2019 and the key issues were discussed. Based on the inputs received from the Workshop, a standardized protocol for Biodiversity survey and monitoring was developed and the same was field tested at Mankulam, Idukki district, Kerala. The survey aimed to (a) to determine the species composition, abundance, richness, and diversity of the following taxonomic groups: (i) Birds, (ii) Odonates, and (iii) Butterflies in the Mankulam Grama Panchayath; (b) the geo-mapping of flora distribution with the help of OSM tracker. PBR, a legal documentation endorsed by the State Biodiversity Board (SBB) plays an important role in developing a conservation agenda for the sustainable use of biological resources and related knowledge, bio prospecting. The survey is the first attempt for the field implementation of new methodology for PBR (ePBR) to document species diversity in a Panchayath level. Current survey data will help Governments and Non-Governmental Organizations (NGOs) in the Panchayath territory to determine conservation assessments and conservation priorities.

3.1.1 DOCUMENTATION OF FAUNA

A. Diversity analysis of fauna of Mankulam Grama Panchayath

Experimental study of fauna was conducted at Mankulam Grama Panchayath for field level implementation of PBR methodology (ePBR).

The objective of the present survey is (i) to determine the species composition, abundance, richness, and diversity of the following taxonomic groups: (a) Birds, (b) Odonates, and (c) Butterflies in the Mankulam Grama Panchayath; (ii) comparison of species with PBR of Mankulam Grama Panchayath; (iii) incorporation of updated information into PBR (ePBR) via BMCs.

Survey Area

The study was conducted in Mankulam Grama Panchayath. The study area is spread in an area between 10° 6' 56'' N latitude 76 ° 55' 4'' E longitudes to 10° 9' 42'' N latitude 76 ° 54' 45'' E longitudes. Nallathanniyar, a tributary of the Periyar flows within the boundary of Kuttampuzha and Mankulam Grama Panchayath. This river basin is mostly fragmented, biodiversity-rich and densely populated cultural landscape which influences the agricultural needs of Mankulam Panchayath.

Sampling

The survey includes taxonomic group such as Birds, Odonates and Butterflies has been carried out during the month February 2020 in the Aanakkulam, Kuwait city and Virinjapara, Virinjaparapalam. Bird survey was conducted during the morning (6.30 to 10.30) and evening (15.30 to 18.00) time to maximize the species richness. Butterfly and Odonates survey was done during morning and afternoon (11.00 to 16.00). Moth study was done in evening time (19.00 to 20.30). Most of the species were photographed in the field with the help of SLR Camera (Canon EOS 600D).

Line Transect

A permanently marked long tract (Two km) was made for avifauna study. The width of the sampling area was 100 meter (50 m on both sides). Observations were carried out walking through this tract, and counting the birds in forward direction. Birds flew above 40 m height were ignored. Standard printed data sheet

were used in the field. Transect was taken at a stretch about an hour in the evergreen forests, grasslands and riparian habitats, the weather condition was clear, and the sky and sun were apparent.

Point Count

It is a line transect done at zero speed for short duration of time. Data is collected standing at a fixed point in the study site for approximately 15 minutes. Distance between two such points was about 200 m. The points were selected at random in the study area. Identify bird species with the help of binocular and spotted scope. Unscrupulous observations were also added to the list to prevent missing of any species during the survey period. These data were used only for activity pattern. Social association, food habits, courtship behaviour etc. Not for species diversity.

Species Evenness and Richness

Species diversity increases with the complexity of habitat. This diversity considers both the richness and evenness of species. Evenness is a measure of the relative abundance of different species making up the richness of an area. This evenness is an important component of diversity indices and expresses evenly distribution of the individuals among different species.

Measurement of Species Richness

Margalef's index was used as a simple measure of species richness

$$\text{Margalef's index} = (S - 1) / \ln N$$

Where S = total number of species; N = total number of individuals in the sample; ln = natural logarithm

Measurement of Evenness

For calculating the evenness of species, the Pielou's Evenness Index (e) was used

$$e = H / \ln S$$

H = Shannon - Wiener diversity index; S = total number of species in the sample

Measurement of Diversity

The diversity of species within a community or habitat called α -diversity, in which the diversity index was calculated using Shannon - Weiner Diversity Index. This Index assumes that individuals are randomly sampled from an independent large population and all the species are represented in the sample. The value of Shannon Weiner Diversity Index usually falls between 1.5 and 3.5

$$\text{Diversity index, } H = - \sum P_i \ln P_i$$

Where $P_i = S / N$; S = number of individuals of one species; N = total number of all individuals in the sample; \ln = logarithm to base e

Simpson Index

The probability that two individuals randomly selected from a sample will belong to the same species was calculated using Simpson Index (D). Simpson's Index gives more weight to the more abundant species in a sample. The addition of rare species to a sample causes only small changes in the value of D . The value of D ranges between 0 and 1. The bigger the value of D , the lower the diversity.

$$D = 1 - \{ \sum n(n-1) / N(N-1) \}$$

Where, n =the total number of taxa of a particular species; N = the total number of taxa of all species

The relative abundance of species per habitat/district was determined using

$$\text{Relative abundance} = n/N$$

Where n is the total number of taxa of a particular species and N is the total number of taxa of all species.

RESULTS AND DISCUSSION

A total of 74 species of birds were collected from the study area. Out of the 310 species reported from HRML study region (United Nations Development

Programme-India, 2014), 74 species were collected from the Mankulam survey. Total 44 species of Odonates was found in Aanakkulam. In Aanakkulam community, s (number of species) = 19; N (total number of individuals) = 84; $\sum n(n-1) = 848$; $\sum N(N-1) = 6972$; $\sum (\text{sum}) \text{ of } p_i^2 = 0.132$; $\sum (\text{sum}) \text{ of } p_i \ln p_i = -2.410$ (Annex 1 to 3).

A diversity index is a mathematical measure of species diversity in a given community. The Shannon index is an information statistic index; it assumes all species are represented in a sample and that they are randomly sampled.

The abundance and diversity of a species is an indicator of a healthy ecosystem, which serve as a useful measure of ecological status of that habitat. Birds are important pollinators of many plant species and play a vital role in seed dispersal. We identified three marshy lands during the transect. Water contamination can be monitored by detecting the presence of certain Odonate species. They provide crucial information about the health of aquatic habitats and variations occurring in the climate. Odonates are good pest controllers. The Odonate fauna needs to be protected because as a significant role as biological indicators and also in wetland conservation. The aberrant rain pattern and the continuous flooding in the study area could have devastated the population of Odonates.

Typical values of Shannon are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon index increases as both the richness and the evenness of the community increase. In our study all the study areas show Shannon indices between 2.4 to 3.5, which shows good species richness and good species evenness. The effective number of species of 34.5 shows approximately 35 species in that area with very good evenness. Simpson Diversity is a measure of dominance, so as D increases, diversity (in the sense of evenness) decreases. Thus, Simpson's index is usually reported as its complement $1-D$ (or sometimes $1/D$). Since D takes on values between 0 and 1 and approaches 1 in the limit of a monoculture, $(1-D)$ provides an intuitive proportional measure of diversity that is much less sensitive to species richness. Our study areas shows

indices between 0.02 to 0.1 which shows no dominance of any species and on calculating its diversity index it ranges to 0.9 which shows high diversity in all our study areas, which is also represented in through its reciprocal index. The summary of faunal diversity is depicted in Table 5.

Table 1: Diversity Indices of Birds found in the Aanakkulam community (Community 1)

Sl. No.	Species	(n)	n(n-1)	pi	pi ²	ln pi	pi ln pi
1	Grey Jungle Fowl	1	0	0.006757			-0.03376
2	Asian emerald dove	1	0	0.006757			-0.03376
3	Mountain imperial pigeon	2	2	0.013514			-0.05816
4	Greater coucal	3	6	0.02027			-0.07903
5	<i>Aerodramus unicolor</i>	14	182	0.094595			-0.22307
6	<i>Apus affinis</i>	20	380	0.135135			-0.27047
7	<i>Amaurornis phoenicurus</i>	1	0	0.006757			-0.03376
8	<i>Microcarbo niger</i>	1	0	0.006757			-0.03376
9	<i>Spilornis cheela</i>	1	0	0.006757			-0.03376
10	<i>Accipiter trivirgatus</i>	1	0	0.006757			-0.03376
11	Malabar grey hornbill	1	0	0.006757			-0.03376
12	Stork billed kingfisher	1	0	0.006757			-0.03376
13	White throated kingfisher	1	0	0.006757			-0.03376
14	Chestnut headed bee eater	6	30	0.040541			-0.12995
15	White cheeked barbet	1	0	0.006757			-0.03376
16	Brown capped pygmy woodpecker	1	0	0.006757			-0.03376
17	<i>Picus gutta cristatus</i>	3	6	0.02027			-0.07903
18	<i>Dinopium benghalense</i>	1	0	0.006757			-0.03376
19	Malabar parakeet	2	2	0.013514			-0.05816
20	<i>Loriculus vernalis</i>	7	42	0.047297			-0.14432
21	<i>Oriolus kundoo</i>	1	0	0.006757			-0.03376
22	<i>Aegithina tiphia</i>	4	12	0.027027			-0.09759
23	<i>Dicrurus aeneus</i>	1	0	0.006757			-0.03376
24	<i>Dicrurus paradiseus</i>	5	20	0.033784			-0.11445
25	<i>Lanius cristatus</i>	2	2	0.013514			-0.05816
26	<i>Dendrocitta vagabunda</i>	1	0	0.006757			-0.03376
27	<i>Dendrocitta leucogastra</i>	1	0	0.006757			-0.03376
28	<i>Corvus macrorhynchos</i>	1	0	0.006757			-0.03376

29	<i>Parus cinereus</i>	6	30	0.040541			-0.12995
30	<i>Orthotomus sutorius</i>	4	12	0.027027			-0.09759
31	<i>Acrocephalus dumetorum</i>	1	0	0.006757			-0.03376
32	<i>Pycnonotus gularis</i>	4	12	0.027027			-0.09759
33	<i>Pycnonotus jocosus</i>	15	210	0.101351			-0.23201
34	<i>Acritillas indica</i>	4	12	0.027027			-0.09759
35	<i>Phylloscopus magnirostris</i>	1	0	0.006757			-0.03376
36	<i>Argya subrufa</i>	1	0	0.006757			-0.03376
37	<i>Gracula indica</i>	6	30	0.040541			-0.12995
38	<i>Muscicapa dauurica</i>	2	2	0.013514			-0.05816
39	<i>Dicaeum concolor</i>	3	6	0.02027			-0.07903
40	Purple rumped sunbird	4	12	0.027027			-0.09759
41	<i>Irena puella</i>	3	6	0.02027			-0.07903
42	<i>Chloropsis aurifrons</i>	4	12	0.027027			-0.09759

Table 2: Diversity Indices of Birds found in the Kuwait city community
(Community 2)

Sl. No.	Species	(n)	n(n-1)	pi	pi ²	ln pi	pi ln pi
1	Greater coucal	2	2	0.022472			-20.08529
2	<i>Aerodramus unicolor</i>	20	380	0.224719			-30.33548
3	<i>Amaurornis phoenicurus.</i>	1	0	0.011236			-0.05043
4	<i>Egretta garzetta</i>	1	0	0.011236			-0.05043
5	<i>Ardeola grayii</i>	2	2	0.022472			-0.08529
6	<i>Accipiter badius</i>	1	0	0.011236			-0.05043
7	Jungle owlet	1	0	0.011236			-0.05043
8	Malabar grey hornbill	1	0	0.011236			-0.05043
9	White throated kingfisher	1	0	0.011236			-0.05043
10	White cheeked barbet	1	0	0.011236			-0.05043
11	<i>Dinopium benghalense</i>	1	0	0.011236			-0.05043
12	<i>Loriculus vernalis</i>	7	42	0.078652			-0.19999
13	<i>Pericrocotus flammeus</i>	3	6	0.033708			-0.11427
14	<i>Oriolus kundoo</i>	1	0	0.011236			-0.05043
15	<i>Aegithina tiphia</i>	2	2	0.022472			-0.08529
16	<i>Dicrurus paradiseus</i>	4	12	0.044944			-0.13943
17	<i>Dendrocit tavgabunda</i>	2	2	0.022472			-0.08529
18	<i>Corvus macrorhynchos</i>	4	12	0.044944			-0.13943

19	<i>Parus cinereus</i>	2	2	0.022472			-0.08529
20	<i>Orthotomus sutorius</i>	3	6	0.033708			-0.11427
21	<i>Acrocephalus dumetorum</i>	1	0	0.011236			-0.05043
22	Hill Swallow	1	0	0.011236			-0.05043
23	<i>Pycnonotus gularis</i>	1	0	0.011236			-0.05043
24	<i>Pycnonotus jocosus</i>	8	56	0.089888			-0.21656
25	<i>Acritillas indica</i>	2	2	0.022472			-0.08529
26	<i>Phylloscopus nitidus</i>	1	0	0.011236			-0.05043
27	<i>Gracula indica</i>	6	30	0.067416			-0.18181
28	Common myna	1	0	0.011236			-0.05043
29	<i>Myophonus horsfieldii</i>	3	6	0.033708			-0.11427
30	<i>Cinnyris asiaticus</i>	1	0	0.011236			-0.05043
31	<i>Cinnyris lotenius</i>	1	0	0.011236			-0.05043
32	<i>Motacilla cinerea</i>	3	6	0.033708			-0.11427

Table 3: Diversity Indices of Odonates found in the Anakulam community

Sl. No.	Species	n)	n(n-1)	pi	pi ²	ln pi	pi ln pi
1	<i>Heliocypha bisignata</i>	22	462	0.262	0.069	-1.340	-0.351
2	<i>Dysphaea ethela</i>	6	30	0.071	0.005	-2.639	-0.189
3	<i>Paragomphus lineatus</i>	2	2	0.024	0.001	-3.738	-0.089
4	<i>Pseudagrion indicum</i>	6	30	0.071	0.005	-2.639	-0.189
5	<i>Orthetrum sabina</i>	2	2	0.024	0.001	-3.738	-0.089
6	<i>Orthetrum taeniolatum</i>	1	0	0.012	0.000	-4.431	-0.053
7	<i>Pseudagrion rubriceps</i>	4	12	0.048	0.002	-3.045	-0.145
8	<i>Orthetrum luzonicum</i>	1	0	0.012	0.000	-4.431	-0.053
9	<i>Onychothemis testacea</i>	1	0	0.012	0.000	-4.431	-0.053
10	<i>Burmagomphus laidlawi</i>	1	0	0.012	0.000	-4.431	-0.053
11	<i>Gomphidia kodaguensis</i>	3	6	0.036	0.001	-3.332	-0.119
12	<i>Libellago indica</i>	16	240	0.190	0.036	-1.658	-0.316
13	<i>Orthetrum pruinosum</i>	1	0	0.012	0.000	-4.431	-0.053
14	<i>Trithemis aurora</i>	6	30	0.071	0.005	-2.639	-0.189
15	<i>Zygonyx iris Selys</i>	1	0	0.012	0.000	-4.431	-0.053
16	<i>Trithemis festiva</i>	2	2	0.024	0.001	-3.738	-0.089
17	<i>Diplaco destrivialis</i>	6	30	0.071	0.005	-2.639	-0.189
18	<i>Euphaea fraseri</i>	1	0	0.012	0.000	-4.431	-0.053
19	<i>Calocyphala idlawi</i>	2	2	0.024	0.001	-3.738	-0.089

Table 4: Diversity Indices of Butterflies found in the Anakulam community

Sl. No.	Species	(n)	n(n-1)	pi	pi ²	ln pi	pi ln pi
1	<i>Neptis hylas</i>	1	0	0.011494			-0.05133
2	<i>Cuphaerymanthis</i>	3	6	0.034483			-0.11611
3	<i>Pachliopta pandiyana</i>	3	6	0.034483			-0.11611
4	<i>Papilio polymnestor</i>	2	2	0.022989			-0.08673
5	<i>Castalius rosimon</i>	1	0	0.011494			-0.05133
6	<i>Jamides celeno</i>	3	6	0.034483			-0.11611
7	<i>Acytolepis puspa</i>	2	2	0.022989			-0.08673
8	<i>Junonia iphita</i>	3	6	0.034483			-0.11611
9	<i>Ypthima huebneri</i>	5	20	0.057471			-0.16416
10	<i>Appias albina</i>	5	20	0.057471			-0.16416
11	<i>Graphium sarpedon</i>	4	12	0.045977			-0.14159
12	<i>Papilio dravidarum</i>	1	0	0.011494			-0.05133
13	<i>Vindula erota</i>	1	0	0.011494			-0.05133
14	<i>Tanaecia lepidea</i>	1	0	0.011494			-0.05133
15	<i>Tirumala limniace</i>	4	12	0.045977			-0.14159
16	<i>Graphium doson</i>	6	30	0.068966			-0.18442
17	<i>Notocrypta paralysos</i>	1	0	0.011494			-0.05133
18	<i>Odontoptilum angulata</i>	5	20	0.057471			-0.16416
19	<i>Cheritra freja</i>	1	0	0.011494			-0.05133
20	<i>coon</i>	1	0	0.011494			-0.05133
21	<i>Melanitis ledaleda</i>	2	2	0.022989			-0.08673
22	<i>Neopithecops zalmora</i>	1	0	0.011494			-0.05133
23	<i>Iambrix salsala</i>	1	0	0.011494			-0.05133
24	<i>nigger</i>	1	0	0.011494			-0.05133
25	<i>Triodes minos</i>	2	2	0.022989			-0.08673
26	<i>Papilio demoleus</i>	1	0	0.011494			-0.05133
27	<i>Pachliopta aristolochiae</i>	1	0	0.011494			-0.05133
28	<i>Papilioclytia</i>	1	0	0.011494			-0.05133
29	<i>Papilio helenus</i>	1	0	0.011494			-0.05133
30	<i>Pantoporia hordonia</i>	1	0	0.011494			-0.05133
31	<i>Ypthima huebneri</i>	3	6	0.034483			-0.11611
32	<i>Papilio polytes</i>	1	0	0.011494			-0.05133
33	<i>Catopsilia pyranthe</i>	2	2	0.022989			-0.08673
34	<i>Pareronia valeria</i>	1	0	0.011494			-0.05133
35	<i>Hebomoia glaucippe</i>	2	2	0.022989			-0.08673
36	<i>Cirrochroathais</i>	2	2	0.022989			-0.08673

37	<i>Telicota ancilla</i>	1	0	0.011494			-0.05133
38	<i>Megisba malaya</i>	1	0	0.011494			-0.05133
39	<i>Prosotas dubiosa</i>	1	0	0.011494			-0.05133
40	<i>Taractrocera ceramas</i>	2	2	0.022989			-0.08673
41	<i>Eurema blanda</i>	2	2	0.022989			-0.08673
42	<i>Catopsilia pomona</i>	4	12	0.045977			-0.14159

Table 5: Summary of faunal diversity in Mankulam Grama Panchayat

Diversity indices	Odonates	Butterflies	Birds	
			Community-1 (Anakulam)	Community-1 (Kuwait City)
Shannon Index (H)	2.410	3.5	3.3	2.9
Simpson's Index (D)	0.1	0.02	0.05	0.07
Simpson's Index of Diversity (1-D)	0.9	0.98	0.95	0.93
Simpson's Reciprocal Index (1/D)	10	10	10	10
Effective Number of species (ENS)	11.1	34.5	27	19.8
Species Richness	2.1	4.5	3.5	3.4

B. Eravikulam National Park

Eravikulam National Park (ENP) covers an area of 97 Km² which is situated in the Devikulam Taluk of Idukki District of Kerala. The ENP consists of rich and unique diversity of flora and fauna encompassing montane grasslands and shola ecosystem. It was declared as the first NP of Kerala in 1978. Munnar Panchayath, the nearest town is well connected to ENP by road. A total of 191 species of birds are found in ENP of which 16 species are endemic to Western Ghats. Nilgiri Tahr (*Nilgiri tragus hylocrius*), endemic and endangered mammal listed in Schedule I of Wildlife Protection Act, 1972. It is the flagship species in ENP. New locality records of Resplendent Shrub Frog (*Raorchestesres plendens*) found in a three-Km² patch atop Anaimudi summit of ENP. It is a Critically Endangered species

endemic to the Western Ghats. A summary of fauna found in the protected areas of study area based on secondary data is given in Table 6, Annex 4- 28)

C. Chinnar Wildlife Sanctuary

A total of 528 species of fauna are present in Chinnar wildlife sanctuary (CWLS). The sanctuary falls in the Marayoor and Kanthalloor Panchayath of Devikulam Taluk in Idukki District, which is located in the rain shadow region of Western Ghats. The nearest town is Marayoor Panchayath. Considering its unique value of biodiversity richness, the area was declared as a reserved forest in 1942, was notified as CWLS in 1984. It has the only population of Grizzled Giant Squirrel (*Ratufa macroura*) in Kerala as well as the home range for Malabar Giant Squirrel (*Ratufa indica*) and Common flying squirrel (*Petaurista petaurista*). Indian star tortoise (*Geochelone elegans*), is a vulnerable species adapted to the dry deciduous habitat and its distribution restricted to CWLS.

D. Kurinjimala Sanctuary

The sanctuary is located on the eastern slope of the Vattavada village of the high range and 40 Kms. away from the Munnar town. It's under the jurisdiction of Marayoor range of Munnar Forest division. The vegetation of the sanctuary consisted mostly of the shola-grassland system. The area is home to vast stretches of plant species namely Neelakurinji (*Strobilanthes kunthiana* T. Anderson ex Benth.), a shrubby flowering plant which flowers gregariously flowering once in twelve years and converts the entire valleys with a blanket of bluish flowers. The Sanctuary offers a wide range of habitat types to the fauna. 76 species of Birds, 95 species of Butterflies, 10 species of Mammals have been recorded. Its location close to the Pampadum Shola NP as well as Chinnar WLS facilitates unimpeded movements of animals across wider landscape. Elephant movements are seasonal.

D. Pampadum Shola National Park

Pampadum Shola National Park (PNP) is located in the Vattavada Panchayath of Devikulam Taluk, Idukki District. The park has various types of forests which

includes, Shola forests (Southern montane wet temperate forest), Grassland (Southern montane wet temperate grassland), Transition forest (Southern subtropical broad-leaved hill forest), Shrub lands and Plantations. The sanctuary has a large number of plants and animals unique to the shola vegetation. The Shola is an important habitat for Nilgiri marten (*Martes gwatkinsii*), a vulnerable species which is endemic to Western Ghats.

E. Anamudi Shola National Park

Anamudi Shola National Park (ANP) is located in the Kanthalloor and Vattavada Panchayath of Devikulam Taluk of Idukki District. The park has a large number of flora and fauna unique to the high-altitude shola grassland vegetation. The terrain of the park is hilly and serves as an Elephant reserve that houses numerous elephants alongside other species. The park provides a migratory path for Elephants (*Elephas maximus*) from Anamalai to Cardamom hills. There are 74 species of Birds, 97 species of Butterflies and 110 species of Moths were recorded.

F. Thattekkad Bird Sanctuary

Thattekkad Bird Sanctuary is located under the jurisdiction of Kuttampuzha Panchayath. The sanctuary includes *Patta* and revenue lands. The sanctuary is known chiefly for the Sri Lankan frog mouth (*Batrachostomus moniliger*) and other birds endemic to the region. The topographical location of the sanctuary is unique. It is situated in peninsular India in the Western Ghats. The highest point of the Western Ghats, the Anamudi peak, at 8,800 feet (2,682 meters), is only 22 km east of Thattekkad (altitude 35m-523 m). There are 13 or 14 different habitats as one ascends from Thattekkad to Anamudi, from high altitude shola forests to evergreen moist deciduous forests, each having its own unique flora and fauna.

The Thattekkad bird sanctuary is the first bird sanctuary of the state that was established in the year 1983. Thattekkad as it literally means is a flat forest, the region is characterised by dense tropical evergreen low land forest nested between braches of Periyar River. The Sanctuary is known for its rich bird diversity. Dr.

Salim Ali, the bird man of India describes the sanctuary as “the richest bird habitat on Penisular India”. The sanctuary is home to both forest birds as well as water birds. It is known that Thattekkad bird sanctuary is an abode for almost 322 species of birds. Among the 322 species, 160 are strict migrants and of this 17% are international migrants.

As the Sanctuary is nested within the banks of the Periyar, it was affected by flood badly. The sanctuary was flooded and as a result, plastic waste, silt and sand got accumulated in much of the ponds, lake and marshy wetlands of the Sanctuary. Much of the damage done to the aquatic ecosystem was irreparable. A sand bed has appeared on a 5-km stretch from Thattekkad to Kuttikkal on the sides of Periyar River. This was the most preferred place for migratory water birds. The conversion of this marshy wetland to sand bed has drastically reduced the number of wetland birds to these areas. Wetland birds prefers marshy wetlands as these are good source of polychaetes, earth worms, other invertebrate and lower vertebrates which are the much preferred food for most of the water birds. As these wetlands are converted to sand beds the food sources for water birds are depleted which reduces bird activity in these areas. It's noted that certain ponds within the sanctuary were completely covered by sand and silt, out of the 14 check dams 11 were completely destroyed by flood. 32 species of water birds have been greatly affected by the changes brought out by the flood. In certain species of water birds like Whiskered tern only few numbers have been sighted in the current migratory season compared to previous years. Under these scenarios, it should be understood that in long run this would have an ecological imbalance of a bigger magnitude capable of bigger ecological destruction.

G. List of water birds of Thattekkad Bird Sanctuary

The data from ebird for whole of Kerala for the post flooded months September to November 2018 were compared with that of the same in the previous year (2017). 379 species were documented in 2017 when compared to 369 in 2018. There has

been some species that is found new in 2018 compared to 2017 and while it's also to be noted that some species found in 2017 missing in 2018. The migratory season has not been subjected to analysis in the current study and hence cannot be commented up on. The latest Asian water bird census conducted in many wetlands of the State on 6th of January 2018 has recorded an increase in bird count and diversity and hence it again proves that the flood has not had an impact on Birds

Table 6: Summary of fauna found in the study area

NP/WLS	Eravikulam NP	Chinnar WLS	Kurinjimala WLS	Pampadum Shola NP	Anamudi Shola NP	Thattekkad Bird Sanctuary
Surrounding Panchayaths	Munnar	Marayoor, Kanthalloor	Vattavada	Vattavada	Marayoor	Kuttampuzha
Taxa (No. of species)						
Birds	191 (16)	225 (11)	75 (8)	62 (7)	74 (7)	236 (11)
Butterflies	101 (10)	154 (12)	94 (3)	97 (14)	97 (14)	208 (16)
Odonates	-	48 (2)	-	-	-	-
Amphibians	36 (29)	14 (7)	3 (2)	-	-	-
Reptiles	13 (10)	50 (4)	5 (3)	-	-	-
Moths	-	-	-	110 (-)	110 (-)	-
Mammals	48 (3)	32 (3)	10 (2)	10 (3)	-	13 (2)
Total	389 (68)	523 (39)	187 (18)	279 (24)	281 (21)	457 (29)

No. of species endemic to Western Ghats is indicated in parenthesis; - = No species were found.

3.1.2 DOCUMENTATION OF FLORISTIC DIVERSITY

As the first phase the gaps in Knowledge of lower groups of plants and rare and endangered species overexploited for medicinal value was addressed and secondary data was compiled. Floristic diversity refers to the variety and variability of plants in a given region. The present study area includes southern

montane wet temperate forests (sholas) and the adjoining grasslands (beyond an elevation of 1200 ASL).

Details of the following species were compiled:

- a. A Total of 95 Algal species found in the HRML study area, Anjunadu valley, Kerala (**Annexure 29**).
- b. A total of 194 species of Lichen found in the HRML study area, Anjunadu valley, Kerala (**Annexure 30**).
- c. A total of 202 species of Bryophyta found in the HRML study area, Anjunadu valley, Kerala (**Annexure 31**).
- d. Total of 1148 medicinal plants found in the HRML study area, Anjunadu valley, Kerala (**Annexure 32**).
- e. 96 species of wild edible fruits found in the HRML study area, Anjunadu valley, Kerala (**Annexure 33**).
- f. List of 17 selected tradable bio-resources in the HRML study area, Anjunadu valley, Kerala (**Annexure 34**).

Algal diversity of Idukki during pre-monsoon, monsoon and post-monsoon were analyzed of which phytoplankton's are more rampant during the pre-monsoon followed by post monsoon and monsoon season. Five groups such as Cyanophyceae (Blue-green algae), Chlorophyceae (Green algae), Bacillariophyceae (Diatoms), Dinophyceae (Dinoflagellates) and Desmids represent the phytoplankton community in Idukki reservoir. Majority of the species comes under the classes Phaeophyceae, Conjugatophyceae, Florideophyceae, Ulvophyceae and Cyanophyceae. 47 % of algal species are Zygnemataceae family followed by Nostocaceae and Oscillatoriaceae.

The present study area contains large number of species of ecological as well as medicinal important species. A total of 194 species of Lichens were identified, of

which 43 % comes under the family Parmeliaceae. Majority of these lichens are found in Mannavan Shola, Marayoor. A total of 202 species of mosses were documented in the present study area.

A total of 1148 medicinal plants under 135 families were recorded in the HRML area. Among them, Acanthaceae (40 spp.), Apocynaceae (52 spp.), Asteraceae (47 spp.), Leguminosae (134 spp.), Poaceae (47 spp.) and Rubiaceae (44 spp.) are the prominent families. Tribal practitioners have been using medicinal plants for treating several diseases. However, a valid scientific data on the usage of such plants is obscure. A wide variety of those plants are coming under RET and endemic category.

Plants of the Aanakkulam and Kuwait city, Mankulam Grama Panchayath, Idukki, Kerala

Geographical data acquired through floral surveying are particularly very significant in the present era for determining species' ranges. Information can be plotted in GIS systems and used for analyzing species distributions and their link to conservation assessments and ecological niche modelling. The latter is focused to identifying changes in habitat conditions, species distributions over time, and predictions of future conditions under climate change. We used a mobile application called OSM Tracker to track species locality data (geo coordinates). This approach will be an important tool in future habitat restoration projects and in establishing biodiversity-rich areas that incorporate a wide range of habitats that maximize adaptation to climate change.

Table 7: Summary of floral Categories in the survey area of Mankulam Grama Panchayath

Categories of Flora	Location A	Location B	Location C	Location D	Location E
Plantation species	1	4	2	1	2
Angiosperms	12	20	19	5	20
Lichens	-	1	2	-	-
Pteridophytes	-	-	1	1	-
Total	13	25	24	7	22

Table 8: Location A

Sl. No.	Local name	Scientific name	Family	GPS Point		
				Lat.	Long.	Ele.
1. Plantation species						
1		<i>Elettaria cardamomum</i> (L.) Maton		10.118	76.9059	826
2. Angiosperms						
1		<i>Anacardium occidentale</i> L.		10.1255	76.9194	526
2		<i>Cinnamomum malabattrum</i> (Burm.f.) J.Presl		10.1255	76.9194	526
3		<i>Solanum torvum</i> Sw.		10.1158	76.9179	606
4		<i>Ocimum kilimandscharicum</i> Gürke		10.1259	76.9191	518
5		<i>Citrus maxima</i> (Burm.) Merr.		10.1259	76.9191	525
6		<i>Vitex altissima</i> L.f.		10.1255	76.9194	526
7		<i>Lagerstroemia microcarpa</i> Hance		10.1254	76.9069	659
8		<i>Olea dioica</i> Roxb.		10.1253	76.9068	655
9		<i>Cinnamomum camphora</i> (L.) J.Presl		10.125	76.9062	673
10		<i>Aporosa cardiosperma</i> (Gaertn.) Merr.		10.1243	76.9049	676
11		<i>Thottea siliquosa</i> (Lam.) Ding Hou		10.1242	76.9048	673
12		<i>Asparagus racemosus</i> Willd.		10.124	76.9039	708

Table 9: Location B

Sl. No.	Local name	Scientific name	Family	GPS Point		
				Lat.	Long.	Ele.
1. Plantation species						
1		<i>Elettaria cardamomum</i> (L.) Maton		10.1565	76.9095	217
2		<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.		10.1561	76.9091	216
3		<i>Ochlandra travancorica</i> (Bedd.) Gamble		10.156	76.9089	215
4		Mixed		10.1544	76.9076	215
2. Angiosperms						
1		<i>Anacardium occidentale</i> L.		10.1599	76.9115	215
2		<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. & Schult.		10.1595	76.9113	216

3		<i>Ficus hispida</i> L.f.		10.1595	76.9113	216
4		<i>Alstonia scholaris</i> (L.) R. Br.		10.1593	76.9112	217
5		<i>Piper nigrum</i> L.		10.159	76.9111	218
6		<i>Clerodendrum infortunatum</i> L.		10.1587	76.9109	222
7		<i>Acacia mangium</i> Willd.		10.1585	76.9107	220
8		<i>Colocasia esculenta</i> (L.) Schott		10.1581	76.9105	218
9		<i>Justicia gendarussa</i> Burm.f.		10.157	76.9099	217
10		<i>Vanda</i> Spp.		10.1566	76.9096	215
11		<i>Indianthus virgatus</i> (Roxb.) Suksathan & Borchs.		10.1563	76.9093	220
12		<i>Psidium guajava</i> L.		10.1565	76.9095	217
13		<i>Plumeria alba</i> L.		10.155	76.908	213
14		<i>Hydnocarpus pentandrus</i> (Buch.- Ham.) Oken		10.1525	76.9069	210
15		<i>Garcinia gummi-gutta</i> (L.) Roxb. Male		10.1497	76.9055	209
16		<i>Caryota urens</i> L.		10.1547	76.9078	213
17		<i>Lagerstroemia speciosa</i> (L.) Pers.		10.1619	76.9129	218
18		<i>Mimosa pudica</i> L.		10.1585	76.9107	217
19		<i>Bambusa bambos</i> (L.) Voss		10.1387	76.9246	224
20		<i>Olea dioica</i> Roxb.		10.1618	76.9128	223
3. Lichens						
1		<i>Parmelia</i> Spp.		10.1559	76.9088	215

Table 10: Location C

Sl. No.	Local name	Scientific name	Family	GPS Point		
				Lat.	Long.	Ele.
1. Plantation species						
1		<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.		10.1502	76.9059	208
2		<i>Theobroma cacao</i> L.		10.15561	76.908	204
2. Angiosperms						
1		<i>Areca catechu</i> L.		10.1556	76.9087	195
2		<i>Cinnamomum malabattrum</i> (Burm.f.) J.Presl		10.1556	76.9086	202
3		<i>Cyclea peltata</i> (Lam.) Hook.f. & Thomson		10.1555	76.9085	202
4		<i>Artocarpus hirsutus</i> Lam.		10.1551	76.9082	202

5		<i>Elaeocarpus tuberculatus</i> Roxb.		10.1552	76.9082	207
6		<i>Pimenta dioica</i> (L.) Merr.		10.1548	76.9079	203
7		<i>Plumbago auriculata</i> Lam.		10.1548	76.9079	204
8		<i>Crossandra infundibuliformis</i> (L.) Nees		10.1547	76.9079	206
9		<i>Syzygium jambos</i> (L.) Alston		10.1542	76.9074	207
10		<i>Ananas comosus</i> (L.) Merr.		10.1538	76.9074	202
11		<i>Carica papaya</i> L.		10.1528	76.907	202
12		<i>Colocasia esculenta</i> (L.) Schott		10.1528	76.907	200
13		<i>Hydnocarpus pentandrus</i> (Buch.- Ham.) Oken		10.1551	76.9081	205
14		<i>Pueraria phaseoloides</i> (Roxb.) Benth.		10.1522	76.9068	198
15		<i>Glycosmis pentaphylla</i> (Retz.) DC.		10.1521	76.9068	206
16		<i>Saraca asoca</i> (Roxb.) Willd.		10.1505	76.9064	198
17		<i>Garcinia gummi-gutta</i> (L.) Roxb. Male		10.1551	76.9081	203
18		<i>Caryota urens</i> L.		10.1551	76.9081	201
19		<i>Mimosa pudica</i> L.		10.153	76.9071	205
3. Pteridophytes						
1		<i>Drynari aquercifolia</i> (L.) J. Sm.		10.1556	76.9087	203
4. Lichens						
1		<i>Usnea</i> Spp.		10.1556	76.9086	202
2		<i>Parmelia</i> Spp.		10.1557	76.9087	208

Table 11: Location D

Sl. No.	Local name	Scientific name	Family	GPS Point		
				Lat.	Long.	Ele.
1. Plantation species						
1		<i>Theobroma cacao</i> L.		10.1514	76.9068	187
2. Angiosperms						
1		<i>Etlingera elatior</i> (Jack) R.M.Sm.		10.1540	76.9065	195
2		<i>Caryot aurens</i> L.		10.1518	76.9068	197
3		<i>Justicia adhatoda</i> L.		10.1618	76.9129	213
4		<i>Torenia bicolor</i> Dalzell		10.1478	76.9051	195
5		<i>Homonoia riparia</i> Lour.		10.1492	76.905	198
3. Pteridophytes						
1		<i>Pteris tremula</i> R. Br.		10.1543	76.9068	185

Table 12: Location E

Sl. No.	Local name	Scientific name	Family	GPS Point		
				Lat.	Long.	Ele.
1. Plantation species						
1		<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.		10.1389	76.9244	225
2		<i>Ochlandra travancorica</i> (Bedd.) Gamble		10.1379	76.9257	253
2. Angiosperms						
1		<i>Anacardium occidentale</i> L.		10.159	76.9111	222
2		<i>Ficus hispida</i> L.f.		10.1384	76.9251	240
3		<i>Lantana camara</i> L.		10.1593	76.9112	220
4		<i>Mucuna pruriens</i> var. <i>utilis</i> (Wall. ex Wight) L.H.Bailey		10.1591	76.9111	222
5		<i>Sauropus androgynus</i> (L.) Merr.		10.159	76.9111	222
6		<i>Clitoria ternatea</i> L.		10.1589	76.911	220
7		<i>Hibiscus rosa-sinensis</i> L.		10.1588	76.9109	224
8		<i>Clerodendrum infortunatum</i> L.		10.1391	76.9243	227
9		<i>Gliricidia sepium</i> (Jacq.) Walp.		10.1586	76.9108	222
10		<i>Chromolaena odorata</i> (L.) R.M.King&H.Rob.		10.1583	76.9106	223
11		<i>Caryota urens</i> L.		10.1384	76.9251	240
12		<i>Smilax china</i> L.		10.1618	76.9128	231
13		<i>Dillenia pentagyna</i> Roxb.		10.1617	76.9128	222
14		<i>Mimosa pudica</i> L.		10.1391	76.9243	225
15		<i>Alstonia scholaris</i> (L.) R. Br.		10.1385	76.9249	233
16		<i>Macaranga peltata</i> (Roxb.) Müll.Arg.		10.1384	76.9251	240
17		<i>Homonoia riparia</i> Lour.		10.1379	76.9255	253
18		<i>Bombax ceiba</i> L.		10.1379	76.9257	253
19		<i>Utricularia graminifolia</i> Vahl.		10.1387	76.9247	240
20		<i>Bambusa bambos</i> (L.) Voss		10.1379	76.9257	251

TRADITIONAL KNOWLEDGE RELATING TO HEALTHCARE

Idukki is the second largest tribal inhabiting district in Kerala. A number of different tribal groups inhabited in the mountain slopes of Idukki district and is one of the oldest and richest cultural traditions using medicinal plants. Chinnar Wild Life Sanctuary is located along the rain shadow region of the Western Ghats between 10° 15' to 10° 21' N latitude and 77° 05 to 77° 16' E longitude. Sanctuary

lies in both Marayoor and Kanthalloor Grama Panchayath of Devikulam Taluk in Idukki district of Kerala State. Major inhabitants are Muthuvans and Hill Pulayas. Most of the Muthuvans settlements were distributed in the Marayoor sandal division forest area while Hill Pulayas settled in the core of Chinnar Wild Life Sanctuary (CWLS). They cultivate crop varieties like finger millet, rice, potato, yam, pulses, cardamom, coffee, lemon grass, sugar cane etc. These tribal people possess rich knowledge and wisdom regarding wild plants including their usage for treating common ailments and some major diseases.

Tribal traditional healers were identified and interviewed to get the ethno medical informations. Tribal people between 35-75 age groups of both sexes were interviewed and a group discussion were held at each settlement to know about the plants used to cure various ailments/diseases. The informations gathered from tribal traditional healers on local name of the plant, parts used, method of preparation, mode of administration etc. were recorded.

The present study on tribe Muthuvans of the study area resulted in the documentation of 78 species of ethno medicinal plants distributed in 72 genera and 39 families. Out of 78 species, 47 were herbs, 16 were shrubs, 9 trees were and 6 were climbers. Acanthaceae is the dominant family with 7 species followed by Asteraceae as the second dominant family with 6 species and Euphorbiaceae & Lamiaceae third dominant families with 5 species each. They used these medicinal plants for the treatment of 31 kind of different ailments/diseases. The most prevalent medicinal uses of the treated plants are for injuries and dermatological problems. 9 species of plants are used for the treatment of cuts & wounds and skin diseases. 7 species plants used for the treatments of bruise & sprain; diarrhea & dysentery; stomach ache and gas trouble. Other important disease treated are small pox (1 spp), piles (4 spp), leucorrhoea (2 spp), jaundice (1 spp), bone fracture (3 spp.) etc. The analysis of various plant parts which are utilised for the preparation of herbal remedies are composed of leaves (35 usage) areal part (13 usage) tuber (8 usage), stem (6 usage) root (5 usage) seed, whole plant and

rhizome (4 usages each), fruit (2 usage) and bulb & bark 1 usage each.. Most of the remedies are prepared in the form of paste, 45 usages. Other form of preparations are juice 19 usages; direct consumption of plant parts 13 usages; powder form 9 usages; decoction 5 usages; water extract 5 usages; oil, 7 usages and without any preparation/direct application 3 usages etc. Oral dosing and direct application of herbal extracts, oil, powder decoction and using as food are the most frequently recorded ways of administration.

Hill Pulayas are using 74 species of plants belonging to 70 genera in 43 plant families for medicinal purposes. Habit wise analysis showed trees constitute the major proportion with 26 species, followed by herbs 16 species; shrub 21 species; climbers 12 Dominant families are Euphorbiaceae and Malvaceae 5 species each; Asteraceae, Fabaceae, Combretaceae, Rutaceae 4 plant species from each family. The formulations from these plants are used for treating 33 kinds of ailments or diseases. Maximum numbers of plants are used for the treatment of cuts and wounds (14 spp), Bruise and sprain (10 spp) and diarrhoea and dysentery (7 spp). Other major ailments treated are diabetes (4 spp); asthma (3 spp); jaundice (3 spp); kidney stone (4 spp); rheumatic fever (3 spp); skin disease (5 spp), cancer (1 spp) infertility (1 spp) and bone fracture 2 species. Leaves are the widely used plant part (30 usages) followed by stem bark (17 usages) root (12 usages) whole plant (11 usages) fruit (10 usages) Stem and latex (6 usages each) areal part (5 usages) seed (4 usages) flower 2 and tuber 1 usages. Herbal remedies are prepared in different forms such as cold and hot infusions, decoction, powder, juice and paste. Various remedies are prepared in the form of paste (25 usage) juice (21 usage) decoction (15 usage) oil and latex (11 usage), direct consumption (6 usage) etc.

From the studies it is understood that the common problem in tribal areas are cut wounds and 23 sp are used for treating this. Other major ailments treated are bruise & sprain (17 spp), diarrhoea& dysentery (14 spp), skin diseases (13 spp), intestinal worm problems (10 spp), abdominal problems (11 spp), diabetes (7 spp) etc. There are various mode of administration of drugs, including oral

administration and topical application. Ailments such as piles, kidney stone, diarrhoea, menstrual cycle disorders, poisons as snake venom, urinary disorders, helminthiasis, blood pressure, diabetes, jaundice, rheumatic fever, dysentery, ulcer etc. are cured by oral administration of herbal preparations. Most of the skin diseases, cut wounds, bone fracture, headache, oedema and swelling, burns, tooth ache etc. are cured by external application of the herbal extracts.

As the local importance of the species is concerned, of the total 42 informants from both tribes, the species most mentioned are *Aegeratina adenophora* (28 informants), *Bidens pilosa* (32 informants), *Gymnema sylvestre* (28 informants), *Terminalia cuneata* (11 informants), *Solanum violaceum* (18 informants), *Punica granatum* (18 informants), *Anogeissus latifolia* (12 informants), *Cympopogon flexuosus* (27 informants), *Achyranthus aspera* (27 informants), *Aerva lanata* (25 informants), *Lantana camara* (20 informants) etc. Some of the plants are used to treat specific diseases while others are used for improving general health. These categories of plants are not effective against a specific illness but for curing and strengthening the body as a whole. Some are cleansing agents, depurate or detoxicant, help in purifying the blood and removing the toxins possibly by stimulating diuresis. Some are refreshers and anti-inflammatory and as soothing agents. They are effective in relieving pain associated illnesses. Such generic and indefinite therapeutic indications are common in ethnobotany and this can be regarded as genuine information

As for the frequency of species 128 species out of total 152 were defined by informants as very common, 15 as moderately common and 9 as rare and endemic to this region. It should also be noted that 140 species are growing wild in the area and only 12 are cultivated or domesticated. An interesting fact is that for the preparation of medicines, Hill Pulayas collect the medicinal plants from wild itself (forest area) and do not cultivate it, while Muthuvans collect some from wild and others cultivated for preparation and commercialization ie, for distribution of medicine within the community.

Table 13: List of medicinal plants used by both Muthuvans and Hill Pulaya tribes of Marayoor in common for treating various ailments

Sl. No.	Scientific name/Common name	Muthuvan	Hill Pulaya
1	<i>Achyranthes aspera</i> L. var. <i>porphyristachya</i> (Wall. ex Moq.) Hook. f. (Amaranthaceae-Kadalady)	Decoction prepared from root is used for the treatment of diarrhoea and dysentery	
2	<i>Aerva lanata</i> (L.) Juss. ex Schult. (Amaranthaceae-(Koozhappoo/Cheroola)	Root dried in shade and powder dissolved in water used for severe diarrhoea and dysentery (½ teaspoon two times daily)	Decoction prepared using dried whole plant is used for treating dysentery
3	<i>Azadirachta indica</i> A.Juss. (Meliaceae-Veppu)	Leaf paste along with turmeric is used for the treatment of chicken pox and skin diseases	a. Leaf paste along with turmeric is used for the treatment of chicken pox and skin diseases. b. Tender leaf crushed and paste dissolved in water and drink for throat pain. c. Stem bark paste applied over body topically for stroke
4	<i>Blepharis maderaspatensis</i> (L.) Roth (Acanthaceae-Nethram/Chinni)	Leaf paste bandaged to cure bone fracture and cut wounds	a. Leaf juice poured on eyes to cure cataract. b. Leaf used as vegetable, make dishes to improve vision c. Paste of areal part applied externally for bruise and sprain
5	<i>Boerehavia diffusa</i> L. (Nyctaginaceae-Thazhuthama)	Decoction prepared using areal part is used to cure diabetes	a. Used as leafy vegetable to improve vision and cure diabetes b. Juice extracted from leaf and stem given for the treatment of snake bite
6	<i>Calotropis gigantea</i> (L.) R. Br. in Ait.f. (Asclepiadaceae -Erikku)	Leaf paste warmed in coconut oil and is used as massaging oil for bruise, sprain and edema	a. Extracted juice from the warmed leaf is used orally for stomach ache b. Latex and leaf paste applied topically for scorpion bite and skin diseases
7	<i>Celtis philippensis</i> L. (Ulmaceae-Peenari)	Fire the wood and smoke (nebulisation) for curing small pox	Decoction prepared using stem, leaf and bark is used for the treatment of urinary disorders, kidney stone
8	<i>Cissus quadrangularis</i> L. (Vitaceae-Paranta)	Tender wine used to make dishes, used for stomach ache and gas trouble	a. Stem or vine paste applied topically for the treatment of bruise, sprain and bone fracture.

			b. Tender vine eat for stomach ache and abdominal problem
9	<i>Lantana camara</i> L. (Verbenaceae- Unnichedy/Poochedy)	Leaf juice and paste used to heal cut wounds Fresh root crushed, ground and paste dissolved in water and drink for diarrhoea and dysentery	
10	<i>Phyllanthus amarus</i> Schum. & Thonn. (Euphorbiaceae- Keezharnelli)	a) Fresh leaf paste dissolved in goat milk used for the treatment of jaundice. b) Paste of areal part used as hair shampoo for removing dandruff promotes hair growth.	a. Aerial parts crushed juice and paste used for tooth ache. b. Fresh leaf paste dissolved in goat milk used for the treatment of jaundice
11	<i>Sarcostemma brunonianum</i> (Asclepiadaceae- Somalatha/Palakody)	Latex applied topically on feet for curing foot corns and calluses	a. Vine crushed and paste applied topically over neck for the treatment of tonsillitis b. smoke of dried stem is used to get relief from asthma
12	<i>Scoparia dulcis</i> L. (Scrophulariaceae- Kallurukki)	Aerial part shade dried and grind powder mixed with seed powder of Kalluvazha (<i>Ensete superba</i>) and consumed in milk for kidney stone	Whole plant dried in shade, grind and powder dissolved in water and orally used for the treatment of kidney stone
13	<i>Syzygium cumini</i> (L.) Skeels var. <i>cumini</i> (Myrtaceae-Njaval)	Stem bark ground and paste dissolved in water and drink for pile (combination)	Dried fruit ground and powder dissolved in water and drink for diabetes
14	<i>Tribulus terrestris</i> L. (Zygophyllaceae-Njerinjil)	Decoction prepared using entire plant is used for the treatment of urinary disorders and kidney stone	
15	<i>Tridax procumbens</i> L. (Asteraceae- Murikootypacha)	Aerial part crushed and extract used to heal cut wounds	
16	<i>Wrightia tinctorial</i> (Roxb.) R. Br. (Apocyanaceae- Danthapala)	a) Fresh leaves boiled in coconut oil and is used for the treatment of psoriasis and scabies b) Gum or latex put on teeth against toothache	Gum or latex put on teeth against toothache

3.2. Objective 2: Updation of PBR of the region and development of a digital platform in ePBR.

The People Biodiversity Register (PBR) shall contain comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with them. The data recorded in PBR relates to present status as well as changes over recent years in

distribution and abundance; factors affecting distribution and abundance, including habitat transformations and harvests; known uses; and economic transactions involving these organisms. The document also records the perceptions of local people about ongoing ecological changes, their own development aspirations, and their preferences as to how they would like the habitats to be managed.

3.2.1 PBR Preparation in Kerala- A perspective

In Kerala the process of PBR preparation started during 2009 and was completed in 2019. A detailed examination of the PBRs in the Munnar Landscape Study area comprising of 11 Panchayaths spread over three districts of Kerala, Idukki, Ernakulam and Thrissur revealed that the majority of the PBR were prepared on the basis of interviews with elderly persons and group discussions. One of the production sectors which has been covered extensively is Agrodiversity and this may be mainly because it is directly linked with livelihood of the people and the diversity of agricultural crops in the country has evolved over generations through the various field trials carried out by the farmers and inventions based on practical experience. This points to the fact that Mainstreaming Biodiversity in Production sectors and Biodiversity conservation can be achieved only by converting biodiversity into jobs and income on a sustainable basis. The PBR exercise in Kerala had focused on species diversity with special emphasis on Agrodiversity and the use of an ecosystem approach in future can enable, utilization of data recorded for development of local biodiversity conservation and action plan. In Kerala Agriculture department is already promoting an agroecological based cropping pattern in Kerala. In fact in the PBR a traditional cropping pattern and varietal selection by farmers based on soil composition, land topography and local climatic conditions has been recorded in many areas.

As PBR exercise was a onetime exercise seasonal collection of data has not taken place leading to gaps in knowledge of certain plants and animals. The method of data collection has also not followed any specific sampling strategies or employed

rapid biodiversity assessment tools for measuring floral and faunal diversity analysis. Species level information is mostly limited to vertebrates and charismatic species alone and data regarding lower groups of flora and fauna, invertebrates etc. are not included mostly especially data on endemic/ RET species/ etc.. As PBR is the base document for implementing ABS regulations data on commercially traded bio resources and details of various agencies involved in trading or utilization of bioresources for bio-survey or bio-research leading to commercial utilization is necessary which is mostly lacking. One of the major functions is identification of areas which can be conserved outside forest areas as Biodiversity Heritage Sites and this can be accomplished only if exhaustive data of the Ecosystems are available. Another major drawback is the lack of data on biodiversity of forest areas. National working plan code NWPC (2014) of Ministry of Environment, Forest and Climate Change has suggested a periodic revision of the working plans after every 10 years. Biodiversity assessment of the major plant and faunal species and the lower forms of life such as algae, fungi have been suggested to be incorporated in working plan based on data from PBR. The number of species and the changes over time including the status on number and abundance of floral and faunal composition, identification and listing of important Rare, Endangered and Threatened (RET) species together with the status of invasive species has been suggested for the monitoring of biodiversity of major species. Hence the updation of PBR should address these gaps and should be developed such that it is an integral part of working plan of Forest department and also the base document for formulation of Plan schemes of Local Self Government. Such a synergy is necessary for pooling of resources, fostering conservation of natural resources and ultimately mainstreaming biodiversity in production sectors.

The UN Decade on Ecosystem Restoration 2021-2030, aims the restoration of degraded and destroyed ecosystems as a proven measure to fight climate change, and enhance food security, water supply and biodiversity. The Protected Area network system alone cannot sufficiently address threats to biodiversity posed by

the development in the economic production sectors– both spatially and in terms of management jurisdiction. In Kerala Natural forest has reduced from 44% in 1905 to 28% in 2010, substantial portions of the fresh water swamp forests and mangroves were already converted to crop fields/aquaculture areas making the coastal communities vulnerable to climate change and landslides are a major hazard along the Western Ghats. Community-based institutions provide a strong programmatic baseline for mobilizing communities for sustainable natural resource management.

India High Range Mountain Landscape Project aims at developing an effective multiple use management framework for conserving biodiversity in the mountain landscape of the Western Ghats and mainstreaming the biodiversity conservation considerations into production sectors. As part of the project a review of the status of development of PBR and methodologies used were undertaken to suggest future approaches for PBR updation and for developing a standardized protocol for Biodiversity surveys to be employed for PBR updation during the next decade.

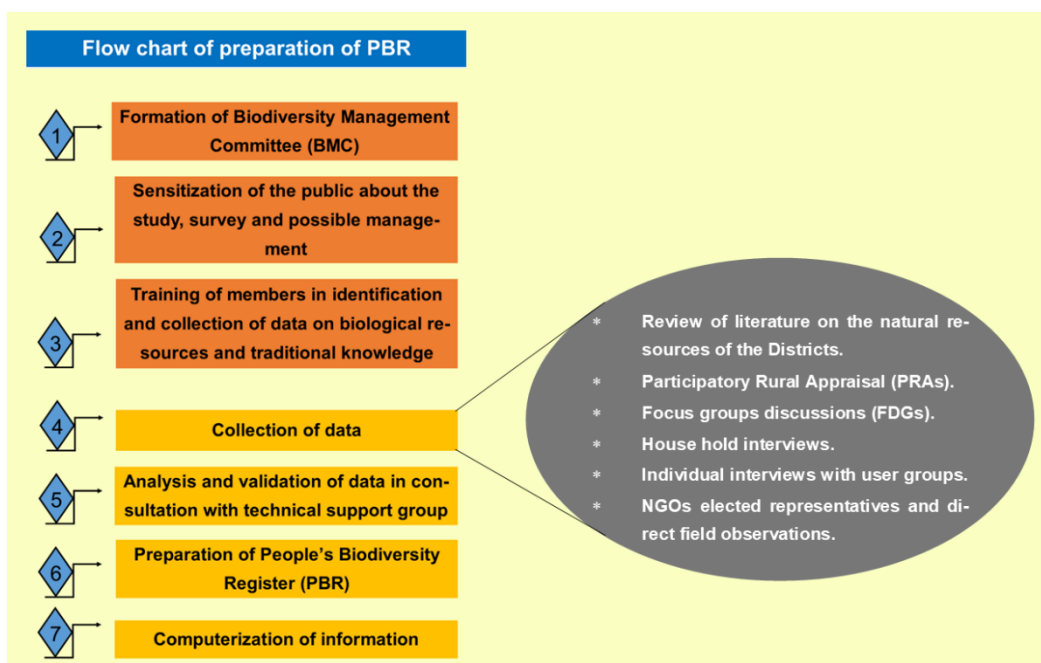
The People's Biodiversity Registers is a document which contains comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with them. Lack of information on seasonal variation and availability of faunal species is one of the limitations of the current PBR. To fill such gaps, KSBB conducted detailed workshops with representatives from various government departments and Technical Support Groups (TSGs) to develop a draft of an innovative methodology, particularly for the updation of species diversity and associated knowledge. Mankulam Grama Panchayath has been selected as a suitable Panchayath for survey the species abundance of Birds, Odonates and Butterflies for the implementation of PBR updation (ePBR), the draft methodology, in field level.

3.2.2 People Biodiversity Register- A tool for Biodiversity Monitoring

The process of PBR preparation is participatory in nature which requires extensive and intensive consultation with large number of local people who need to share their knowledge relating to sustainable utilization of bio-resources. The knowledge of the local people (user groups) developed through their close interaction with nature and resource-use practices are of great value for conservation. Thus, TK of local community with respect to local biodiversity most of which are uncodified forms an integral part of the PBR and this is what sets it apart from other Biodiversity databases. Biodiversity registers prepared after comprehensive documentation of biological resources and associated TK prepared serve as a legal document which confirms the sovereign rights of that BMC/local community over the resources documented in the PBR. This is done by undertaking a Participatory Rural Appraisal (PRA) at the local level along with other ways of data collection such as literature reviews and household interviews, individual interviews with knowledgeable individuals etc. (Figure 1). The PBR is a base document which the local self governments can utilize for

- a) Community regulation of access to biodiversity resources leading to sustainable harvests;
- b) Promoting knowledge-based sustainable management of agriculture, livestock, fish, forests and public health so as to enhance the quality of life of the community members;
- c) Opportunities to generate funds through imposition of collection fees for access to biodiversity resources;
- d) Conserving valued resources;
- e) Value addition to biodiversity resources;
- f) Recording of biodiversity related knowledge, pertaining to management;
- g) Recording of biodiversity related knowledge, coupled to opportunities to generate funds through imposition of collection fees for access to local knowledge;
- h) Sharing in the benefits of commercial application of local knowledge.

The long-term objectives of the PBR include biodiversity monitoring for a long period of time, analysing the trends in population status and biodiversity loss due to various developmental interventions, or natural disasters and base document for developing Local Biodiversity Strategies and Action Plan (LBSAP). 'Decentralization' of biodiversity governance i.e. an inclusive approach transferring decision-making powers to lower, more localized levels are considered as more effective than an exclusive approach. As the rate of biodiversity deterioration and the unsustainable utilization of biodiversity to meet the growing needs of the population is increasing, it is imperative that the PBR be updated periodically based on the constant monitoring of such changes.



3.2.3. Review of existing PBR in the study area

- a) The PBR examination of Munnar landscape study areas of Adimali, Kuttampuzha, Vattavada, Mankulam and Munnar Panchayaths revealed that most of the PBRs were prepared on the basis of interviews and group discussions with the elderly.
- b) The PBR exercise in Kerala had focused on species diversity with special emphasis on Agrodiversity.

- c) PBR exercise was a one-time exercise seasonal collection of data has not taken place leading to gaps in knowledge of certain plants and animals.
- d) The method of data collection has not followed any specific sampling strategies or employed rapid biodiversity assessment tools for measuring floral and faunal diversity analysis.
- e) Species level information is limited to vertebrates and charismatic species and does not include data on lower groups of flora and fauna, invertebrates, etc.

3.3 Major Gaps in the existing PBR

The major gap areas based on the PBR review are tabulated (Table 2).

Table 14: Major gaps in the existing PBR

Sl. No.	Gap areas
1	Tribal knowledge/practices
2	Commercially traded bio resources and details of various agencies involved and nature of market
3	Sacred groves/ ponds
4	Major ecosystems/degraded ecosystems/quarries
5	Unique ecosystems as Mangroves, laterite hills etc.
6	Riparian diversity
7	Soil and related information
8	Areas which can be proposed for BHS
9	Wetland data
10	Endemic/ local landraces for GI registration
11	Prevailing management practices/ forest areas/ community conservation
12	List of local Vaidyas/Hakims/Traditional knowledge holders

3.2.3. Methodology for documentation of biodiversity and associated knowledge

The consultative workshop conducted with help of experts from various fields as part of UNDP- Munnar Landscape Project flagged the necessity for a standardized

protocol for biodiversity surveys and monitoring through a three pronged approach using volunteers with different levels of knowledge. The need for dedicated user friendly mobile apps for surveying, collaboration between institutions involving taxonomists and biodiversity experts, networking existing databases and citizen scientists at the local level was highlighted. Necessity for Training tools and modules for different categories of volunteers, local/regional field guides, survey manuals on major groups was stressed. The participation from Literacy mission volunteers/ NSS/NGO/ Citizen Scientists and interested youth by a standardized protocol would help to improve the quality of PBR. Involvement of student groups (graduates, PG and scholars) in the field of Wildlife / Zoology / Botany/ Forestry/Environmental science, ensures species specific inventory/ change assessment with community participation.

Based on these recommendations a methodology manual for uniform replicable standardized protocol for survey of flora/ fauna/ecosystem with trained local resource persons for surveys, monitoring and preparation of action plans in parallel with use of standard PRA and RRA techniques for consultation with a wide range of user groups of bioresources was prepared. The 32 formats provided by the National Biodiversity Authority (NBA) for documenting PBR has been regrouped into 5 forms in the PBR developed by NIC mainly General information of the BMC, Geo-scape of the BMC, Biodiversity observation, Associated knowledge and Access & benefit sharing. The five pronged approach were tested at one of the project sites in the UNDP Munnar Landscape project. Field surveys, PRA and semi structured interviews following standardized protocols were conducted at Mankulam panchayat, Idukki. Based on the outcomes of this exercise Biodiversity survey was conducted using citizen scientists in areas perceived as Biodiversity rich areas by local community. Methodology used a semi structured data collection process, based on specific planned activities as what, where, when, and who made the observations, but also how observations of species are made. PBR being a document to be prepared at the grassroot level, inclusion of people from the locality is inevitable and this was ensured by PRA, RRA and FDG with diverse user groups.

Survey teams are selected based on requirements, type of assessment planned and appropriate training provided. Prerequisites taken for the data collection mandates the hands-on training for methods such as PRA/RRA/FDGs, Transect walk, Point sampling etc., supplementing electronic field guides, local/regional survey manuals for local biodiversity surveys/rapid biodiversity assessments etc. The training, review of literature, maps etc. bridged the gap between what data and information exists, and whether it is accessible and what more to find.

The lacuna in the data collection has been addressed by adopting measures such as identification of potential volunteers, standardized methods for recording biodiversity related data, defining the methodology for field survey for biodiversity and associated knowledge, methodology for ecological survey for identification of biodiversity rich sites etc. prior to which pilot or baseline inventory to be done.

The methodology also followed a chain of steps in identification of tradable bioresources with ABS potential through literature surveys and primary data collection at three different levels: industry level, organization level and local level. The methodology made possible identification of locally important/ rich biodiversity areas which can be conserved as Local Biodiversity Heritage Sites. As part of the surveys done one such area was identified in Mankulam and the community perceptions of the area was corroborated by detailed surveys. The results and the observation from the Mankulam Panchayath and the Methodology Manual for Biodiversity Documentation and monitoring can be effectively scaled up for application across the State for Conservation of biodiversity and sustainable utilization of bioresources.

The proposed methodology includes interviews with representatives from relevant Government agencies and departments, individuals and organisations that played a critical part in the policy-making processes, including NGOs,

academics and scientific institutes. Various floral and faunal scientific fraternities, citizen scientists and nature conservation enthusiasts were brought together to discuss and review the present methodologies adopted for the development of PBR, discussion for the gaps of data collection and interpretation of PBR, future strategies for PBR updation during the next decade.

A list of people interviewed and a list of questions used to guide the interviews were randomly distributed to participants actively involved in PBR preparation to understand the current status, process and gaps in the PBR process in the State. These interviews were conducted between April 2019 and February 2020. Based on the input received from the workshops, a pilot study was conducted at Mankulam Grama Panchayath, Idukki District, Kerala to fill the gaps in PBR.

The whole process started with a PRA in which BMC members, farmers and the people from three wards 6th mile, Munipara, and Mankulam participated. The sectors covered in the PRA are Agriculture, animal husbandry and associated knowledge, natural disasters, cultural expressions, climate change perceptions. This was followed by another PRA in which four tribal colonies at Kozhiyilakudi participated (Pampumkayam). The representatives of the 4 settlements and about 35 tribes participated in this programme. Through this, major areas covered are agriculture, seasonal calendar, natural hazards, climate change, cultural aspects and a natural resource mapping was also undertaken. The entire process was facilitated by facilitators for eliciting knowledge from the local community and to provide scientific input only for analysing the data. A checklist of known endemic and RET species also will help in encouraging a detailed exploration of the biodiversity. The data was gathered from prime sectors such as flora and fauna survey, socio-economic-cultural-ecological screening, analysis of tradable bio-resources with ABS potential, analysis of land use and cropping pattern, soil and water analysis, agriculture method and seasonal calendar preparation etc. The data was recorded as audio, video, sketches, and a drawing etc. was taken.

Learnings from the Process

The major learning's from the exercise is

- a) The need for dedicated mobile applications for easy and accurate identification of surveys, especially flora and fauna;
- b) Interdisciplinary association between taxonomists and biodiversity experts who are in R and D institutions, Universities and colleges etc.;
- c) A database and network team of taxonomists, local experts/par taxonomists/ Citizen scientists to assist in collecting information from the field;
- d) Training tools and modules for different categories of volunteers.
- e) Development of standardized protocols for biodiversity surveys so that PBR can be used as a tool for biodiversity monitoring

Before starting the survey the following parameters should be taken into consideration for selecting facilitators/ volunteers

- a) How Should Biodiversity Be Recorded? E.g. Field survey, Focused group discussions etc.
- b) What is methodology for Field survey for flora and fauna and associated knowledge to be adopted for a citizen science project e.g. Survey unit, Frequency of monitoring, local knowledge relating to cause of decline of biodiversity etc.
- c) What is methodology for Ecological survey for identification of Biodiversity rich site? e.g. Species richness, endemism, species diversity etc.

It was concluded that instead of adopting a single technique for data collection in order to bring in more meaningful information a wider range of volunteers/ facilitators shall be made use of. A five pronged approach can be adopted and some of these were tested at one the project site. This includes

- a) PBR exercise by State Biodiversity Boards/ BMC through volunteers/ Kudumbasree/ Asha workers etc.
- b) School and college level individual and group projects, relating to local biodiversity. The various clubs established in educational institutions as Biodiversity clubs, Green corps, Nature clubs etc. may be utilized for this.
- c) Biodiversity survey using Literacy mission volunteers/ NSS/NGO/ Citizen scientists and interested youth by a standardized protocol
- d) Field survey through identified educational institutions under the leadership of a faculty involving extensive PRA with user groups, semi structured interviews as well as biodiversity survey by a standardized protocol.

STAGE 1: Plus Two (Science) and Degree (Zoology) students/ NGO/ Citizen Scientists for baseline inventory.

STAGE 2: Post graduate and Research students in Wild life / Zoology / Botany/ Forestry/Environmental science for species specific inventory/ change assessment

Biodiversity Information System by linking scientific biodiversity databases, Citizen Science projects and PBRs. Training of volunteers/ felicitation team is an important step and they shall be selected based on requirements, type of assessment planned. Some of the training needs identified are:

- a) Hands-on Training for data collection methods such as PRA/RRA/FDGs
- b) Training for data collection methods such as Transect walk, Point sampling etc.
- c) Development of training materials as YouTube tutorials, Electronic Manual, Electronic field guides.
- d) Local/regional survey manuals for local biodiversity surveys/rapid biodiversity assessments.

- e) Field guides and other printed material for species identification.
- f) Databases such as e bird, PictureThis, Qfield, iNaturalist, Pl@ntNet, Indian Birds, PathangaSuchaka-AI, Merlin Bird ID App, Leafsnap, Indian Butterflies. Google Lens., Indian Flowers, Frog Find, Indian Frog, Indian Snakes.
- g) Use of Statistical tools as Indices such as species richness, species diversity, abundance/density, dominance, evenness/ Free software such as PAST

Source of Secondary Data

Panchayath resource maps, Development plans of Panchayath, Forest Management Plans, Data bases. Publications of departments of Agriculture, Forest, Fisheries, etc. (List of departments with schemes directly or indirectly connected with biodiversity). Dissertations/Publications/Reports, Market surveys

Primary Data Collection

The following approach can be used for data collection.

Participatory Approach: All relevant stakeholders including the local people, as well as women and youth members to be consulted to provide their viewpoints on bioresources of their locality. The following method can be adopted.

Interviews: Information related to landscape aspects and biodiversity to be collected from knowledgeable individuals identified, through personal interviews.

Group Discussions/ Focus Group Discussion/ PRA/RRA: The investigating team shall utilize all of these survey tools with the identified user groups. Local communities can be shown PowerPoint presentations of notified species / RET species/ Endemic species etc. on various taxa (flora and fauna) and asked to list the flora and fauna of the area. Format for questionnaire survey.

Biodiversity Survey can be undertaken with the help of Citizen Scientists, NGOs, Educational institutes, other volunteers interested in biodiversity conservation.

Mixed methods framework: A mix of quantitative and qualitative methods such as visits, key informant interviews, questionnaire surveys and focus group discussions (FGD) along with Biodiversity survey to collect and analyse data.

The following techniques were adopted for this study:

- a) Undertake a review of the existing PBR and identify gaps.
- b) Undertake a review of literature, maps etc. and this part of the assessment should establish what data and information exists, and whether it is accessible. Data sources can include geographic information systems. Obtain all relevant literature regarding flora and fauna for the area, including species lists, threatened plant species, surveys conducted by Forest dept., Forest management plan, papers, and reports. If local specific data is not available district level data can be collected which can be ground truthed through PRA exercise.
- c) The PBR updation process can start with a Panchayath/ BMC meeting to build the capacity of BMC about the importance of biodiversity conservation and to define the objectives of biodiversity assessment.
- d) The team can develop a list of key stakeholders/ user groups such as Farmers maintaining diversity, Fishermen, Tribals etc. during this meeting and Focus group discussions/PRA's can be held with each of the user groups. During this meeting sites can be identified for Biodiversity survey also.
- e) Based on inputs received knowledgeable individuals can be selected and personal interviews/ questionnaire survey conducted.
- f) Resource mapping of Panchayath can be done by the people themselves to study about villagers' perceptions of natural resources found in the Panchayath and how they are used. The resource mapping can cover natural resources, river, stream, forest land, agriculture land, buildings roads and other structures, human wildlife conflict areas etc.

- g) Local communities can be shown local field guides on various taxa (e.g. birds, mammals, butterflies and reptiles) and asked to list the species found in their village, their local names and uses and their current status.
- h) Local communities can also be shown PowerPoint presentations of threatened species and major traded bioresources of their locality to get information about nature of trade.
- i) During each of the FDG associated knowledge relating to the following are to be collected
 - i. Art and Culture
 - ii. Agriculture
 - iii. Animal husbandry
 - iv. Architecture
 - v. Biodiversity Conservation and utilization
 - vi. Eco-friendly practices
 - vii. Fisheries
 - viii. Forest and Wild life Management
 - ix. Health Care
 - x. Medicinal plants and Food Plants
 - xi. Rural Technology
- j. Biodiversity surveys: Select survey team/ citizen scientists having expertise in specific sectors and based on the nature of assessment. For faunal surveys, opportunistic documentation can be carried out and species observed recorded as discussed later on. For floristic surveys, the team can note down important trees, shrubs and herbs within the area. Spatial technology and mobile apps can be utilized for species identification. For floristic surveys, spatial technology and mobile apps can be used. For faunal surveys, opportunistic documentation can be carried out and species

observed recorded. Transect walk and Point counts are the most widely utilized form of standardized survey methods for flora and fauna. Point-transects can be used where habitats are difficult to walk over. Point counts tend to range from 5 to 30 minutes in length. The surveyor can conduct up to 10 counts between a time periods. The points will be predetermined and positioned at minimum of 100 meters apart. The surveyor will count and record the number of all species identified by sight and call as well as their distance from the observer. Transect counts entail counting the numbers and species along a fixed route ('transect') on a regular basis (e.g. weekly) throughout a given time of the year. Line transects are recommended for rapid assessments in order to sample the greatest area of interest continuously. It is best to restrict one transect to one habitat and land-use type. Walk transects at a slow, constant pace and Count individual species in an imaginary box. When no species have been observed zero-counts are marked. Point are marked where a count is performed for point count. All location are georeferenced either through mapping tools or through the GPS system. By collecting counts of each species, analysts can better estimate population abundance. Record additional biological notes such as behaviours, activity-time, vocalisations, diet, feeding plants, host plants. Nesting site, number of individuals sighted. Document the importance of the species to local people and associated knowledge. Document any observed threats for each species.

- k. A complete information base can only emerge if year round, seasonal observations and recording is carried out
- l. After reporting is done online, an initial first screening can be done by TSG/ Reviewers automatically for the first stage of the validation process. Validation can be done by crosschecking whether the survey was done at a suitable date, time of day, weather conditions for the species. The optimum time for different taxa is provided in the individual sections. The reviewer can check the accuracy of identification whether the record is within the

known range of the species; the species is typically flying during the noted period; behavioural pattern is normal; are there odd patterns involving rare species?

The major points put forward based on the survey in Mankulam Grama Panchayath.

- a) A standardized protocol for biodiversity surveys and monitoring through a three-pronged approach using volunteers with different levels of knowledge.
- b) The development of user-friendly mobile apps for surveying.
- c) Collaboration between institutions involving taxonomists and biodiversity experts.
- d) Networking existing databases.
- e) Citizen scientists at the local level.
- f) Necessity for Training tools and modules for different categories of volunteers, local/regional field guides, survey manuals.
- g) The participation from Literacy mission volunteers/ NSS/NGO/ Citizen Scientists and interested youth.
- h) Involvement of student groups (graduates, PG and scholars) in the field of Wildlife/Zoology/Botany/ Forestry/Environmental science ensures species specific inventory/ change assessment with community participation.

A Methodology Manual for Biodiversity Documentation and monitoring - ePBR was developed based on this and was peer reviewed by a group of scientists and all suggestions incorporated and is ready to be officially released.

3.2.4 Pilot study for validation of the methodology for PBR updation:

A biodiversity survey at Mankulam Panchayath of Idukki district conducted with the help of skilled persons who were experts in the faunal group. Conducted surveys of birds, Odonates and butterflies in certain selected areas of Mankulam Panchayath such as Aanakkulam, Kuwait city, Virinjapara and Virinjaparapalam.

Transact walk and point count were the two methodologies used for the survey. A checklist of birds, butterflies and Odonates was prepared and calculated the diversity index using Shannon - Weiner Diversity Index, Simpson's Index. The relative abundance of species per habitat/ district was determined using Relative abundance. The results have shown the high richness of species in Mankulam Panchayath. The results of the study were already presented in sections 3.1.1. A.

This perspective has presented an overview of the integrated tools, concepts, and field experience that are necessary to authenticate the PBR. PBR is a dynamic document and hence updation is a continuous process. The updated PBR should address among other things promotion of conservation of biodiversity, deal with ways to accrue benefits to community, quantification of resources, and serve as an impact assessment tool for developmental activities. PRA requires experienced facilitators to enable local people conduct their own analysis and accordingly design their own action plan for conservation of biodiversity. Preparation of PBR, its updation and development of an electronic database of PBR is an enormous task which has to be addressed in phases extending over several years and should be updated time to time involving different data collection methods, recorder groups and user groups. Based on the experiences and analysis of the perceived difficulties encountered during PBR preparation it is suggested that PBR updation be done through a approach using volunteers with different levels of knowledge. The experiences gathered from the field trial and data collection methodology developed for updating the PBR, may help in updating PBR in other states in India. This grassroots effort and increasing emphasis on local people and their knowledge will create more impetus to scale-up community-based approaches.

3.3 Objective 3: Documentation of Economically Important Flora/ Fauna - Tradable Bio-Resources with ABS Potential.

Kerala is a biodiversity rich state and many economically important plant and marine species are found in Kerala. Over exploitation of bioresources has led to population decline of several species. Biological Diversity Act facilitates regulation of access to bioresources for commercial; utilization in certain cases. India,

supplies of 700 out of 776 Indian plant species used commercially for preparation of medicines. But there is no proper information on their current status and possible levels of over-exploitation with either Governmental agencies or pharmaceutical industry. The only reliable information on these issues, albeit limited to their own localities, resides with local forest produce collectors who are employed by agents of pharmaceutical companies, or with folk practitioners of herbal remedies.

Over exploitation of bioresources has led to population decline of several species. Biological Diversity Act facilitates regulation of access to bioresources for commercial; utilization in certain cases. This requires adequate information on biological resources, their actual and potential economic value, and the various stakeholders utilizing bioresources for commercial use or for bio survey for commercial utilization.

3.3.1 Commercially Utilized Bioresources

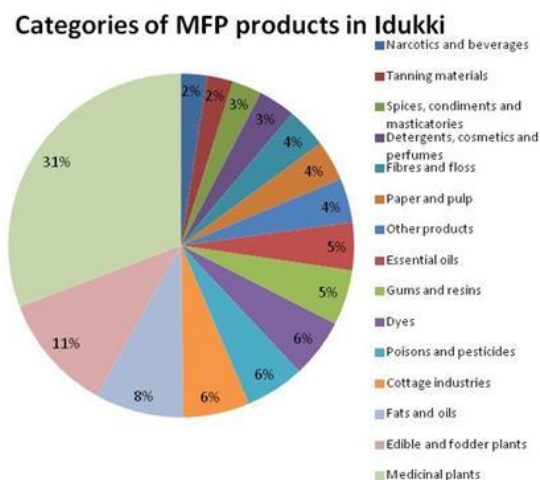
Based on the PBR revisions, a list of bio-resources was identified for commercial potential. For the purposes of this review items which are normally traded as commodities were also included under the definition of bioresources.

Table 15: Panchayath wise concise list of commercially potential bioresources from PBRs of Idukki district (Annexure 36-38)

Name of Panchayath	Total Nos.
Mankulam	107
Vattavada	41
Adimali	89
Kuttampuzha	29
Munnar	192
Edamalakudy	12
Athirapally	78

Minor Forest Produces (MFP) from Idukki District, Kerala

Non-Wood or Non-Timber Forest Produces (NWFP or NTFP), formerly known as Minor Forest Produces (MFP), include all forest products including grass, fruit, leaves, animal products, soil and minerals except timber, small wood and firewood, which are considered as the major produces. Minor Forest Produce



(MFPs) contributes over 50 per cent of the forest revenue and 70 per cent of the export income. MFPs are classified as Group I (Minor Forest Produce of plant origin, Minor Forest Produce of animal origin, Minor Forest Produce of mineral origin) and Group II (Tourism, Recreation and wildlife). The major habitat of the NWFP plants of the State is the natural forests, occurring mainly in the hilly uplands and the highlands. Destruction or modification of habitats and ranges, Over-exploitation for commercial, scientific and educational purposes, Disease and pest attacks, Inadequacy of existing regulative mechanisms, other natural and man-made factors. Due to unregulated exploitation of this natural resource base, of late, there has also arisen the need to conserve many of them. Taking stock of the present availability and resource status of the plants and products, identification of species which deserve protection and propagation, delimitation of areas of NWFP plant concentration for overall conservation, formulating non-destructive methods of harvest and sustainable utilization and evolving methods for their regeneration are certain aspects which deserve immediate attention to ensure the continued availability of products and benefits from this group of plants in future.

A total of 110 MFP yielding plants were identified in the Idukki District (Annex 39- 38). Based on the usage, MFP produced plants is categorized into 17 different trading sectors. Medicinal plants (89) , spices, condiments and masticatories (8),

gums and resins (15), dyes (16), tanning materials (7), essential oils (13), detergents, cosmetics and perfumes (10), narcotics and beverages (7), fibres and floss (11), edible and fodder plants (32), fats and oils (24), paper and pulp (11), poisons and pesticides (16), plants used in cottage industries (18) and plants yielding certain other specific products classified under the head 'other products' (12).Based on the usage, MFP produced plants is categorized into 15 different trading sectors.

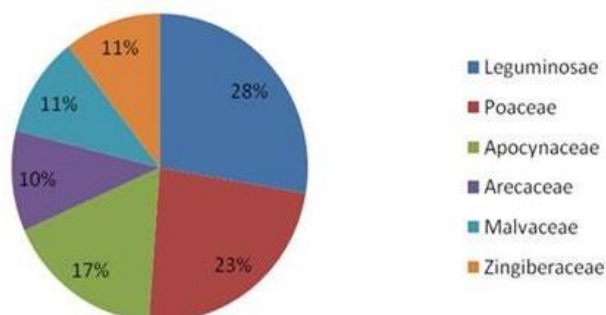
Table 16: Commercially potential MFPs of the Idukki District

Categories of MFP	Total Numbers of MFP products
Medicinal plants	89
Edible and fodder plants	32
Fats and oils	24
Cottage industries	18
Poisons and pesticides	16
Dyes	16
Gums and resins	15
Essential oils	13
Other products	12
Paper and pulp	11
Fibres and floss	11
Detergents, cosmetics and perfumes	10
Spices, condiments and masticatories	8
Tanning materials	7
Narcotics and beverages	7

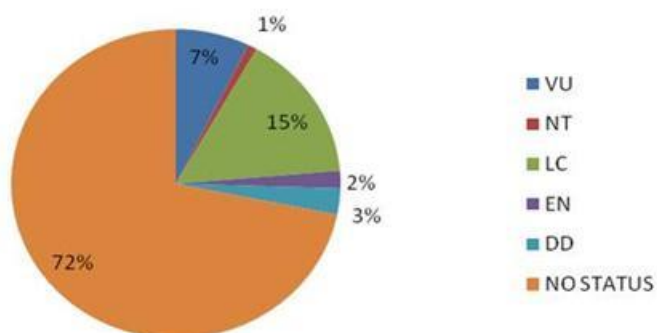
Considerable increase is noticed in the demand for drug plants due to the rapid growth of Ayurvedic medicines by people belonging to different countries all over the world. In addition to Ayurveda, other systems like Sidha, Unani, Homeopathy and Allopathy which

also depend on medicinal herbs for many of their drug preparations. This increased demand of raw materials is not available in sufficient quantity in forests

Major Families of MFPs



IUCN Status of MFPs



to meet the people's need.

This increasing demand leads to excessive collection of the medicinal plants and other NWFP species from their natural abode. This may lead to paving way to erosion of other resources. This is a good time to increase MFPs'

products, especially in the pharmaceutical and industrial applications. The BMCs in the respective Panchayaths as well as the Forest Department can make periodic interventions in the existing management system to increase MFP output from the existing stock. A detailed analysis of the demand and supply chain, effective access to high-demand MFPs, and the implementation of benefit-sharing sheds light on the need of sustainable utilization of MFPs through appropriate management strategies. The management strategies should prioritize the MFP yielding plants in the study area and it is essential to know the distribution of natural habitat of different species. This will shed light on distribution patterns, population size, and the identification of rare and endangered MFP species. This information will be very useful in identifying in situ conservation areas and in determining *ex situ* protection strategies to be followed for different or endangered species.

3.3.2. Methodology for the identification of Tradable Bio-Resources with ABS Potential

As part of the UNDP-HRML project, a draft methodology was developed for the identification of tradable bio-resources with ABS potential. The project was ongoing in the 11 Grama Panchayath such as Marayoor, Munnar, Kanthalloor, Vattavada, Chinnakanal, Mankulam, Devikulam and Edamalakudy in Devikulam block of Idukki District; Adimali Grama Panchayath in Adimali block, Idukki District; Athirapally in Chalakkudy block of Thrissur District and Kuttampuzha in Kothamangalam block in Ernakulum District, India with the geographical area of 2198 km². Preparing the existing list of flora and fauna in the Idukki district and categorized the species according to the conservation status of IUCN, CITES and WPA.

Methodology for the identification of tradable bio-resources

Government level	Preliminary level	At Secondary level
1. Management plan	1. Kerala Forest and Wildlife Department ¹	Field visits especially the forest patches to understand the potential of certain species which are available in the area. (GPS information)
2. Conservation strategies	2. Kerala State Federation of SC ST Development Co-operatives Ltd (MFP Societies)	
3. Scientific approach adopted (if any)	3. NGO associations	Development of questionnaire in local language ²
4. Working plan	4. Authentic websites	Locations for data collections: High, Medium and Low populated areas in and around the forest fringes.
	5. Information pertaining to national and International scenarios who directly linked with the trading of bio-resources.	
	6. Published research articles.	Methods of data collections: Rapid Rural Appraisal (RRA) ³ , Participatory Rural Appraisal (PRA) ⁴ , Focus group studies ⁵ , key interview ⁶
	7. Preparing the existing list of flora and fauna in district wise and categorized the species according to the conservation status of IUCN, CITES and WPA.	Data compilation and statistical analysis (Excel).
		Preparing a Species Selective Index (SSI) A novel tool designed for bio-resource selection under Access and Benefit Sharing (ABS) mechanism ⁷

¹DFO, Wildlife warden, RFO, Assistant wildlife Warden, SFO, BFO, Reserve Watcher, Forest check posts, Vanashree, Vana Samrakshana Samithies (VSS), Eco-development Committees (EDC)

³RFO, Assistant wildlife Warden, SFO and MFP Societies.

⁴Native peoples and tribal villagers

⁵BMCs, elderly people, medical practitioners, youth, women

⁶Local market owners, bio-resources collectors, traditional healers/vaidyas, Reserve Watchers

At preliminary level, the literature survey was conducted with government authorities such as Kerala Forest and Wildlife Department (DFO, Wildlife warden, RFO, Assistant wildlife Warden, SFO, BFO, Reserve Watcher, Forest check posts, Vanashree, Vana Samrakshana Samithies (VSS) and the Eco-development Committees (EDC), Kerala State Federation of SC ST Development Co-operatives Ltd (MFP Societies) NGO associations authentic websites, linked with the trading of bio-resources.

Field survey was conducted in all the Panchayaths; Field visits were conducted especially to the forest patches to understand the potential of certain species which are available in the area and questionnaire developed in local language (Annex 39).Data from various locations were gathered through Conducting Rapid Rural Appraisal (RRA) involving RFO, Assistant wildlife Warden, SFO and MFP Societies, Conducting Participatory Rural Appraisal (PRA) among the native people and tribal villagers, Focus group studies with BMCs, elderly people, medical practitioners, youth, women to get information related to medicinal plant species. Key interview with local market owners, bio-resources collectors, traditional healers/vaidyas, Reserve Watchers and casual conversations, were the methods of investigation. The study sought to collect multiple indicators related to the insider's knowledge of the situation. The study was conducted at three different levels: Industry level, Organization level and Village level. The method followed for the study, at all the three-level included questionnaire-based survey and personal interviews

At industries level, basic information about:

- a) Procurement of raw materials to the manufacturing of the final product.
- b) Management policies at the different level of operations were discussed with the officials of the concerned industry.
- c) Questions related to forest-based bio-resources.
- d) The collection procedure.

- e) Quantity, demand and supply mechanism.
- f) Sharing of royalty or ABS information.
- g) Other associated cost, by-products.
- h) Management and R&D related information.

Similarly, the study at government level was conducted using the methodology followed for industries. (a) management plan; (b) conservation strategies; (c) the scientific approach adopted (if any) were discussed; (d).Also, the working plan was reviewed for the collection of information on floral and faunal diversity. Based on such interactions, villages from where the raw materials (bioresources) are procured were selected.

Survey at village level was conducted using Participatory Rural Appraisal (PRA) and RRA, (Annex 40) (a) Questionnaires and personal interviews; (b) The BMC (Biodiversity Management Committee);(c) Self Help Groups (SHGs), were the target audience for the data collection at the village level; (d) The data collected was further analysed by SPSS (16.0); (e) The Boston Consulting Group (BCG) matrix was also analysed for the selection of the species under ABS mechanism.

Prepared a Species Selective Index (SSI) a novel tool designed for bio-resource selection under Access and Benefit Sharing (ABS) mechanism (Annex 37).

3.3.3. Bio-Resources with ABS Potential

Data of 15 NTFPs traded in large quantities during the last two years documented. Of which *Kattukurumulaku*, *Karikurinja*, *Pinari*, *Marotti*, *Pachottitholi* were selected for detailed supply chain analysis. The Movement of '*Kattupadavalam*' from collection point to pharmaceutical companies were identified (Table 17).Ayurvedic products marketed by 'Oushadhi' prepared using '*Kattupadavalam*' as one of the main ingredients (Table 18).

A manual on "Tradable Bio-resources' Documentation (Database) and Identification of its ABS potential with Supply Chain: A Manual" was prepared.

Table 17: Movement of 'Kattupadavalam' from collection point to pharmaceutical companies

S. No.	Date of sale	Name of Companies	Quantity (kg)	Unit price (Rs.)	Total amount (Rs.)
1	27/5/2019	Nagarjuna Herbal Concentrates Ltd, Kalayanthani P.O., Thodupuzha, Idukki District Raw materials delivered to Nagarjuna job work Centre, Naga herbals, Kanjicode	1200	250	3,00,000
2	30/12/2019	Kerala Ayurveda Limited, Athani Post, Aluva, Ernakulam District, Kerala	-	-	3,20,000
3	28/01/2020	Kerala Ayurveda Limited, Athani Post, Aluva, Ernakulam District, Kerala	1000	280	2,80,000
4	02/02/2020	Oushadhi, The Pharmaceutical Corporation (IM) Kerala Limited Kuttanellur, Thrissur	1300	250	3,25,000
5	09/02/2020	Oushadhi, The Pharmaceutical Corporation (IM) Kerala Limited Kuttanellur, Thrissur	1300	250	3,25,000

Table 18: Finished products of Oushadhi products with Kattupadavalam

Sl. No.	Medicines	Quantity (kg)
1	Aragwadharishtam (450 mL)	29.76
2	Aravindasavam (450 mL)	5.76
3	Chandanasavan (450 mL)	3.0
4	Chavikasavam (450 mL)	57.6
5	Dasamolarasayanam (25 g)	0.77
6	Gulguluthgikthakam K C (1 kg)	120
7	Gulguluthgikthakam Ghritham (450 mL)	30.72
8	Gulguluthgikthakam Kashayam (200 mL)	15
9	Kaidaryathi K C (1000 g)	32
10	Mahamanjishtadi K C (1000 gm)	14.13
11	Mahamanjishtadi Kashayam (200 mL)	6.28
12	Mahathikthaka Ghritham (450 mL)	0.41

13	Mahathikthakam Kashayam (200 mL)	7.5
14	Nimbadi Choornam (500 g)	10
15	Nimbadi Kashayam (200 mL)	27.32
16	Padadvadi Ghritham (200 mL)	0.72
17	Padoladhiganam Kashayam (200 mL)	42
18	Padolamooladhi (1 kg)	36
19	Padolathiganam K C (1000 g)	80
20	Panchathikthakam K C (1000 g)	288
21	Patoladi Ghritham (450 mL)	1.54
22	Punarnavadhi KSC (500 g)	96
23	Punarnavadhi K C (1000 g)	192
24	Punarnavasavam (450 mL)	7.2
25	Punarnavadhi Kashayam (200 mL)	31.25
26	Siva Gulika (10 Nos)	46.08
27	Sudarsana Choornam (500 g)	6
28	Sudarsananam tablet (100 Nos)	6
29	Thikthaka Ghritham (450 mL)	30.7
30	Thrayandyadhi Kashayam (200 mL)	45.5
31	Useerasavam (450 mL)	6
32	Vajraka Ghritham (900 mL)	1.21
33	Vajrakam Kashayam (200 mL)	27.74
34	Panchathikthakam Kashayam (200 mL)	50
35	Aragwadhadi Kashaya Choornam (1000 g)	50
36	Nilavembu Kudineer (100 g)	15
Total		1419.2

3.3.4. List of Bio-Resources transported through selected check posts in divisional forest office, Devikulam, Munnar, Idukki District, Kerala

The commercially important biological resources found in the Western Ghats play a vital role in India's economic development, especially in the export sector. The check posts served as custom house to collect *chunkam* (tax) against the hill produce. The data collected from the check posts helped to trace the trade of biological resources within Kerala or other States. Information on tradable biological resources from major forest check posts (Palar and Bodimettu in

Devikulam Range, Thalakode in Neriya Mangalam Range and Panamkutti in Adimali Range) under the Devikulam Divisional Forest Office, Idukki District, Kerala were collected (Annex 41).

The Ministry of Environment, Forests and Climate Change (MoEFCC), in consultation with the National Biodiversity Authority (NBA), has declared that the provisions under Section 40 of the Biological Diversity Act 2002 (18 of 2003) do not apply to the trade of 421 biological resources which are normally traded as commodities (The Gazette of India: Extraordinary Part II-Sec. 3(ii))^{l, m}. Seven species such as *Grevillea robusta* and *Ochlandra Travancore*, *Santalum album*, *Macaranga peltata*, *Artocarpus hirsutus*, *Swietenia mahogani*, *Erythrina variegata* are not mentioned in the list of NTC by the MoEF&CC.

Grevillea robusta (Silky oak), is a native species in the Northern New South Wales and southern Queensland, Australia, commonly planted as a boundary tree around the perimeter of tea plantations in Munnar. It is planted for timber and as a windbreak. The silky oak provides abundant quantities of leaf mulch, which may accumulate to a depth of 30 - 40 cm. This thick layer protects the soil and maintains soil temperature. It is used to provide high shade in tea and coffee plantations.

Ochlandra travancorica (Elephant grass or Etta or Oda), is a species of clump-forming, perennial bamboo with short rhizomes, endemic to the Western Ghats, India. This species are commonly harvested from the plains and foot hills of reserved forest areas of Adimali, Kuttampuzha and Mankulam by Kerala State Bamboo Corporation Ltd. Angamaly in Kerala. The leaves are used for thatching. The culms are in demand for manufacturing mats and baskets, umbrella handles, fishing rods, handicraft, and for making the walls of huts. The mats made from reeds are used for making 'Bamboo ply'. The culms are one of the most important sources of long-fibre raw material for paper pulp. The shoots, when 6 to 9 months old, constitute a splendid paper material. The fibre has been pronounced superior to esparto but the expense of chemicals required in the process makes it uneconomic.

Table 18: List of bio-resources transported through selected check posts in the Study area of Idukki District

Common name	Species	Family	IUCN red list category and criteria	Part used for trade	Source of collection	Sale/ trade destination
<i>Eucalyptus</i>	<i>Eucalyptus</i> spp.	Myrtaceae	-	Wood	Kundala, Idukki District	Perumbavoor
Silver oak	<i>Grevillea robusta</i> A.Cunn. ex R.Br.	<i>Proteaceae</i>	Least Concern ver 3.1	Wood	<i>Eco-point, Munnar</i>	Perumbavoor
Ginger	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Data Deficient ver 3.1	Rhizome	Rajakumary, Idukki district	Theni District, Tamil Nadu
Cardamom	<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	-	Fruit/Seed	Border of Bodimettu, Kerala	Nedumbassery market for both domestic and world over trade
Black pepper	<i>Piper nigrum</i> L.	Piperaceae	-	Fruit	Nedumkandam, Idukki district	Erode District, Tamil Nadu
Tea	<i>Camellia sinensis</i> (L.) Kuntze	Theaceae	Data Deficient ver 3.1	Leaf	Munnar, Kerala	Ernakulam for both domestic and world over trade.
Reeds	<i>Ochlandra trauancorica</i> (Bedd.) Gamble	Poaceae	-	Wood	Reserve forests in Idukki District	Kerala State Bamboo Corporation Ltd. Angamaly in Kerala.
Sandalwood	<i>Santalum album</i> L.	Santalaceae	Vulnerable A2de ver 3.1	Wood	Marayoor Government Dep.	various places in Kerala
Theetapullu / Co3 / Co5	<i>Pennisetum purpureum</i> Schumacher.	Poaceae	Least Concern ver 3.1	Tender stem and leaves	Various Patta Land in Adimali	Maniyarankudi, Vazhathoppu, Idukki District

Jack Fruit Tree	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	-	Wood	Various places in Idukki District	Perumbavoor
Tree of Heaven	<i>Ailanthus excels</i> Roxb.	Simaroubaceae	-	Wood	Various places in Idukki District	Perumbavoor
Vatta	<i>Macaranga peltata</i> (Roxb.) Müll.Arg.	Euphorbiaceae	-	Wood	Various places in Idukki District	Perumbavoor
Mango tree	<i>Mangifera indica</i> L.	Anacardiaceae	Data Deficient ver 2.3	Wood	Various places in Idukki District	Perumbavoor
Neem	<i>Azadirachta indica</i> A.Juss.	Meliaceae	Least Concern ver 3.1	Wood	Various places in Idukki District	Perumbavoor
Rubber	<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.	Euphorbiaceae	Least Concern ver 3.1	Wood	Various places in Idukki District	Perumbavoor
Anjili	<i>Artocarpus hirsutus</i> Lam.	Moraceae	Least Concern ver 3.1	Wood	Various places in Idukki District	Perumbavoor
Cashew tree	<i>Anacardium occidentale</i> L.	Anacardiaceae	-	Wood	Various places in Idukki District	Perumbavoor
Small-leaved Mahogany tree	<i>Swietenia mahogany</i> L.	Meliaceae	Near Threatened A2cd ver 3.1	Wood	Various places in Idukki District	Perumbavoor
Murik	<i>Erythrina variegata</i> L.	Leguminosae	Least Concern ver 3.1	Wood	Various places in Idukki District	Perumbavoor

Indian sandalwood (*Santalum album*) is one of the most important economic tree species harvested mainly for its heartwood and oil. It is commonly found in dry deciduous forests of India. The Marayoor sandal reserve in Kerala State is considered one of the vanishing treasures of India. The Kerala Forest Department maintains about 8,500 acres of natural sandalwood in the Marayoor Sandal Reserve Forest. According to Saby Varghese, DFO, Marayoor, approximately 26 companies, temple committees and individuals participate in the auction. The companies included soap manufacturers, pharmaceutical companies and sandalwood extracting firms.

Macaranga peltata (*Vatta*), a Dioecious tree, the wood is commonly used as Firewoods. Wood also used for making carton boxes.

Artocarpus hirsutus (Anjili or Ayani), is a tall evergreen tree up to 35 m tall and up to 5 m in girth. Fruits are edible. It is endemic to the Western Ghats- South, Central and Maharashtra Sahyadris. The wood is used for boat and shipbuilding, construction works, furniture and for agricultural implements. This timber woods have much influenced the expression of cultural diversity of Keralites particularly in construction (roofing, foundations, walls and floor of temples, palaces and mansions).

Swietenia mahogani, a native of south Florida, large, semi evergreen tree, rounded canopy and casts light, dappled shade, suitable for maintaining a lawn beneath. It can reach 75 feet in height with a 50-foot-spread. The dense, strong wood of Mahogany is quite resistant to wind-damage. Plants will respond with rapid growth to rich, well-drained soil and regular fertilizing. The bark has been used for dyeing and tanning leather.

Erythrina variegata, is a much-branched deciduous tree growing from 3 - 27 meters tall. The plant is widely cultivated throughout the tropics. In India, this species is grown as an ornamental tree or a living fence or hedge plant or medicinal plant or shade tree or for soil conservation. The white wood is light in weight, soft, spongy and fibrous, powdered and used as a face powder. It is also used locally for

making spears, shields, troughs, outriggers for canoes, and as floats for fishing-nets, making statues, toys etc. The wood has been tested as a source of pulp for the paper industry. The wood can smoulder for a long time without going out and so is traditionally used for keeping a fire in the house.

3.4. Objective 4: Documentation of the impact of landslides/floods on selected ecosystems and keystone/indicator species.

The disturbances caused by floods and landslides have brought in major temporal and spatial heterogeneity in the structure and dynamics of natural communities and ecosystems. Being a slope-modifying process, landslides and floods induced changes in the spatial heterogeneity through erosional and deposition processes, with areas of exposed parent material with humidity deficit (e.g. upper scarps of landslides), and lower/downstream water-logged areas with colluvial deposition. These slope-processes further resulted in the movement of many nutrient elements, like calcium and phosphorus, along the altitude gradient to downstream areas. These catastrophic events, particularly landslides, flooding and erosion have an important role in distribution of nutrients.

Landslides reset the „pedogenic clock“ of the affected areas, causing retrogressive ecological succession processes. Consequently, the effects of landslides end up in terrain modification. They create habitat discontinuities in natural systems, like forests and grasslands, causing an increase in spatial and functional diversity. However, the increase of heterogeneity, driven by landslides and floods, is not always perceived as beneficial in maintaining biodiversity. Some studies emphasized that these events cause the installation of invasive alien and nomadic plant species which affect the food web and functional dynamics of the system. It is therefore imperative to study the impact of landslides and floods on biodiversity of the affected area.

Impact of Floods and Landslides on Biodiversity and the changes that occurred to Bio-resources in selected areas of Idukki District were studied.

3.4.1. Post-Flood /Landslide Scenario in Idukki

This district has seen worst scenario during the floods and landslides during 2018. Repeated landslides in the upper region resulted in the exposure of soils with poor water holding capacity. Heavy floods and associated loss of surface soils also resulted in loss of soil nutrients. In this process, highlands and midlands have been bereft of topsoil along with subsoil. Thousands of trees had been uprooted. Usually landslides result in fragmented vegetation, and partial or total removal of native woodlands. This kind of severe destruction must have indisputably resulted in loss of habitats for animal species; loss of critical habitat for endangered species; and finally accounting for the loss of floral and faunal biodiversity. Over a period of time, if left naturally, regeneration can happen. Often, there would be competition from the ground vegetation, and between herbaceous and arboreal flora; leading to a new shift in species with regard to succession. It might take decades before the ecosystem stabilizes itself.

The study emphasized the qualitative and quantitative aspects with respect to selected ecosystem and sites. Analysis highlighted various aspects of the effect of floods and landslides on:

- a) Different agro-communities
- b) Different bio-resources production and the loss incurred
- c) Loss in biodiversity
- d) Socio-Economic Impact

Floral, Faunal and Ecological Survey

Following techniques were employed in the study;

- a) A survey of floral remnants in the study sites was conducted by collecting details from the panchayat records, discussion with key officials and secondary source of information from Agriculture and Forest departments. Secondary data was also collected from websites, newspaper cuttings and journals.

- b) Explorative study was conducted at severely affected locations in the panchayat. This ground reality was assessed through focus group discussions and in depth interviews with the affected people.
- c) All the available data on the post flood situation collected from different sources and methods were collated with the available details in the pre flood situation (again made available from different secondary sources) to arrive at conclusions.

Results of the Study

The data collected with respect to floral, faunal and ecosystem biodiversity have been analysed and results are consolidated as given below (Annex 43):

The main occupation of the people in Idukki is agriculture. The prominent crops grown in the district are cardamom, tea, cool season vegetables, fruit crops, garlic, potato, etc. The flash floods, mudslides and landslides had a terrific impact and painted a grim picture on the biodiversity of one of the most biodiversity rich districts of the State. Every panchayat recorded destruction of varying magnitude and phenomena like sand piping and formation of sand bars. This report depicts a post scenario of floods in the district with respect to different biodiversity aspects.

During the flooding period, almost all the Grama Panchayats in Idukki district witnessed flooding and landslides. According to the Government report Idukki recorded 278 major landslides and 1800 mudslides which took 35 human lives along with the death of several animals and birds in the homestead. The damage was assessed over a net area of 340 ha. of land. The flow of landslide debris and deposition of sediments from flood destroyed many cultivation terrains. The primary survey conducted by CMD revealed more details of losses and biodiversity status at a point of seven months after the devastating flood.

3.4.2.1. Assessment of Floral Biodiversity in Idukki District

Impact on Shrubs and Herbs.

Shrubs represent perennial woody plants while herbs are annual/ biennial/ perennial herbaceous plants. The different Grama Panchayats of Idukki district supported a wide range of shrubs and herbs ranging from spices, tea, medicinal plants, tuber crops, flowering plants, coffee, weeds, and many other native crops in the region. The landslides, debris flow and sedimentation were the main reasons for these losses. In flooded areas, the accumulation of water in the root zone and the absence of oxygen created severe stress to the roots generating toxic compounds in the rhizosphere, which killed many plants. In flooded areas, when the height of turbid water stood above the plant level, there could have been sedimentation of clay particles on the foliage which ultimately reduced the receipt of sunlight on plants thereby a forced reduction in Photosynthesis. This forced the plants to utilize the stored food reserves within the plant, eventually killing it. The erosion of surface soils from the sloppy terrains also resulted in the dislodging of plants from its growing environment. Further, many flora were also eliminated by the secondary fungal infections which developed subsequently.

The natural restoration of many species will happen over a period of time with the left over root systems or seeds. If restoration of a particular species is required within a time frame, purposeful introduction of that species will have to be done through seeds/ seedlings/ vegetative cuttings as the case may be.

Impact on Trees

Many trees naturally established in the landslide area along with planted ones particularly in the plantation and fruit sector have been uprooted. At some points, the erosion has resulted in the exposure of roots. Root infections also brought down the health of trees. Flooding had reduced the oxygen levels in the soil and triggered the production of toxic compounds which killed most of the roots of the trees. The extent of stress felt by each tree depended on the species, age of the

plant, the duration of flood, the height of flood water and extent of sedimentation, soil erosion, root exposure & toxic compounds generated in the root zone.

In the case of fruiting trees, most of the fruits started shedding within 4-5 days of flooding. There was defoliation from trees particularly after the flood water had receded. Though many perennial trees withstood the flood continuously for a week, there was buckling of leaves/ nuts (in case of coconut) and shedding of fruits in other cases. The time taken to exhibit these symptoms by each plant varied considerably. The accumulation of sediments and the nature of sediments deposited, decided the timeframe for manifestation of root diseases. For various reasons perennial trees at different locations started drying.

It was difficult to assess the extent of damage at many places as there were no proper mechanisms to evaluate it. Physical verification of the entire area was not possible within the short span of time considering the constraints of the study. Further, when the survey was conducted after a period of 7 months subsequent to the flood, there was natural restoration and natural regeneration of flora and the exact impact of flood on the floral biodiversity could not be assessed particularly when data is collected through the semi-structured interviews and inputs from key officials. From the survey results, it is more or less clear that maximum damage had occurred to annual shrubs and weeds.

3.4.2.2 Impact on Fauna in Idukki District

Fauna refers to the entire collection of animals within a specified region, time period, or both. This includes soil dwelling organisms, flying and non- flying insects, crustaceans, molluscans, reptiles, fishes, mammals, amphibians, birds and lower group fauna. This group of animals had responded to flood and landslides in different ways. It is reported in the survey that removal of surface soil through landslides had removed many innate beneficial microbial organisms. Continuous flooding in soil has also resulted in the eliminated most of the soil dwelling organisms from that particular region. However in the case of bacteria, fungi or actinomycetes sporulation might have taken place in soil under unfavourable

conditions or there must have been an automatic reduction in their population. In the case of bacteria there must have been a shift from aerobic to anaerobic with the flooding of the soil. Soil insects like Mole Cricket and many small organisms must have perished in the flood due to their inability to make quick movements to escape adverse situation. In such cases their population might have gone down and restoration could occur only over a long period of time. However in the case of insects which could fly must have made its escape from the flooded area to safer regions providing very less count in that region. As far as such insects are concerned their population will automatically get restored with the reversal of the adverse situation and the establishment of the host plants on which these insects depend.

In the case of crustaceans, they must have been either been washed off or killed under landslides. Their restoration will also take time and is not a concern. Regarding the birds, very few references have come in the survey report. This might be due to the fact that birds are not affected by land slide or flooding and they have enough opportunity to migrate or escape to safer places particularly inside the forests.

Being a hilly terrain, the scope for fish farming is very limited and its rearing was restricted to mainly different dams and a few fish farms at Kanjikuzhy and Kamakshy Panchayats. The release of water from dams must have provided opportunities for these fishes to escape and the destruction of fish farms in the district by landslides must have killed the fishes contained within it. In the case of reptiles, as flood levels increased and started invading their dwelling place, they moved to higher regions of safety. But in this situation most of the reptiles found asylum in the nearby forest area or on trees. Once the conditions are conducive for their return, they may opt to go back to their own habitat.

Impact on Animal Husbandry and Fisheries

Damage to the Animal husbandry and Fisheries in this district was marginal. Death of 364 numbers of birds in the district was reported. Causalities reported

with respect to other animals were as follows; buffalo (17 numbers), cow (58) and goat (97). The fish farms in Idukki Kanjikuzhy, Kamakshy Panchayats were destroyed due to floods and landslides. This has eliminated many reared species of fishes and fingerlings. Four fish farms were reported to be destroyed from the above Panchayats.

3.4.2.3 Assessment of Agro-Biodiversity

Agricultural sector suffered the maximum damages. The damages were reported in spices, banana, tubers, vegetables, rice, coconut and many fruit trees. Among the spices; cardamom, pepper, clove, cinnamon & nutmeg suffered damages. In the case of turmeric and ginger there was rampant decay of rhizomes beyond regeneration. Because of the land slides, fertile soils from the surface had been removed, exposing lesser fertile soils. Sedimentation brought about by the floods, across different Panchayats reported damages to many annual crops. The natural compaction that had gone into the soil during the flood reduced the aeration capacity of the soil and extended moisture availability in soil invited many rhizosphere issues to many crops, necessitating chemical and biological interventions.

A majority of the tuber crops grown in the area suffered total damage as these plants cannot withstand even a few hours of flooding or excessive wetness in the soil. Restoration of all the crops can only be attempted by suitable agronomic practices that need to be undertaken at these sites. It is better to adopt crop rotation, or relay cropping besides taking necessary measures to control soil borne diseases. Necessary soil conservation measures need to be adopted based on the situation to reduce possible soil erosion.

3.4.2.4. Impact on ecosystem in Idukki District

Landslides

Almost all the Panchayats in the district reported landslides which generated debris flows, rock falls, rock slides and mud slips. The rain water which enters the

soil increases the weight of the unconsolidated soil materials causing instability and this moves downward, under the influence of gravity causing damages to the entire course of its run. In this situation surface soils are removed, trees are uprooted, buildings on the way are demolished. Finally, less fertile sub soils are exposed and in extreme cases, ravines are created or developed making the area quite unsuitable even for pastures or even for the movement of men and animals. Sometimes the surface becomes so irregular that even the use of machinery becomes impossible.

Occurrences of landslides at different locations resulted in the destruction of the hilly terrains, loss of fertile soil, human lives, death of domesticated animals and birds, destruction of houses either partially or totally and damages to many buildings ranging from severe to mild. Compared to other districts, loss of domestic animals and birds were few. Usually landslides are accelerated with the human interferences like deforestation, excavation of land, mining and quarrying, obstructing the natural flow of water along slopes.

Sedimentation/ Sand bar/ Sand piping

The heavy rains which were received in the high ranges and different catchment areas supplied flood water to Periyar. The water in this river and its tributaries gathered different kinds of materials ranging from boulders to clay through sand and silt either through erosion of soil or landslides. The extent of siltation that occurred along the river bed or in other places could not be ascertained. During the river spate, the flood water crossed the flood way and started flowing along the flood plains and these materials were also deposited in an indiscriminate way and there was a gradual build up of these sediments at all points. The nature of the sedimentation depended mainly on the type of material carried by the water. However in certain panchayat areas particularly along the river banks, there has been sand bar formation due to consistent deposition of sedimentary sandy fractions of soil for some reasonable length. The sand bar formation of different sizes has been reported from Kamakshy, Kanjikkuzhy, Kanchiyar, and

Edamalakudy Grama Panchayats. The phenomenon of sand piping which results in the caving in of soils dominated by sandy fractions damaging the terrain has also been reported from Mariyapuram, Kanjikkuzhy, Kanchiyar, and Kamakshy, Grama Panchayats. Restoration of this area also seems to be difficult; research work on the permanent restoration has to be taken by a multidisciplinary team on geo-technical and geo- morphological aspects. The standing flood water carrying suspended clay and silt particles on the land had virtually reduced the aeration and infiltration capacity of the soil at many locations, which may affect the ground water recharge in future. Individual status of this aspect can be seen from the survey reports from different Panchayats.

River bank erosion/collapse

Periyar River is the parent one and its main tributaries viz., Muthirapuzha River., Mullayar River, Cheruthoni River, Perinjankutti River and Edamala River and their tributaries flow through various panchayats negotiating different terrains. During the spate period, flow in main and sub tributaries will be very fast and flowing water carries lot of suspended sediments and debris of various kinds which hit the embankments and eventually those embankments which were not strong or protected collapsed, adding further sediments to water. In this process, the riparian vegetation along the sides was also lost. In majority of the cases, the restoration of the collapsed sites was not undertaken. As such the destroyed sites still offer threat for further collapse with another rise in water in river. Medium to severe damages have been reported in many panchayats. Parts of Rajakumari, Vellathooval, Sathanpara, Kamakshi, Kanjikkuzhy, Mariyapuram, Munnar and Konnathady area witnessed medium river bank erosion while severe damages to river banks have been reported from parts of Adimali, Erattayar, Bison Valley, Mankulam, Vazhathope, Kanjikkuzhi, Pallivasal and Munnar

Various Impact of flood/landslide on riverine ecosystem of Idukki region based on the study and information available from secondary sources is shown in the below table 19

Table 19: Impact of flood/landslide on Riverine Eco system of Idukki

Sl. No	Affected river portion	Name of River/Streams/Lake	Intensity of Flood in Grama Panchayats		
			Moderate	Severe	Very severe
1	Main River	Periyar			Adimali, Kanjiyar, Vellathuval, Kanjikuzhi, Mariyapuram, Vazhathoppu
2	Tributaries	Nallathonipuzha, Mankulampuzha, Nallathonipuzham, Panniyarpuzha, Muthirapuzha, Karikkintholam, Vimalagiri, Chattikuzhi, Chittadikkavala, Arimattompadi, Thakaramedu, Kottarampadi, Kadalakkapadi, Deviyarpuzha, Erattayar, Muthirapuzhayar, Manjalupara, Ellikkamedu, Padukamelpara, Palakada, Thovarayar, Kalyanath, Idukkipadi, Kalthotti, Chettayiladi, Arakyanalpadi	Kanjikuzhy, Udumbanchola Mariyapura, Munnar, Konnathady, Rajakumari, Vellathuval, Santhanpara, Kamakshi	Adimali, Pallivasal Kanjikuzhi, Vazhathoppu, Adimali, Erattayar, Bisonvalley, Munnar, Mankulam, Kanjiyar	

Flooding of paddy fields

Floods and landslides displaced large quantities of surface soil particularly from sloped areas and deposited them at different locations. In this context, many paddy fields were affected by deposits. Kanjiyar, Vazhathope, Kanjikuzhy, Mariyapuram, Konnathadi and Rajakumari panchayats reported extensive deposits of debris and sediments in many paddy fields. The extent of deposits could be rated from moderate to severe. The variety of sedimentary deposits brought into paddy lands will alter the physico - chemical properties of the paddy

soils and rectification of this issue is possible only in the due course of time and intensive agricultural operations and agronomic interventions are needed.

Table 20: Impact of Flood/landslide on Agro-ecosystem of Idukki

Sl.No.	Name of Grama Panchayat	Name of Paddy Field	Flood Intensity
1	Kanjikkuzhi	Makkuvalli	Severe
2	Mariyapuram	Kochukarimbakuthirakallu	Most severe
3	Vazhathoppu	Vazhathoppu paddy field	Severe
4	Kanjiyar	Attappalli	Moderate
5	Rajakumari	Nadummattam	Moderate
6	Konnathady	Parathodu	Severe

Destruction of land

Being a hilly terrain, the impact of landslides caused severe destruction of the land. Fast flowing water, picks up particles of soil and rock along with it and as the velocity or speed of the water increases the suspended or carried particles hit or rub against loose soil and detach them further and force them back into the running water. River bends without proper embankment protection are the most vulnerable sites. When water flows through sloped areas, rill erosion in the form of small channels are created on the slopes and more soils from this course are removed gradually. At the end, the formation of a large number of rills in an area causes transportation of large quantities of fertile soil and thereby destroying the land. Many forest reserve areas in the district reported extensive land damage. Thattekani forest area, Neriyaamangalam, Achuruli, Mathikettan Shola National Park, Rajamala forest area are the few prominent ones. Private plantations have also suffered severe loss. Udumbanchola, Mariyapuram, Vazhathope, Adimali, Kajikkuzhi and Kamakshi panchayat areas faced severe damage in private sector and the main plantations affected are cardamom, rubber, pepper, coffee, cocoa, and tea. The restoration of these sectors will take a long time.

Sheet erosion resulting from the flowing of flood water may not be apparent but when this happens over an extensive area, the loss turns to be significant. Several square kilometer of land was assessed to be lost either through landslide, rill erosion or sheet erosion in Idukki district and the materials carried by water resulted in the different kinds of deposits on the soil surface. Impact of flood/landslide on terrestrial ecosystem of Idukki is given in the table 21.

Table 21: Impact of flood/landslide on Terrestrial Ecosystem

Sl.No.	Type of Ecosystem	Name of Grama Panchayat	Name of Ecosystem	Intensity
1	Forest (Protected Area)	Kanjikkuzhi	Thattakanni Forest Thekkanthoni, Palaplavu, Makuvallimanayathadam	Severe
		Vazhathoppu	Forest Area	Severe
		Adimali	Neryamangalam	Severe
		Kanjiyar	Anjuruli	Moderate
		Munnar	Rajamalai Forest	Severe
		Santhanpara	Mathikettan shola National Park	Moderate
2	Plantation (Public/Private)	Kamakshi	Udayagiri, Kaalvari mount, Karikkinmede Tea estate, Cardamom estate, Coffee estate, Banana & Cocoa estate	Severe
		Kanjikkuzhi	Banana, Coffee, Nutmeg, Rubber, Cocoa Plantations	Severe
		Mariyapuram	Rubber & Pepper plantation	Most severe
		Udumbanchola	Cardamom Plantation	Most severe
		Vazhathoppu	Pepper & Cocoa	Most severe
		Adimali	Cardamom plantation	Moderate
		Irattayar	Cardamom, Pepper, Rubber & Banana	Severe
		Nedumkandam	Cardamom	Severe
		Kanjiyar	Cardamom & Pepper	Severe
		Mankulam	Pepper plantation	Most severe
		Munnar	Tea Estate	Severe
		Rajakumari	Cardamom, Pepper, Banana	Severe
		Konnathadi	Cardamom & Pepper plantation Mullarikudi	Severe
		Pallivasal	Cardamom, Pepper, Banana, Nutmeg	Severe
		Vellathooval	Cardamom, Pepper, Rubber, Nutmeg	Severe
Rajakkad	Cardamom, Pepper, Banana	Severe		
Santhanpara	Cardamom	Moderate		

3	Wetland	Kamakshi	Kamakshi-Thankana	Severe
		Kanjikkuzhi	Thattakkanni	Severe
		Mariyapuram	Idukki mini dam	Moderate
		Vazhathoppu	Cheruthoni	Severe
		Kanjiyar	Ayyappankovil, Vellilamkandam, Vellilamkandam, Kozhimala	Moderate
		Rajakumari	Rajakumari wetland area	Moderate

Impact on Environment

During the floods, sedimentation of different types of materials had occurred at many places including river basins, water bodies and wells and low lying areas. Major items that got deposited are sand, silt and clay along with sewage waste, plastic waste and municipal solid wastes. Plastic wastes and other organic debris strewn around many places were clearly visible and this was an upcoming threat in increasing the water and soil pollution. Many of the wells available in the different panchayats were damaged either partially or severely due to sedimentation or by contaminations from sewage or solid waste. All the polluted wells in the different panchayats have been restored to normal condition within a time frame. Most of the restorative activities were carried out by Governmental organizations along with the support of NGOs and local people.

The environmental impact has been separately assessed through two major studies i. Impact on Soil ii. Impact on Water The data, analysis, results and interpretations are given in the section 3.3

Socio- economic impact

The recent flood and extensive landslides in Idukki district have caused extensive impact on the socio-economic status of the people in the district. During this period, most of the people had to stay back from routine activities to ensure protection for self and family members. This eventuality kept many out of their routine jobs forgoing their daily income. The floods and landslide have damaged their houses and landed properties causing severe concern and agony. Many established plantations of coffee, tea, cocoa and banana were destroyed either

partly or completely beyond restoration. Heavy rains and high humidity destroyed many pepper plantations. Soil erosion which accompanied heavy rains removed extensive quantities of surface soils and brought down the fertility of soil. Breaches of roads on account of landslide snapped the transportation facilities, which indirectly affected the marketing and the freedom of people to move. The tribes of Idukki district was also put to severe stress during this period as they lost their cultivated land, dwellings, and in some cases, their domesticated animals. Many settlers could not take up their daily jobs, forfeiting their daily income. Further, tribal people were unable to collect and market the minor forest produce like honey and lac from forest due to adverse conditions, forcing them to run out of food supply for few days. The education of children was also hampered with the loss of their study materials. The psychological impact which every member in the house experienced was beyond description.

Many lower group flora were washed off during the flood and caused considerable reduction of their population in many locations. But natural restoration is expected for this group. Many shrubs and herbs were destroyed in flood either through washing out or due to subsequent decay. Natural restoration is expected over a period of time. Many trees, naturally positioned near the flood way or in the landslide areas were uprooted and removed. Severe loss had occurred on this account. Many flowering plants were destroyed during the floods and landslides. Sedimentation of materials over the plants also created destruction. Many medicinal plants which faced the brunt of flood got destroyed either during the flood or during the subsequent period. Wide variety of the weeds perished during the floods. It might be due to the stress imposed on them by standing water or due to sedimentation of clay colloids on the leaves, which reduced photosynthesis during subsequent period. Most of the floating aquatic plants were washed off during the floods. Aquatic plants like Lotus and Lilies survived due to the presence of their rhizomes in the lakebed or water bodies where they existed.

Most of the soil dwelling insects were eliminated during the floods. Earthworms were also killed in large numbers. Flying insects faced lesser extinction as they could manage to fly to safer regions. However after the floods and the landslides, many flying insects and butterflies were reported to be less sighted due to washing away of their breeding grounds. Many birds common to some affected locations were also sighted in less numbers. The unexpected rise of flood water at many locations did not provide time to many owners to rescue their animals to safer places. Both let off animals and caged animals and birds perished in the floods. Many fish farms were destroyed during the floods. The flood water which overflowed the fish farms, removed most of the reared fishes and fingerlings. Sedimentation of different materials destroyed the breeding ground of many fishes.

Almost all the cultivated annual crops like paddy, banana, vegetables, tuber crops etc. suffered total loss compared to other perennial crops. Those plants which temporarily survived the floods also got destroyed through secondary infections from soil at a subsequent period. Production of toxic materials due to lack of oxygen in the soil was one of the main reason for drying of many crops.

Sedimentation had occurred at various points during flood or land slide. Different kinds of materials carried by water were deposited either along the riverbed or its sides or in the flood plains. The muddy water carrying lot of clay and slit materials also got deposited at many places, building up thin to thick layers of clay over many cultivated land, which subsequently created anaerobic conditions or lesser permeability in soil. The gradual build-up of sandy sediments along the river bank has also resulted in the formation of sand bars.

During flooding, in certain patches of land, inherently weak in the soil structure, there was internal erosion of soil particles leading to the formation of voids. The erosion in this region is caused by internal seepage and when it becomes continuous, a piping phenomenon is formed. This is reported in Idukki district. Filling up of this sunken area, with soil materials are not going to yield permanent solutions. This is a Centre for Management Development 97 geo-technical issue and it needs to be addressed with a multidisciplinary research.

River bank collapse was a common sight along the main rivers and the tributaries in Idukki district. This was severe on river bends and unprotected embankments. The speed of flow of water, obstructions for free flow of flood water; nature and quantum of sediments it carried along and the weakness of soil along the river banks decided the extent of impact.

The major water pollution in Idukki was due to sedimentation of pollutants and sewage wastes, in wells and all water bodies. Though this aspect has been restored in all the wells, frequent monitoring of water quality and adequate chlorination should be resorted to avoid any relapse of water quality in the upcoming periods.

Though flooding and sedimentation of paddy fields had reportedly resulted in damage to the existing crop, it offered some advantage too, through the ready availability of various mineral nutrients required for the growth and development of paddy. This has resulted in enhanced yield of paddy after the flood at many flooded locations.

Though land have been destroyed at many locations by several ways, the general reason for common destruction was mainly due to sheet erosion on plain areas and rill erosion along sloppy terrains, initiated by heavy rains and flood. Extensive damage to surface soils have been reported.

Due to continuous rain and flood, landslides have been triggered on sloppy terrains causing extensive damage to large areas of the terrain. The debris flow, mud flow which accompanied the landslide resulted in human loss, animal loss, and heavy losses to plantation sector mostly in an irreversible way.

Suggested interventions

- a) The accumulated waste materials particularly plastics need to be removed. If sediments are much less or can't be removed for some reason, the same can be ploughed in, to avoid possible crust formation.
- b) In order to reduce the possible congestion in the floodway; all canals, tributaries and sub tributaries need to be cleared of its sediments together

- with weeds established in the area and desilting of the bed to facilitate quick discharge of water downstream.
- c) In many panchayats, particularly along the river banks, there has been sand bar formation due to deposition of sand. This sand interrupts the carrying capacity of rivers and in some cases caused meandering of rivers also. Sand collected from desilting can be commercially utilized by the Government.
 - d) Erosion resulting from the flow of flood water may remove appreciable quantities of top soil affecting its fertility and this could be prevented by providing a grass cover to vulnerable areas and in regions of extreme threat, geo-textiling is recommended. Erosions can also be contained by planting Vetiver (*Chrysopogon zizanioides*).
 - e) Unprotected river bank in areas can be protected by planting bamboo whose roots spread out forming a dense, underground network of rhizomes and roots making it a very effective barrier to erosion.
 - f) In order to restore the microbial population lost during flood, purposeful efforts must be made to enrich the microbial mass in soil through various interventions. Introduction of VAM/ AMF at the time of new planting, addition of Trichoderma enriched Neem cake-cow dung mixture at the new or existing planting sites, application of Pseudomonas mixed with cow dung, use of PGPRI to soil can help to rebuild the lost microbial population and ensure natural protection to growing plants from possible fungal diseases from soil to a great extent. Liberal use of cow dung/ compost/ organic manure must be encouraged in the root zone of crops.
 - g) At the replanting of sensitive annual crops like ginger/ turmeric/ tuber crops in areas where the previous crop has been devastated by soil fungal organisms, extra care must be taken to avoid the same place for replanting. If no other alternative space is available for replanting, the same place can be utilized after sterilizing the area through solarisation process or through drenching the site with suitable copper fungicides.
 - h) During the period of flood, landslides and debris flow, extensive sedimentation landed on many terrains either masking the cultivated lands

with poor quality materials or destroying the terrain features. The sedimented materials are likely to create perennial issues and these needs to be removed wherever possible to make future cultivation of crop successful.

- i) Future erosions in some vulnerable area which remove fertile soils could be prevented by providing a grass cover or resort to Geotextiling. Erosions can also be averted by planting Vetiver (*Chrysopogon zizanioides*) whose roots have strong binding power on soils.
- j) Soil conservation measures adopted in the Bison valley panchayat, in sloped areas had reportedly incurred less loss in the recent disaster period compared to un-terraced areas in other panchayat area. So priority should be fixed for ensuring soil conservation measures in sloped areas before attempting cultivation.

General Recommendations

- a) There has to be better utilization and coordination of many modern technologies like IT application, GIS etc., involving Artificial Intelligence to predict, monitor, mitigate and manage disasters.
- b) Co-ordinated and structured activities between, different Government departments like Revenue, Agriculture, Health, Irrigation, Water Authority, PWD, Disaster Management etc. has to be ensured before every monsoon period to avert major disasters.
- c) In the tribal areas, efforts to include local participation of people should be made in all the restoration works, which may offer more job opportunities for the tribal group. This is also applicable all flood affected areas where local restoration can be effected through people's participation.
- d) Desiltation of dams, river basins, tributaries and its rivulets has to be taken up for enhancement of storage and carrying capacity to subdue the flood impacts in future.

- e) Along with it, all natural drainage systems, canals and streams to be improved by de-silting, protection of banks etc. so that flood water is quickly drained out.
- f) Planting of Bamboo, Atuvanchi etc., which are native to the riverine ecosystem, are good protectors of soil. Ramacham plants with extensive root system should be are also promoted on many extremely vulnerable embankments which are not protected.
- g) During the survey, it has been noted that soil conservation measures adopted in the Bison valley panchayat in Idukki district has reduced the impact of damage on sloppy terrains. The exact technology adopted at that region may be evaluated further and implemented in other regions with modifications if any needed to match local needs.
- h) Manmade ecosystems: - Implementation in farm tourism and tourism in fragile eco lands to be regulated by law to mitigate the possible adverse impacts on environment.
- i) Building rules in landslide areas should be enforced in letter and spirits to protect the area and reduce the sprawling construction activities in the region, which alter the natural ecosystems.
- j) Since the major issues connected with water pollution in almost all the areas, particularly low lying terrain was on the account of breaches on sewerage and collapse of septic tanks and soak pits. All Grama Panchayat should ensure that there should be comprehensive waste water management policies wherein the establishment of soak pits in low land areas which contaminate the fresh water may be regulated.
- k) An effective decentralized solid and liquid waste management policy encouraging the waste reduction and waste disposal at source should be popularized to reduce the waste generation.
- l) Frequent water quality checks in open areas, wells and other water bodies may be done at regular intervals to ensure water quality. Wherever possible protected water supply may be provided.

- m) The Grama Panchayats should give priority on initiatives for protecting all water sources against contamination such as strengthening the structures like bunds, increasing the height of the side walls of tanks and wells etc.
- n) Though Disaster Management Plan (DMP) is available at every Panchayat level and District level, many residents of the flood affected areas were in dark about the various contingent plans. Awareness programmes may be arranged. The various supports and facilities available under the aegis of Government and other agencies are to be published and displayed prominently before the onset of monsoon seasons, so that people can avail such facilities and services. There should also be awareness and training programmes in future for local people/leaders to act under a demanding situation of flood.
- o) The affected people have opined that during rescue operations, it was difficult to find a safe rescue route as all areas were flooded. To circumvent this issue it is suggested that suitable markings of sufficient height maybe provided all along these routes so as to identify the road path even when the entire region is flooded.
- p) Embankment breaches and breaches in river banks may be restored by irrigation departments by proper design so that these breaches may not recur in future.
- q) The major complaint raised by many victims of flood was the absence of an early warning system, which if present, could have averted many losses in various sectors.
- r) The sediments brought into terrains by flood water, deposited tremendous amount of clayey materials on soil surface. Such small clay colloids which got deposited will clog the pore spaces in soil and its build up over the soil again will prevent easy infiltration of water into that soil. This will definitely reduce the groundwater recharge and the ability of the soil to absorb the rain water, which ultimately will result in quick flooding even with rains of less intensity and magnitude. This can be avoided through purposeful tillage in open areas to facilitate better infiltration of water.

Assessment of impact of flood/landslide on the ecosystem and Biodiversity in the Athirappilly Panchayath

The Athirappilly Grama Panchayath is located $10^{\circ} 14' 47.72''$ - $10^{\circ} 22' 59.77''$ N and $76^{\circ} 26' 18.78''$ - $76^{\circ} 54' 5.56''$ E in the Chalakkudy Taluk of Thrissur district, 24-95 km East from the Chalakkudy town along the Anamala Road. Athirappilly Panchayath has high biodiversity richness and is an important eco-tourism location in Southern India, blessed with the famous Vazhachal and Athirappilly Waterfalls and the Vazhachal-Sholayar Forests. The Vazhachal Forest Division completely comes within the Administrative boundary of the Grama Panchayath and portions of Parambikulam Tiger Reserve and Chalakkudy Forest Division of central forest circle account for high biodiversity value. There are 13 tribal settlements in the Panchayath including Kadar PVTG and Malayar and Muthuvan tribes.

The Vazhachal Forest Division with high biodiversity value comes completely under the Athirappilly Grama Panchayath. This area is important Hornbill Habitat in the Western Ghats. The low elevation riparian forests are unique habitat to the Southern Western Ghats with high endemic and threatened plants and animal diversity including Cochin Forest Cane turtle, Tiger, Lion Tailed Macaque, Nilgiri Tahr, and King Cobra etc. The area is also an Important Bird Area (IBA) with high diversity of birds, butterflies and Odonates.

Land use and Vegetation

Majority of the area is forest areas and the Primary Evergreen forest types of both Medium and Low elevation dominates along with secondary or degradation types such as secondary semi evergreen or deciduous forests. The low elevation riparian evergreen forests and the freshwater hill Wally Marshy wetlands or Vayals constitute the unique Ecosystems.

Table 22: Land Use and Vegetation

Sl.No	Vegetation type	Area in Sq.km
1	Primary Forest Types and Sub types	231.5003
2	Secondary Forest Types	63.75119
3	Non Forest Plantations	6.18
4	Forest Plantations	45.022

The major forest types in the location include Wet Evergreen Forests (WEVF), Low Elevation Evergreen Forests (LEEVF), Semi Evergreen Forests (SEVF) and Moist Deciduous Forests (MDF). Each forest type characterized by specific composition of trees occupying the specific position in the canopy level.

Wet Evergreen Forests are dominated with plants like *Palaquium ellipticum*, *Cullenia exarillata* etc. in the emergent layers; *Canarium strictum*, *Vateria indica*, etc. in the top close canopy; *Drypetes malabarica*, *Aglaia barberi*, etc. in the third tree layers, *Hydnocarpus macrocarpa*, *Reinwardtiidendron anamalaiense*, etc.

Low Elevation Evergreen Forests are dominated with *Vateria indica*, *Dipterocarpus indicus*, *Kingiodendron pinnatum* etc. in the canopy; *Myristica beddomei*, *Pterospermum reticulatum*, etc. in the sub canopy; *Myristica beddomei*, *Mallotus tetraococcus*, etc. in the medium sized trees. *Baccaurea courtallensis*, *Leea indica*; etc. in the small trees. The shrubs include; *Allophylus concanicus*, *Barleria acuminata* etc. The lianas include; *Entada rheedei*; *Ancistrocladus heyneanus* etc.

Semi evergreen forests includes the plants *Xylia xylocarpa*, *Terminalia paniculata*, in the top tree layer; *Wrightia tinctoria*, *Aporosa cardiosperma*, etc. in the medium trees and *Tabernaemontana alternifolia*, *Leea indica*, etc. among the small trees. The shrubs include *Desmodium pulchellum*, *Glycosmis macrocarpa*; lianas include *Acacia caesia*, *Chonemorpha grandiflora*, etc.; the herbs include *Desmodium gangeticum*, *Desmodium triquetrum*, etc. and the climbers include *Ziziphus oenoplia*, *Trichosanthe snervifolia*

etc. Moist Deciduous Forests are dominated with plants like *Macaranga peltata*, *Wrightia tinctoria*, *Terminalia paniculata* etc.

Endemic Flora

Out of the 1164 species of plants listed, 269 of them were endemic. These include *Andrographis atropurpurea*, *Zingiber cernuum*, *Bulbophyllum aureum*, *Dysoxylum beddomei*, *Helicanthes elastica*, *Pogostemon rotundatus*, *Beilschmiedia bourdillonii*, *Ficus dalhousiae* etc. The family Acanthaceae shows the most endemism with 20 species, followed by Rubiaceae and Euphorbiaceae with 16 and 14 species respectively. 103 species were endemic to the Western Ghats, 43 endemic to Peninsular India, 1 endemic to South West India, 4 endemic to India, 100 endemic to the Southern Western Ghats, 4 endemic to Peninsular India and Sri Lanka, 7 endemic to South India, 2 endemic to Kerala, 2 endemic to South India and Sri Lanka, 1 endemic to Asian Sub-Continent, Indonesia, India Africa and Sri Lanka.

Threatened (IUCN) Angiosperms plants in the study area.

Out of the 1164 plants listed, 70 (6%) of them comes under the IUCN conservation Status. The following 7 of them are Critically Endangered *Allophylus concanicus*, *Impatiens auriculata*, *Dryptes malabarica*, *Aglaia malabarica*, *Syzygium occidentaleis*, *Syzygium travencoricum*, *Piper barberi*. 21 Endangered including *Pothoscrassi pedunculatus*, *Humboldtia vahliana*, *Glochidion zeylanicum*, *Bulbophyllum aureum*, *Vepris bilocularis*, *Desmos viridiflorus*, *Aralia malabarica*, *Kingiodendron pinnatum*. 34 taxa comes under Vulnerable category including *Mycetia acuminata*, *Ochreinauclea missionis*, *Semecarpus travencorica*, *Solenocarpus indicus*, *Orophea uniflora*, *Ceropegia metziana*, *Impatiens herbicola*, *Garcinia wightii*, *Dipterocarpus indicus*, *Hopea parviflora*, *Hydnocarpus macrocarpa*, *Actinodaphne malabarica*, *Aglaia lawii*, *Amomum petrocarpum* under Least concern and 6 are Near Threatened *Anaphyllum wightii*, *Phaeanthus malabaricus*, *Tabernaemontana alternifolia*, *Tabernamontana gamblei*, *Arisaema barnesii*, *Elaeocarpus munronii*.

Herbs, Shrubs AND Trees affected BY Landslide and Flood

The most affected plant species with in the land slide locations are *Diospyros assimilis*, *Drypetes venusta*, *Canarium strictum*, *Actinodaphne malabarica*, *Aglaia anamalaica*, *Agrostistachys borneensis*, *Antidesma montanum*, *Aporosa acuminata*, *Remusatia vivipara*, *Strobilanthes anamallaica* etc. The flood impacted species are *Aglaia lawii*, *Baccaurea courtallensis*, *Bamboosa bambos*, *Barringtonia acutangula*, *Canscora diffusa*, *Cinnamomum malabratrum*, *Cinnamomum riparium*, *Dillenia pentagyna*, *Dimocarpus longan*, *Dioscorea oppositifolia*, *Elaeocarpus serratus* var. *serratus*, *Elaeocarpus tuberculatus*, *Ochlandra scriptoria*, *Ochlandra travancorica*, *Ochlandra wightii*, *Ochreinaulea missionis*, *Terminalia paniculata*, *Tetrameles nudiflora* etc. Among the impacted vegetation the following species had maximum impact. The impact frequency estimate shows *Vateria indica*, *Garcinia gummi-gutta*, *Schleichera oleosa*, *Gmelina arborea*, *Xanthophyllum arnottianum*, *Ochlandra travancorica* etc had the major impact.

Impact on Endangered flora and habitat

The estimate on affect of flood on Endemic and Endangered taxa revealed that nearly 63 Endemic plants were affected during the landslide and flood. Of them 24 are endemic to Southern Western Ghats which includes *Cinnamomum riparium*, *Cinnamomum sulphuratum*, *Cullenia exarillata*, *Dipterocarpus indicus*, *Drypetes venusta*, *Dryptes malabarica* etc. and 27 are endemic to Western Ghats including *Calamus hookerianus*, *Calamus thwaitesii*, *Calophyllum calaba*, *Canscora diffusa*, *Canscora pauciflora*, *Capparis rheedei* etc., *Diospyros candolleana*, *Ensete superbum*, *Diospyros paniculata*, *Ficus virens* etc are endemic to Peninsular India and *Artabotrys zeylanicus* is endemic to Peninsular India and Sri Lanka.

Nearly 21 threatened angiosperms species were enumerated. *Dryptes malabarica* and *Syzygium occidentale* were under the critically endangered status. *Glochidion zeylanicum*, *Hopea ponga*, *Humboldtia vahliana*, *Kingiodendron pinnatum* and *Mesua ferrea* L. var. *coromandeliana* were Endangered, *Elaeocarpus munronii* is considered as Near Threatened and 11 species including *Arenga wightii*, *Actinodaphne malabarica*,

Aglaia barberi, *Capparis rheedei*, *Cinnamomum riparium*, *Dalbergia latifolia*, *Dipterocarpus indicus*, *Garcinia wightii* etc. were Vulnerable.

Since the landslides completely destroyed the areas affected but still some plants showed maximum resistance to check landslides such as *Bombax ceiba*, *Mesua ferrea*, *Dysoxylum malabaricum*, *Calophyllum polyanthum*, *Ceiba pentandra*, *Diospyros paniculata*, *Dipterocarpus indicus*, *Elaeocarpus tuberculatus*, *Ficus arnottiana*, *Kingiodendron pinnatum* etc. The riparian plants are generally resistant to the natural flood and that was reflected in the list of the resilient taxa. The impact to the riparian vegetation happened because of the torrential flow downstream to the dams. The species such *Hopea parviflora*, *Madhuca nerifolia*, *Lophopetalum wigtianum* etc. showed high resistance to the flood. The species such as *Ochlandra scriptoria*, *Barringtonia acutangula*, *Syzygium occidentale*, *Bamboosa bambos*, *Calophyllum calaba*, *Diospyros montana*, *Gmelina arborea Roxb*, *Grewia tiliifolia*, *Homonoia riparia*, *Hopea parviflora*, *Humboldtia vahliana* etc. showed moderate resistance to the torrential flow and resistance to the natural flood. These species are regenerating back even after they had hit badly by the torrential flow. Also many of the herbs such as *Mollugo oppositifolia* and *Ludwigia peruviana* showed more regeneration in river bank after the flood.

Impact of flood/ landslide on fauna in the Athirappilly Grama Panchayath

Most severely affected areas are the Riparian areas downstream to Poringalkuthu dam and Orukomban-Poringal areas (downstream areas of Parambikulam Group dams). About 70% of the riparian areas were affected with high flow during the flood and dam water release. Unfortunately these areas are important bird areas also important for butterflies and Odonates. The less abundance of many species along the riparian areas even though areas marked high species diversity may be because of loss of riparian habitats especially islands. The riverine areas are either washed out or deposited with silt totally altering the microhabitats prevailing there suitable for butterflies and Odonates.

Suggested interventions, prioritisation and eco restoration

1. Since the areas of Athirappilly Grama Panchayath affected by 28 landslides resulting a loss of 283.72 ha of land restoration activities has to be given priority.
2. Since most of the landslides were occurred in the forest area (95%) and the Anamalai road traversing the forest areas at different hilly terrains the restoration of landslide areas has to be brought into the priority action list of LSG as well as Forest Department and PWD.
3. Eco restoration require restoration of species suitable to the local bioclimate and succession stages from local gene pools and not mere planting of some easily available species.
4. The road construction along the steep terrains require much physical support for the embankments, steel bars along with boulders if necessary used along railway lines can be a good interventions which can support prevention of landslip as well can maintain growth of vegetation cover.
5. Necessary pathways for movement of animals especially larger mammals like elephants as well as arboreal species are required across the roads with steep slopes and hairpin bends. The embankments shall be provided with gaps which enable movement of ground dwelling organisms
6. Proper management of waterways across the roads is also a necessity i.e. the dimension of the Chappath or Culverts shall be made assessing the order, slope and water level in the extreme monsoon.
7. The steep cutting or the straight running streams in very hill terrain also found to be causing landslides and chance increases with degraded landuse and slope. These areas shall be notified as 'Vulnerable zones' and since such areas more prone to landslides, making residential zones downstream to such areas should be avoided. Intervention in landuse pattern leading to degradation in such areas shall be prevented.
8. The Chalakkudy River flowing through the Athirappilly Grama Panchayath affected with torrential flow especially downstream to the

- dams. The areas at Vazhachal - Athirappilly and further down up to Thumboormuzhi were badly affected. The LSG and The Forest Department shall take necessary initiatives to provide priority for river restoration activities.
9. Since the riparian vegetation more resilient to the flood impact and they functioned it well in the areas preventing further damage to the river and riverine biota restoration of the damaged riparian areas and their monitoring based on a detailed plan is a necessity.
 10. The details of resilient riparian taxa, species composition etc. are given in the chapter 7 in detail and that has to be accommodated into the plan of LSG as well as the forest department.
 11. A Total of 5 landslides occurred in residential areas one in Non- tribal land Pandarampara and 4 landslides occurred in the tribal agricultural land mainly in Thavalkkuzyppara, Anakayam, Adichilthotty and Kappayam. Special action plans has to be developed for the restoration of the residential as well as agricultural areas in these locations.
 12. One of the high impacted landslides occurred at Pandarampara area near Vettikuzhin in the 1st ward of the Athirappilly Grama Panchayath. This has completely c washed out the agricultural crops from this area mainly Rubber, Arecanut, Coffee, Nutmeg etc. More than 14 acres of agricultural land damaged by this landslide. Quick normal recovery is not possible in this site and which require additional support for restoration of the land, vegetation and the streams
 13. The Anakkayam Tribal settlement is another badly affected use to a clustered huge landslide happened along the Anamalai Road in the Anakkayam Valley. The people were shifted to the quarters of Electricity Boards and now they moved their own to top of a rock near the Anakkayam forest area. Being a PVTG tribal group with special right under FRA 2006 including the CFR and habitat right Their Grama Sabha has to be consulted to prepare a proper relocation plan.

14. Since the individual land claims of the Anakayam settlements were settled, CFR claims are recognised and they are protected from resettlement from their original habitat under habitat right of FRA 2006, they can be given equal land in which they have the titles where their Grama Sabha propose to have a new settlement. The Grama Panchayath has the authority to initiate the process under the act.
15. The post flood fish catch data is very lower than the pre flood year data and average of the two indicating a heavy a decline in fish catch in 2018 as compared to 2017. Species recovery plans has to be prepared for the Fish Diversity. This shall include the flowing criteria.
16. Ranching of non-native species has to be banned because that can over predate the surviving population of native fishes, Restoration of riverine habitat to enhance the breeding and population of rich fish diversity in the river depending on specific riverine habitat, Restoration of riparian vegetation since that has great correlation with fish diversity and abundance and 4. Localized breeding of native fishes from their local population involving indigenous people has to be planned for proper fish diversity conservation.
17. Since the habitat loss in riverine habitat, riparian islands and river bank vegetation cause serious threats to the birds, fishes, Odonate etc. A monitoring has to be done in every season involving local community with the leadership of BMC and tribal Grama Sabhas.
18. Awareness shall be created locally on other endangered species such as trees like *Cryptocarya anamalayana*, *Kingiodendron pinnatum*, riverine herbs such as *Lagenandra nairii*, *Willisia selagenoides*, Cochin Forest Cane Turtle, The balloon Frog etc.
19. Involving students, women groups and indigenous communities in awareness and monitoring programme is important.
20. The BMCs can take initiatives to make action plans for ecorestoration and monitoring programs incorporating MNREGS for the areas coming under

Athirappilly Grama Panchayath for the above said matters and the details can be used form the present study.

21. Declaration of the Riparian forest areas along with river stretches into a protected area of the Hornbills and Kadar indigenous community or as Biodiversity Heritage Site is essential for the conservation of the unique low elevation riparian forests in the Athirappilly Grama Panchayath.

A. Identification of the research and management priorities for long term conservation of Munnar landscape

The present study has been carried out through a series of stakeholder consultations/ policy dialogues. A policy document on Mainstreaming Biodiversity in Agriculture and Fisheries sector has been brought out which aims to provide guidance to integrate biodiversity conservation themes/actions into the Production sectors.

Ref : Impact assessment of flood/landslides on biodiversity and ecosystem of Idukki District and Kuttanad, Centre for Management Development Thiruvananthapuram Funded by KSBB Assessment of impact of flood/landslide on biodiversity and developing methodology for long-term monitoring and evaluation of changes in the ecosystem and biodiversity: A case study in the Athirappilly Panchayath. Dr. K. H. Amithabachan, Research Department of Botany, MES Asmabi College, Vemballur, Kodungallur, Thrissur, Kerala.

Table 23:

Project title	Documentation and compilation of existing information on various taxa (Flora and Fauna), and identification of critical gaps in knowledge in the GEF-Munnar landscape project area	
Objectives A: Group wise and Taxa wise documentation and compilation of flora and fauna		
Activities	Output	Outcome
Complete list of flora in the study area	Checklist of Mosses, liverworts, lichens, algae, medicinal plants and other plants were prepared	The current list of flora and fauna can be updated into the PBR of respective Gram Panchayats. BMC can formulate strategies and action plans for conservation of such species.
Complete list of fauna in the study area	Checklist of Mammals, birds, reptiles, Odonates, butterflies were prepared.	

RET and Endemic categorization on of Flora and fauna	All Flora and Fauna species were categorized based on IUCN, CITES, WPA.	
Objectives B: Updation of PBR of the region and development of a digital platform in ePBR.		
Identification of major gaps in the existing PBR	Identified the relevant gap areas in the existing PBR and shortcomings of the existing data collection methods	
Consultative workshops for PBR data gathering	Two state level workshops and three consultative meetings with experts/ consultants held for developing a PBR updation methodology Classes, awareness programmes and interactive sections were conducted for Panchayaths officials and BMCs in 10 panchayats.	
A standardized methodology for data collection developed which was peer reviewed by experts	The methodology involves uniform replicable standardized protocol for survey of flora/fauna/ecosystem with trained local resource persons for surveys, monitoring and preparation of action plans in parallel with use of standard PRA and RRA techniques for consultation with a wide range of user groups of bioresources	The participation of diverse groups as Citizen scientists and BMC members is effective in the data collection for PBR. The present study, with field validation is confirming that. Therefore, based on these, a new methodology guideline was prepared. In future
Analyse the applicability of mobile applications to review information collected from the field.	OSM Trakker, ebird, Plantsnap etc. are used in the field study. Each of the applications have its own pros and cos.	this can be successfully implemented for the PBR updation of Grama panchayat in
Conducted field trials based on new methodologies.	Focal Discussions with knowledge providers conducted in 10 panchayats. Conducted Biodiversity survey at Mankulam Panchayat with the help of experts for developing PBR methodology. Conducted PRA and RRA at Mankulam Panchayat for local peoples, 4 tribal communities, BMC separately for resource mapping and resource use change.	Kerala State and other States in India.

Preparation of Books/reports/publications related to PBR enrichment	A draft of Methodology for PBR updation was prepared	
Objectives C : Documentation of tradable bio-resources with ABS potential		
Compile list of bio-resources commercially utilized.	Checklist of commercially potential bioresources of the study area were prepared.	A Standardized methodology for Tradable bio-resources documentation developed.
List of bio resources with ABS potential	Data of 15 NTFPs traded in large quantities during the last two years documented.	
To investigate a detailed supply chain analysis of bio-resources.	Detailed supply chain analysis of selected bio-resources.	
Preparation of Books/reports/publications related to ABS and Economics of supply chain.	Tradable Bio-resources' Documentation (Database) and Identification of its ABS potential with Supply Chain: A Manual" prepared	
Objectives D: Documentation of the impact of landslides/floods on selected ecosystems and keystone/indicator species.		
Impact of flood/ landslides on Biodiversity documented Major flora/ fauna impacted identified		
Objectives E: Identification of the research and management priorities for long term conservation of Munnar landscape		
Identification of Biodiversity-rich important areas	Identified a biodiversity rich area at Mankulam through PRA and biodiversity survey conducted with the help of experts. The survey at Mankulam documented 50 species of birds, 30 species of butterflies, 20 species of Odonates. Documented 4 case studies and 3 best practices in Mankulam which can serve as a set example to other panchayats including 300 organic farmers at Mankulam.	
Formulate encouraging policies to overcome mainstream biodiversity concerns.	A policy document on mainstreaming Biodiversity in Agriculture and Fisheries	

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Annexure 1

Checklist of Birds identified in Mankulam survey

Sl. No.	Common name	Scientific name	IUCN/WPA/CITES status
1	Little swift	<i>Apus affinis</i>	LC
2	Little cormorant	<i>Microcarbo niger</i>	LC
3	White-breasted water hen	<i>Amaurornis phoenicurus</i>	LC
4	Little egret	<i>Egretta garzetta</i>	LC
5	Indian pond heron	<i>Ardeola grayii</i>	LC
6	Oriental honey buzzard	<i>Pernis ptilorhynchus</i>	LC
7	Crested serpent eagle	<i>Spilornis cheela</i>	LC
8	Legge's Hawk-Eagle	<i>Nisaetus kelaarti</i>	LC
9	Crested goshawk	<i>Accipiter trivirgatus</i>	LC
10	Shikra	<i>Accipiter badius</i>	LC
11	White-breasted waterhen	<i>Amaurornis phoenicurus</i>	LC
12	Little cormorant	<i>Microcarbo niger</i>	LC
13	Indian swiftlet	<i>Aerodramus unicolor</i>	LC
14	Indian Pygmy Woodpecker	<i>Picoides nanus</i>	LC
15	Greater Flameback	<i>Picus guttacrastatus</i>	LC
16	Black-rumped Flameback	<i>Dinopium benghalense</i>	LC
17	White-bellied Woodpecker	<i>Dryocopus javensis</i>	LC
18	Plum-headed parakeet	<i>Psittacula cyanocephala</i>	LC
19	Blue-winged parakeet	<i>Psittacula columboides</i>	LC
20	Vernal hanging parrot	<i>Loriculus vernalis</i>	LC
21	Small minivet	<i>Pericrocotus cinnamomeus</i>	LC
22	Orange minivet	<i>Loriculus vernalis</i>	LC
23	Indian golden oriole	<i>Oriolus kundoo</i>	LC
24	Malabar woodshrike	<i>Tephrodornis sylvicola</i>	LC
25	Common iora	<i>Aegithina tiphia</i>	LC
26	Bronzed Drongo	<i>Dicrurus aeneus</i>	LC
27	Greater Racquet-tailed Drongo	<i>Dicrurus paradiseus</i>	LC
28	Brown Shrike	<i>Lanius cristatus</i>	LC
29	Rufous Treepie	<i>Dendrocitta vagabunda</i>	LC
30	White-bellied Treepie	<i>Dendrocitta leucogastra</i>	LC
31	Large-billed Crow	<i>Corvus macrorhynchos</i>	LC
32	Cinereous Tit	<i>Parus cinereus</i>	
33	Common Tailorbird	<i>Orthotomus sutorius</i>	LC
34	Blyth's Reed-warbler	<i>Acrocephalus dumeorum</i>	LC
35	House Swallow	<i>Hirundo javanica</i>	LC

36	Flame-throated Bulbul	<i>Pycnonotus gularis</i>	LC
37	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC
38	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	LC
39	Yellow-browed Bulbul	<i>Acritillas indica</i>	LC
40	Green Warbler	<i>Phylloscopus nitidus</i>	LC
41	Large-billed Leaf-warbler	<i>Phylloscopus magnirostris</i>	LC
42	Dark-fronted Babbler	<i>Rhopocichla atriceps</i>	LC
43	Indian Scimitar-babbler	<i>Pomatorhinus horsfieldii</i>	LC
44	Rufous Babbler	<i>Argyasu brufa</i>	LC
45	Jungle Babbler	<i>Turdoides striata</i>	
46	Southern Hill Myna	<i>Gracula indica</i>	LC
47	Malabar Starling (Blyth's Starling)	<i>Sturnia blythii</i>	
48	Asian Brown Flycatcher	<i>Muscica padauaurica)</i>	LC
49	Malabar Whistling-thrush	<i>Myophonus horsfieldii</i>	LC
50	Nilgiri Flower pecker	<i>Dicaeum concolor</i>	LC
51	Crimson-backed Sunbird	<i>Leptocoma minima</i>	LC
52	Purple Sunbird	<i>Cinnyris asiaticus</i>	LC
53	Loten's Sunbird	<i>Cinnyris lotenius</i>	LC
54	Little spider hunter	<i>Arachnothera longirostra</i>	LC
55	Asian fairy-bluebird	<i>Irena puella</i>	LC
56	Golden-fronted leafbird	<i>Chloropsis aurifrons</i>	LC
57	Forest wagtail	<i>Dendronanthus indicus</i>	LC
58	Grey wagtail	<i>Motacilla cinerea</i>	LC
59	White-browed wagtail	<i>Motacilla maderaspatensis</i>	LC
60	Grey Jungle Fowl	<i>Gallus sonneratii</i>	LC
61	Grey capped emerald dove	<i>Chalcophaps indica</i>	LC
62	Mountain imperial pigeon	<i>Ducula badia</i>	LC
63	Greater coucal	<i>Centropus sinensis</i>	LC
64	Malabar grey hornbill	<i>Ocyroceros griseus</i>	LC
65	Stork billed kingfisher	<i>Pelargopsis capensis</i>	LC
66	White throated kingfisher	<i>Halcyon smyrnensis</i>	LC
67	Chestnut headed bee eater	<i>Merops leschenaulti</i>	LC
68	White cheeked barbet	<i>Megalaima viridis</i>	LC
69	Brown capped pygmy woodpecker	<i>Dendrocopos nanus</i>	
70	Malabar parakeet	<i>Psittacula columboides</i>	LC
71	Purple rumped sunbird	<i>Leptocoma zeylonica</i>	LC
72	Jungle owlet	<i>Glaucidium radiatum</i>	LC
73	Hill Swallow	<i>Hirundo domicola</i>	
74	Common myna	<i>Acridotheres tristis</i>	LC

LC = Least Concern

Checklist of Butterflies identified in Mankulam survey

Sl. No.	Common name	Scientific name	Family	IUCN/WPA/CITES status
1	Southern Birdwing	<i>Triodes minos</i>	Papilionidae	LC
2	Malabar Rose	<i>Pachliopta pandiyana</i>	Papilionidae	LC
3	Common Rose	<i>Pachliopta aristolochiae</i>	Papilionidae	LC
4	Crimson Rose	<i>Pachliopta hector</i>	Papilionidae	LC/Sch I (Part IV)
5	Common Bluebottle	<i>Graphium sarpedon</i>	Papilionidae	
6	Common jay	<i>Graphium doson</i>	Papilionidae	
7	Common mime	<i>Papilio clytia</i>	Papilionidae	Sch I (Part IV)
8	Lime butterfly	<i>Papilio demoleus</i>	Papilionidae	
9	Malabar banded swallowtail	<i>Papilio liomedon</i>	Papilionidae	Sch I (Part IV)
10	Malabar raven	<i>Papili odravidarum</i>	Papilionidae	
11	Red Helen	<i>Papilio helenus</i>	Papilionidae	
12	Common mormon	<i>Papilio polytes</i>	Papilionidae	
13	Blue Mormon	<i>Papilio polymnestor</i>	Papilionidae	
14	Paris peacock	<i>Papilio paris</i>	Papilionidae	
15	Malabar banded peacock	<i>Papilio buddha</i>	Papilionidae	
16	Common emigrant	<i>Catopsilia pomona</i>	Pieridae	
17	Mottled emigrant	<i>Catopsilia pyranthe</i>	Pieridae	
18	Three-spot grass yellow	<i>Eurema blanda</i>	Pieridae	
19	Common jezebel	<i>Delias eucharis</i>	Pieridae	
20	Plain puffin	<i>Appias indra</i>	Pieridae	
21	Common albatross	<i>Appias albina</i>	Pieridae	
22	Common wanderer	<i>Pareronia valeria</i>	Pieridae	
23	Great orange-tip	<i>Hebomoia glaucippe</i>	Pieridae	
24	Travancore Evening Brown	<i>Parantirrhoea marshalli</i>	Nymphalidae	Sch II
25	Common Evening Brown	<i>Melanitis ledaleda</i>	Nymphalidae	
26	Dark Evening Brow	<i>Melaniti sphedima</i>	Nymphalidae	
27	Common Palmfly	<i>Elymniashy permnestra</i>	Nymphalidae	
28	Common Bushbrown	<i>Mycalesis perseus</i>	Nymphalidae	
29	Dark brand bush brown	<i>Mycalesis mineus</i>	Nymphalidae	
30	Malabar Glad-eye Bushbrown	<i>Mycalesis junonia</i>	Nymphalidae	
31	Medus Brown	<i>Orsotriaen amedus</i>	Nymphalidae	

32	Common Four-ring	<i>Ypthima huebneri</i>	Nymphalidae	
33	Indian Nawab	<i>Charaxes bharata</i>	Nymphalidae	
34	Tamil Lacewing	<i>Cethosia nietneri</i>	Nymphalidae	
35	Cruiser	<i>Vindula erota</i>	Nymphalidae	
36	Rustic	<i>Cuphaery manthis</i>	Nymphalidae	
37	Common Leopard	<i>Phalanta phalantha</i>	Nymphalidae	
38	Tamil Yeoman	<i>Cirrochro athais</i>	Nymphalidae	
39	Chestnut-streaked Sailer	<i>Neptis jumbah</i>	Nymphalidae	
40	Common Sailer	<i>Neptis hylas</i>	Nymphalidae	
41	Common Lascar	<i>Pantoporia hordonia</i>	Nymphalidae	
42	Commander	<i>Moduza procris</i>	Nymphalidae	
43	Clipper	<i>Parthenos sylvia</i>	Nymphalidae	Sch II
44	Grey Count	<i>Tanaecialepidea</i>	Nymphalidae	Sch II
45	Baron	<i>Euthalia aconthea</i>	Nymphalidae	
46	Angled Castor	<i>Ariadne ariadne</i>	Nymphalidae	
47	Common Castor	<i>Ariadne merione</i>	Nymphalidae	
48	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae	
49	Peacock Pansy	<i>Junonia almana</i>	Nymphalidae	
50	Grey Pansy	<i>Junonia atlites</i>	Nymphalidae	
51	Chocolate Pansy	<i>Junonia iphita</i>	Nymphalidae	
52	Great Eggfly	<i>Hypolimnas bolina</i>	Nymphalidae	
53	Danaid Eggfly	<i>Hypolimnas misippus</i>	Nymphalidae	Sch II
54	Glassy Tiger	<i>Parantica aglea</i>	Nymphalidae	
55	Blue Tiger	<i>Tirumala limniace</i>	Nymphalidae	
56	Dark Blue Tiger	<i>Tirumala septentrionis</i>	Nymphalidae	
57	Striped Tiger	<i>Danaus genutia</i>	Nymphalidae	
58	Common Indian Crow	<i>Euploea core</i>	Nymphalidae	
59	Common Pierrot	<i>Castalius rosimon</i>	Kycaenidae	Sch I
60	Common Hedge Blue	<i>Acytolepis puspa</i>	Kycaenidae	
61	Plain Hedge Blue	<i>Celastrina lavendularis</i>	Kycaenidae	
62	Common Quaker	<i>Neopithecops zalmora</i>	Kycaenidae	
63	Malayan	<i>Megisba malaya</i>	Kycaenidae	Sch II
64	Tiny Grass Blue	<i>Zizula hylax</i>	Kycaenidae	
65	Gram Blue	<i>Euchrysop scnejus</i>	Kycaenidae	Sch II
66	Forget-me-not	<i>Catochrysops strabo</i>	Kycaenidae	
67	Dark Cerulean	<i>Jamides bochus</i>	Kycaenidae	
68	Common Cerulean	<i>Jamides celeno</i>	Kycaenidae	
69	Transparent Six-Lineblue	<i>Nacaduba kurava</i>	Kycaenidae	
70	Opaque Six-Lineblue	<i>Nacaduba beroe</i>	Kycaenidae	
71	Common Lineblue	<i>Prosotas nora</i>	Kycaenidae	Sch II
72	Tailless Lineblue	<i>Prosotas dubiosa</i>	Kycaenidae	
73	Dingy Lineblue	<i>Petrelae adana</i>	Kycaenidae	

74	Yamfly	<i>Loxura atymnus</i>	Kycaenidae	
75	Common Imperial	<i>Cheritra freja</i>	Kycaenidae	
76	Cornelian	<i>Deudorix epijarbas</i>	Kycaenidae	Sch I
77	Slate Flash	<i>Rapala manea</i>	Kycaenidae	
78	Pale Green Awlet	<i>Burara gomata</i>	Kycaenidae	
79	Common Spotted Flat	<i>Celaenorrhinus leucocera</i>	Kycaenidae	
80	Fulvous Pied Flat	<i>Pseudocoladen iadan</i>	Kycaenidae	
81	Common Small Flat	<i>Sarangesada sahara</i>	Kycaenidae	
82	Chestnut Angle	<i>Odontoptilum angulata</i>	Kycaenidae	
83	Bush Hopper	<i>Ampittiadio scorides</i>	Kycaenidae	
84	Chestnut Bob	<i>Iambrix salsala</i>	Kycaenidae	
85	Dusky Partwing	<i>Psolos fuligo</i>	Kycaenidae	
86	Common Banded Demon	<i>Notocrypta paralysos</i>	Kycaenidae	
87	Restricted Demon	<i>Notocrypta curvifascia</i>	Kycaenidae	
88	Restricted Spotted Flat	<i>Celaenorrhinusputra</i>	Kycaenidae	
89	Giant Redeye	<i>Gangarathyrasis</i>	Kycaenidae	
90	Palm Redeye	<i>Erionotathrax</i>	Kycaenidae	
91	Tawny-spotted Grass Dart	<i>Taractroceraceras</i>	Kycaenidae	

Annexure 3

Checklist of Odonates identified in Mankulam survey

S. No.	Common name	Scientific name	Family
1	Burmagomphus laidlawi	<i>Burmagomphus laidlawi</i> Fraser	Anisoptea
2	Kodagu Clubtail	<i>Gomphidia kodaguensis</i> Fraser	Anisoptea
3	Common Hooktail	<i>Paragomphus lineatus</i>	Anisoptea
4	Trumpet-Tail	<i>Acisoma panorpoides</i> Rambur	Libellulidae
5	Granite Ghost	<i>Bradino pygageminata</i>	Libellulidae
6	Ground Skimmer	<i>Diplacodes trivialis</i>	Libellulidae
7	Asiatic Blood Tail	<i>Lathrecista asiatica</i>	Libellulidae
8	Fulvous Forest Skimmer	<i>Neurothemis fulvia</i>	Libellulidae
9	Stellate River Hawk	<i>Onychothemis testacea</i>	Libellulidae
10	Brown-Backed Red Marsh	<i>Orthetrum chrysis</i>	Libellulidae
11	Blue Marsh Hawk	<i>Orthetrum glaucum</i>	Libellulidae
12	Tricoloured Marsh Hawk	<i>Orthetrum luzonicum</i>	Libellulidae
13	Crimson-Tailed Marsh Hawk	<i>Orthetrum pruinosum</i>	Libellulidae
14	Green Marsh Hawk	<i>Orthetrum sabina</i>	Libellulidae
15	Ashy Marsh Hawk	<i>Orthetrum taeniolatum</i>	Libellulidae
16	Wandering Glider	<i>Pantala flavescens</i>	Libellulidae

17	Pigmy Skimmer	<i>Tetrathemis platyptera</i>	Libellulidae
18	Coral-Tailed Cloud-Wing	<i>Tholymis tillarga</i>	Libellulidae
19	Black Marsh Trotter	<i>Tramea limbata</i>	Libellulidae
20	Crimson Marsh Glider	<i>Trithemis aurora</i>	Libellulidae
21	Black Stream Glider	<i>Trithemis festiva</i>	Libellulidae
22	Iridescent Stream Glider	<i>Zygonyx iris Selys</i>	Libellulidae
23	Brown Dusk Hawk	<i>Zyxomma petiolatum</i>	Libellulidae
24	Stream Glory	<i>Neurobasis chinensis</i>	Calopterygidae
25	Clear-Winged Forest Glory	<i>Vestalis gracilis</i>	Calopterygidae
26	Myristica Sapphire	<i>Calocyphala idlawi</i>	Chlorocyphidae
27	Stream Ruby	<i>Oabisignata</i>	Chlorocyphidae
28	River Heliodor	<i>Libella goindica</i>	Chlorocyphidae
29	Violet-Striped Slender Dartlet	<i>Aciagrionap proximans</i>	Coenagrionidae
30	Green-Striped Slender Dartlet	<i>Aciagrion occidentale</i>	Coenagrionidae
31	White Dartlet	<i>Agriocnemis pieris</i>	Coenagrionidae
32	Pygmy Dartlet	<i>Agriocnemis pygmaea</i>	Coenagrionidae
33	Golden Dartlet	<i>Ischnura rubilio</i>	Coenagrionidae
34	Green-Striped Grass Dart	<i>Pseudagrion decorum</i>	Coenagrionidae
35	Grass Dart	<i>Pseudagrion indicum</i>	Coenagrionidae
36	Saffron-Faced Grass Dart	<i>Pseudagrion rubriceps</i>	Coenagrionidae
37	Black Torrent Dart	<i>Dysphaea ethela</i>	Euphaeidae
38	Malabar Torrent Dart	<i>Euphaea fraseri</i>	Euphaeidae
39	Forest Spreadwing	<i>Lestesdo rothea</i>	Lestidae
40	Emerald Spreadwing	<i>Lestese latus</i>	Lestidae
41	CoorgBambootail	<i>Caconeura ramburi</i>	Platycnemididae
42	Yellow Bush Dart	<i>Coperamar ginipes</i>	Platycnemididae
43	Blue Bush Dart	<i>Copera vittata</i>	Platycnemididae
44	Black Bambootail	<i>Prodasinera verticalis</i>	Platycnemididae

Annexure 4

Checklist of Reptiles recorded in Eravikulam National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN
1	Anamalai Spiny Lizard	<i>Salea anamallayana</i>	Agamidae	WG	LC
2	Buff striped keelback	<i>Amphiesma stolatum</i>	Colubridae		
3	Common Gecko	<i>Dravidogecko anamallensis</i>	Gekkonidae		NT
4	Gunther's vine snake	<i>Ahaetulla dispar</i>	Colubridae	WG	NT
5	Keeled Grass Skink	<i>Eutropis carinata</i>	Scincidae		LC
6	Large-scaled pitviper	<i>Trimeresurus macrolepis</i>	Viperidae	WG	NT
7	Malabar pit viper	<i>Trimeresurus malabaricus</i>	Viperidae	WG	LC

8	Palni shieldtail	<i>Uropeltis pulneyensis</i>	Uropeltidae	WG	LC
9	Perrotet's mountain snake	<i>Xylophis perroteti</i>	Colubridae	WG	LC
10	Purple-red Earth Snake	<i>Teretrurus sanguineus</i>	Uropeltidae	WG	
11	Shield tail snake	<i>Uropeltis maculata</i>	Uropeltidae	WG	DD
12	Travancore ground skink	<i>Kaestlea travancorica</i>	Scincidae	WG	LC
13	Travancore Ristella	<i>Ristella travancorica</i>	Scincidae	WG	DD

WG = Western Ghats; IUCN = International Union for Conservation of Nature; LC = Least Concern; NT = Near Threatened

Annexure 5

Checklist of birds recorded in Eravikulam National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	African Grass-owl	<i>Tyto capensis</i>	Tytonidae		LC	Sch. IV
2	Alpine Swift	<i>Tachymarpis melba</i>	Apodidae		LC	Sch. IV
3	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae		LC	Sch. IV
4	Ashy Prinia	<i>Prinia socialis</i>	Cisticolidae		LC	Sch. IV
5	Asian Fairy-bluebird	<i>Irena puella</i>	Irenidae		LC	Sch. IV
6	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	Vangidae		LC	Sch. IV
7	Black baza	<i>Aviceda leuphotes</i>	Accipitridae		LC	Sch. I
8	Black Bulbul	<i>Hypsipetes leucocephalus</i>	Pycnonotidae		LC	Sch. IV
9	Black Eagle	<i>Ictinaetus malayensis</i>	Accipitridae		LC	Sch. I
10	Black Kite	<i>Milvus migrans</i>	Accipitridae		LC	Sch. I
11	Black naped oriole	<i>Oriolus chinensis</i>	Oriolidae		LC	Sch. IV
12	Black-and-orange Flycatcher	<i>Ficedula nigrorufa</i>	Muscicapidae	WG	NT	Sch. IV
13	Black-capped Bulbul	<i>Pycnonotus melanicterus</i>	Pycnonotidae		LC	Sch. IV
14	Black-hooded Oriole	<i>Oriolus xanthornus</i>	Oriolidae		LC	Sch. IV
15	Black-lored Tit	<i>Machlolophus xanthogenys</i>	Paridae		LC	Sch. IV
16	Black-naped Monarch	<i>Hypothymis azurea</i>	Monarchidae		LC	Sch. IV
17	Black-rumped Flameback	<i>Dinopium benghalense</i>	Picidae		LC	Sch. IV
18	Black-throated Munia	<i>Lonchura kelaarti</i>	Estrildidae		LC	Sch. IV
19	Black-winged Kite	<i>Elanus caeruleus</i>	Accipitridae		LC	Sch. I
20	Blue Rock-thrush	<i>Monticola solitarius</i>	Muscicapidae		LC	Sch. IV
21	Blue-bearded Bee-eater	<i>Nyctyornis athertoni</i>	Meropidae		LC	
22	Blue-capped Rock-thrush	<i>Monticola cinclorhyncha</i>	Muscicapidae		LC	Sch. IV

23	blue-tailed bee-eater	<i>Merops philippinus</i>	Meropidae		LC	
24	Blyth's Reed-warbler	<i>Acrocephalus dumetorum</i>	Acrocephalidae		LC	Sch. IV
25	Blyth's Swift	<i>Apus leuconyx</i>	Apodidae		LC	Sch. IV
26	Bonelli's Eagle	<i>Aquila fasciata</i>	Accipitridae		LC	Sch. I
27	Booted Eagle	<i>Hieraaetus pennatus</i>	Accipitridae		LC	Sch. I
28	Booted Warbler	<i>Iduna caligata</i>	Acrocephalidae		LC	Sch. IV
29	Brahminy Kite	<i>Haliastur indus</i>	Accipitridae		LC	Sch. I
30	Broad-tailed Grassbird	<i>Schoenicola platyura</i>	Locustellidae	WG	VU	Sch. IV
31	Bronzed Drongo	<i>Dicrurus aeneus</i>	Dicruridae		LC	Sch. IV
32	Brown Shrike	<i>Lanius cristatus</i>	Laniidae		LC	Sch. IV
33	Brown-backed Needletail	<i>Hirundapus giganteus</i>	Apodidae		LC	Sch. IV
34	Brown-breasted Flycatcher	<i>Muscicapa muttui</i>	Muscicapidae		LC	Sch. IV
35	Brown-cheeked Fulvetta	<i>Alcippe poiocephala</i>	Alcippeidae		LC	Sch. IV
36	Buff-spotted Flameback	<i>Chrysocolaptes lucidus</i>	Picidae		LC	Sch. IV
37	Cattle Egret	<i>Bubulcus ibis</i>	Ardeidae		LC	Sch. IV
38	Changeable Hawk-Eagle	<i>Nisaetus cirrhatius</i>	Accipitridae		LC	Sch. I
39	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	Meropidae		LC	
40	Cinereous Tit	<i>Parus cinereus</i>	Paridae		LC	Sch. IV
41	Common Buzzard	<i>Buteo</i>	Accipitridae		LC	Sch. I
42	Common Chiffchaff	<i>Phylloscopus collybita</i>	Phylloscopidae		LC	Sch. IV
43	Common Flameback	<i>Dinopium javanense</i>	Picidae		LC	Sch. IV
44	Common Grasshopper-warbler	<i>Locustella naevia</i>	Locustellidae		LC	Sch. IV
45	Common Hawk-Cuckoo	<i>Hierococcyx varius</i>	Cuculidae		LC	Sch. IV
46	Common Iora	<i>Aegithina tiphia</i>	Aegithinidae		LC	Sch. IV
47	common myna	<i>Acridotheres tristis</i>	Sturnidae		LC	Sch. IV
48	Common Rosefinch	<i>Carpodacus erythrinus</i>	Fringillidae		LC	Sch. IV
49	Common Tailorbird	<i>Orthotomus sutorius</i>	Cisticolidae		LC	Sch. IV
50	Common Woodshrike	<i>Tephrodornis pondicerianus</i>	Vangidae		LC	Sch. IV
51	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	Megalaimidae		LC	Sch. IV
52	Crested Goshawk	<i>Accipiter trivirgatus</i>	Accipitridae		LC	Sch. I
53	Crested Serpent-eagle	<i>Spilornis cheela</i>	Accipitridae		LC	Sch. I
54	Crimson-backed Sunbird	<i>Leptocoma minima</i>	Nectariniidae	WG	LC	Sch. IV

55	Dark-fronted Babbler	<i>Rhopocichla atriceps</i>	Timaliidae		LC	Sch. IV
56	Dusky Crag Martin	<i>Hirundo concolor</i>	Hirundinidae		LC	
57	Eastern Imperial Eagle	<i>Aquila heliaca</i>	Accipitridae		VU	Sch. I
58	Eurasian Blackbird	<i>Turdus merula</i>	Turdidae		LC	Sch. IV
59	Eurasian Buzzard	<i>Buteo buteo</i>	Accipitridae		LC	Sch. I
60	Eurasian hoopoe	<i>Upupa epops</i>	Upupidae		LC	Sch. IV
61	Eurasian Skylark	<i>Alauda arvensis</i>	Alaudidae		LC	Sch. IV
62	Eurasian Sparrowhawk	<i>Accipiter nisus</i>	Accipitridae		LC	Sch. I
63	Flame-throated Bulbul	<i>Rubigula gularis</i>	Pycnonotidae		LC	Sch. IV
64	Golden-fronted leafbird	<i>Chloropsis aurifrons</i>	Chloropseidae		LC	Sch. IV
65	Great Tit	<i>Parus major</i>	Paridae		LC	Sch. IV
66	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae		LC	Sch. IV
67	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	Dicruridae		LC	Sch. IV
68	Green Bee-eater	<i>Merops orientalis</i>	Meropidae		LC	
69	Green Imperial-pigeon	<i>Ducula aenea</i>	Columbidae		LC	Sch. IV
70	Green Sandpiper	<i>Tringa ochropus</i>	Scolopacidae		LC	Sch. IV
71	Greenish Warbler	<i>Phylloscopus trochiloides</i>	Phylloscopidae		LC	Sch. IV
72	Grey Junglefowl	<i>Gallus sonneratii</i>	Phasianidae		LC	Sch. IV
73	Grey Wagtail	<i>Motacilla cinerea</i>	Motacillidae		LC	Sch. IV
74	Grey-breasted Prinia	<i>Prinia hodgsonii</i>	Cisticolidae		LC	Sch. IV
75	Grey-capped Emerald Dove	<i>Chalcophaps indica</i>	Columbidae		LC	Sch. IV
76	Grey-headed Bulbul	<i>Brachypodius priocephalus</i>	Pycnonotidae	WG	NT	Sch. IV
77	Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	Muscicapidae		LC	Sch. IV
78	Hill Swallow	<i>Hirundo domicola</i>	Hirundinidae		LC	
79	House Crow	<i>Corvus splendens</i>	Corvidae		LC	Sch. IV
80	House Sparrow	<i>Passer domesticus</i>	Passeridae		LC	Sch. IV
81	Indian blackbird	<i>Turdus simillimus</i>	Turdidae		LC	Sch. IV
82	Indian Blue Robin	<i>Larvivora brunnea</i>	Muscicapidae		LC	Sch. IV
83	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	Phalacrocoracidae		LC	Sch. IV
84	Indian Cuckoo	<i>Cuculus micropterus</i>	Cuculidae		LC	Sch. IV
85	Indian Golden Oriole	<i>Oriolus kundoo</i>	Oriolidae		LC	Sch. IV
86	Indian Nightjar	<i>Caprimulgus asiaticus</i>	Caprimulgidae		LC	Sch. IV
87	Indian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	Monarchidae		LC	Sch. IV
88	Indian Peafowl	<i>Pavo cristatus</i>	Phasianidae		LC	Sch. IV
89	Indian Pond-Heron	<i>Ardeola grayii</i>	Ardeidae		LC	Sch. IV
90	Indian river tern	<i>Sterna aurantia</i>	Laridae		NT	Sch. IV

91	Indian Rufous Babbler	<i>Turdoides subrufus</i>	Leiothrichidae	WG	LC	Sch. IV
92	Indian Scimitar-babbler	<i>Pomatorhinus horsfieldii</i>	Timaliidae		LC	Sch. IV
93	Indian Swiftlet	<i>Aerodramus unicolor</i>	Apodidae		LC	Sch I (Part III)
94	Indian Yellow Tit	<i>Machlolophus aplonotus</i>	Paridae			Sch. IV
95	Intermediate Egret	<i>Ardea intermedia</i>	Ardeidae		LC	Sch. IV
96	Jerdon's baza	<i>Aviceda jerdoni</i>	Accipitridae		LC	Sch I (Part III)
97	Jerdon's Nightjar	<i>Caprimulgus atripennis</i>	Caprimulgidae		LC	Sch. IV
98	Jungle Myna	<i>Acridotheres fuscus</i>	Sturnidae		LC	Sch. IV
99	Jungle Nightjar	<i>Caprimulgus indicus</i>	Caprimulgidae		LC	Sch. IV
100	Jungle Prinia	<i>Prinia sylvatica</i>	Cisticolidae		LC	Sch. IV
101	Kashmir Flycatcher	<i>Ficedula subrubra</i>	Muscicapidae		VU	Sch. IV
102	Large-billed Crow	<i>Corvus macrorhynchos</i>	Corvidae		LC	Sch. IV
103	Large-billed Leaf-warbler	<i>Phylloscopus magnirostris</i>	Phylloscopidae		LC	Sch. IV
104	Legge's Hawk-Eagle	<i>Nisaetus kelaarti</i>	Accipitridae		LC	Sch. I
105	Lesser Coucal	<i>Centropus bengalensis</i>	Cuculidae		LC	Sch. IV
106	Lesser Yellownape	<i>Picus chlorolophus</i>	Picidae		LC	Sch. IV
107	Little Egret	<i>Egretta garzetta</i>	Ardeidae		LC	Sch. IV
108	Little Grebe	<i>Tachybaptus ruficollis</i>	Podicipedidae		LC	Sch. IV
109	Little Spiderhunter	<i>Arachnothera longirostra</i>	Nectariniidae		LC	Sch. IV
110	Little Swift	<i>Apus affinis</i>	Apodidae		LC	Sch. IV
111	Long-billed Pipit	<i>Anthus similis</i>	Motacillidae		LC	Sch. IV
112	Long-tailed Shrike	<i>Lanius schach</i>	Laniidae		LC	Sch. IV
113	Loten's Sunbird	<i>Cinnyris lotenius</i>	Nectariniidae		LC	Sch. IV
114	Malabar barbet	<i>Psilopogon malabaricus</i>	Megalaimidae	WG	LC	Sch. IV
115	Malabar Grey Hornbill	<i>Ocyrceros griseus</i>	Bucerotidae	WG	LC	Sch. I
116	Malabar Lark	<i>Galerida malabarica</i>	Alaudidae		LC	Sch. IV
117	Malabar Parakeet	<i>Psittacula columboides</i>	Psittaculidae	WG	LC	Sch. IV
118	Malabar Starling	<i>Sturnia blythii</i>	Sturnidae		LC	Sch. IV
119	Malabar Trogon	<i>Harpactes fasciatus</i>	Trogonidae		LC	Sch. IV
120	Malabar Whistling-thrush	<i>Myophonus horsfieldii</i>	Muscicapidae		LC	Sch. IV
121	Malabar Woodshrike	<i>Tephrodornis sylvicola</i>	Vangidae		LC	Sch. IV
122	Montagu's Harrier	<i>Circus pygargus</i>	Accipitridae		LC	Sch. I

123	Mountain Imperial-pigeon	<i>Ducula badia</i>	Columbidae		LC	Sch. IV
124	Nilgiri blue robin	<i>Myiomela major</i>	Muscicapidae	WG	EN	Sch. IV
125	Nilgiri Flowerpecker	<i>Dicaeum concolor</i>	Dicaeidae		LC	Sch. IV
126	Nilgiri Flycatcher	<i>Eumyias albicaudatus</i>	Muscicapidae	WG	NT	Sch. IV
127	Nilgiri Pipit	<i>Anthus nilghiriensis</i>	Motacillidae	WG	VU	Sch. IV
128	Nilgiri Woodpigeon	<i>Columba elphinstonii</i>	Columbidae	WG	VU	Sch. IV
129	Olive-backed Pipit	<i>Anthus hodgsoni</i>	Motacillidae		LC	Sch. IV
130	Oriental honey-buzzard	<i>Pernis ptilorhynchus</i>	Accipitridae		LC	Sch. I
131	Oriental Magpie-robin	<i>Copsychus saularis</i>	Muscicapidae		LC	Sch. IV
132	Oriental Skylark	<i>Alauda gulgula</i>	Alaudidae		LC	Sch. IV
133	Oriental White-eye	<i>Zosterops palpebrosus</i>	Zosteropidae		LC	Sch. IV
134	Pacific Swift	<i>Apus pacificus</i>	Apodidae		LC	Sch. IV
135	Paddyfield Pipit	<i>Anthus rufulus</i>	Motacillidae		LC	Sch. IV
136	Painted Bush-quail	<i>Perdica erythrorhyncha</i>	Phasianidae		LC	Sch. IV
137	Painted Bush-Quail	<i>Perdica erythrorhyncha</i>	Phasianidae		LC	Sch. IV
138	Palani laughingthrush	<i>Montecincla fairbanki</i>	Leiotherichidae	WG	LC	Sch. IV
139	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>	Dicaeidae		LC	Sch. IV
140	Pallid Harrier	<i>Circus macrourus</i>	Accipitridae		NT	Sch. I
141	Pied Bushchat	<i>Saxicola caprata</i>	Muscicapidae		LC	Sch. IV
142	Pied Thrush	<i>Geokichla wardii</i>	Turdidae		LC	Sch. IV
143	Plain Prinia	<i>Prinia inornata</i>	Cisticolidae		LC	Sch. IV
144	Puff-throated Babbler	<i>Pellorneum ruficeps</i>	Pellorneidae		LC	Sch. IV
145	Purple Sunbird	<i>Cinnyris asiaticus</i>	Nectariniidae		LC	Sch. IV
146	Purple-rumped Sunbird	<i>Leptocoma zeylonica</i>	Nectariniidae		LC	Sch. IV
147	Red Spurfowl	<i>Galloperdix spadicea</i>	Phasianidae		LC	Sch. IV
48	Red-rumped Swallow	<i>Cecropis daurica</i>	Hirundinidae		LC	
149	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae		LC	Sch. IV
150	Red-wattled Lapwing	<i>Vanellus indicus</i>	Charadriidae		LC	Sch. IV
151	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Pycnonotidae		LC	Sch. IV
152	Rock pigeon	<i>Columba livia domestica</i>	Columbidae		LC	Sch. IV
153	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Psittaculidae		LC	Sch. IV
154	Rufous Babbler	<i>Argya subrufa</i>	Leiotherichidae	WG	LC	Sch. IV
155	Rufous Treepie	<i>Dendrocitta vagabunda</i>	Corvidae		LC	Sch. IV
156	Rufous-bellied Eagle	<i>Lophotriorchis kienerii</i>	Accipitridae		NT	Sch. I

157	Rusty-tailed Flycatcher	<i>Ficedula ruficauda</i>	Muscicapidae		LC	Sch. IV
158	Scaly Thrush	<i>Zoothera dauma</i>	Turdidae		LC	Sch. IV
159	Scarlet Minivet	<i>Pericrocotus flammeus</i>	Campephagidae		LC	Sch. IV
160	Shikra	<i>Accipiter badius</i>	Accipitridae		LC	Sch. I
161	Short-toed Snake-eagle	<i>Circaetus gallicus</i>	Accipitridae		LC	Sch. I
162	Short-toed Snake-Eagle	<i>Circaetus gallicus</i>	Accipitridae		LC	Sch. I
163	Southern Hill Myna	<i>Gracula religiosa</i>	Sturnidae		LC	Sch. I
164	Square-tailed Bulbul	<i>Hypsipetes ganeesa</i>	Pycnonotidae		LC	Sch. IV
165	Streak-throated Swallow	<i>Petrochelidon fluvicola</i>	Hirundinidae		LC	
166	Streak-throated Woodpecker	<i>Picus xanthopygaeus</i>	Picidae		LC	Sch. IV
167	Tahiti Swallow	<i>Hirundo tahitica</i>	Hirundinidae		LC	
168	Tawny-bellied Babbler	<i>Dumetia hyperythra</i>	Timaliidae		LC	Sch. IV
169	Thick-billed Flowerpecker	<i>Dicaeum agile</i>	Dicaeidae		LC	Sch. IV
170	Thick-billed Warbler	<i>Acrocephalus aedon</i>	Acrocephalidae		LC	Sch. IV
171	Tickell's Leaf-warbler	<i>Phylloscopus affinis</i>	Phylloscopidae		LC	Sch. IV
172	Tytler's Leaf-Warbler	<i>Phylloscopus tytleri</i>	Phylloscopidae		NT	Sch. IV
173	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Sturnidae		LC	Sch. IV
174	Verditer Flycatcher	<i>Eumyias thalassinus</i>	Muscicapidae		LC	Sch. IV
175	Vernal Hanging-Parrot	<i>Loriculus vernalis</i>	Psittaculidae		LC	Sch. IV
176	Wayanad Laughingthrush	<i>Pterorhinus delesserti</i>	Leiothrichidae	WG	LC	Sch. IV
177	Western Crowned Leaf-warbler	<i>Phylloscopus occipitalis</i>	Phylloscopidae		LC	Sch. IV
178	Western Spotted Dove	<i>Spilopelia suratensis</i>	Columbidae		LC	Sch. IV
179	white-bellied blue robin	<i>Sholicola albiventris</i>	Muscicapidae		VU	Sch. IV
180	White-bellied Blue-flycatcher	<i>Cyornis pallidipes</i>	Muscicapidae	WG	LC	Sch. IV
181	White-bellied Treepie	<i>Dendrocitta leucogastra</i>	Corvidae		LC	Sch. IV
182	White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae		LC	Sch. IV
183	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Rallidae		LC	Sch. IV
184	White-browed Bulbul	<i>Pycnonotus luteolus</i>	Pycnonotidae		LC	Sch. IV
185	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	Motacillidae		LC	Sch. IV
186	White-cheeked Barbet	<i>Psilopogon viridis</i>	Megalaimidae		LC	Sch. IV
187	White-rumped Spinetail	<i>Zoonavena sylvatica</i>	Apodidae		LC	Sch. IV
188	Yellow-billed Babbler	<i>Turdoides affinis</i>	Leiothrichidae		LC	Sch. IV
189	Yellow-browed Bulbul	<i>Acritillas indica</i>	Pycnonotidae		LC	Sch. IV

190	Yellow-throated Sparrow	<i>Gymnoris xanthocollis</i>	Passeridae		LC	Sch. IV
191	Zitting Cisticola	<i>Cisticola juncidis</i>	Cisticolidae		LC	Sch. IV

WG = Western Ghats; IUCN = International Union for Conservation of Nature; NE = Not Evaluated; CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LC = Least Concern; NT = Near Threatened; WPA = Wildlife Protection Act; Sch. = Schedule.

Annexure 6

Checklist of Mammals recorded in Eravikulam National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Asian Small Clawed Otter	<i>Amblonyx cinereus</i>	Mustelidae		NT	Sch I (Part I)
2	Black Naped Hare	<i>Lepus nigricollis</i>	Leporidae		LC	Sch IV
3	Bonnet Macaque	<i>Macaca radiata</i>	Cercopithecidae		VU	Sch II (Part I)
4	Day's Shrew	<i>Suncus dayi</i>	Soricidae		EN	
5	Elephant	<i>Elephas maximus</i>	Elephantidae		EN	Sch I (Part I)
6	Etruscan pygmy shrew	<i>Suncus etruscus</i>	Soricidae		LC	
7	Eurasian otter	<i>Lutra</i>	Mustelidae		NT	Sch II (Part I)
8	Fawn Colored Mouse	<i>Mus cervicolor</i>	Muridae		LC	
9	Golden jackal	<i>Canis aureus</i>	Canidae		LC	Sch II (Part I)
10	Greater short-nosed fruit bat	<i>Cynopterus sphinx</i>	Pteropodidae		LC	Sch IV
11	Grizzled giant squirrel	<i>Ratufa macroura</i>	Sciuridae		NT	Sch I (Part I)
12	Hanuman Langur	<i>Semnopithecus entellus</i>	Cercopithecidae		LC	Sch II (Part I)
13	House Shrew	<i>Suncus murinus</i>	Soricidae		LC	
14	Indian bison	<i>Bos gaurus</i>	Bovidae		VU	Sch I (Part I)
15	Indian Brown Mongoose	<i>Herpestes fuscus</i>	Herpestidae		LC	
16	Indian crested porcupine	<i>Hystrix indica</i>	Hystricidae		LC	Sch IV
17	Indian Flying Fox	<i>Pteropus giganteus</i>	Pteropodidae		LC	Sch IV
18	Indian Grey Mongoose	<i>Herpestes edwardsii</i>	Herpestidae		LC	Sch II (Part I)
19	Indian muntjac	<i>Muntiacus muntjack</i>	Cervidae		LC	
20	Indian Wild Dog or Dhole	<i>Cuon alpinus alpinus</i>	Canidae		EN	Sch II (Part I)
21	Jungle Cat	<i>Felis chaus</i>	Felidae		LC	Sch II (Part I)
22	Jungle palm squirrel	<i>Funambulus tristriatus</i>	Sciuridae		LC	
23	Kelaart's long-clawed shrew	<i>Feroculus feroculus</i>	Soricidae		EN	
24	Leopard	<i>Panthera pardus</i>	Felidae		VU	Sch I (Part I)
25	Leopard cat	<i>Prionailurus</i>	Felidae		LC	Sch I (Part I)

		<i>bengalensis</i>				
26	Lesser hairy-winged bat	<i>Harpiocephalus harpia</i>	Vespertilionidae		LC	
27	Lion Tailed Macaque	<i>Macaca silenus</i>	Cercopithecidae	WG	EN	Sch I (Part I)
28	Little Indian field mouse	<i>Mus booduga</i>	Muridae		LC	Sch IV
29	Malabar giant squirrel	<i>Ratufa indica</i>	Sciuridae		LC	Sch II (Part I)
30	Malabar spiny dormouse	<i>Platacanthoymys lasiurus</i>	Platacanthomyidae		NT	
31	Montane Shrew	<i>Sorex monticolus</i>	Soricidae		LC	
32	Mouse deer	<i>Tragulus meminna</i>	Tragulidae			
33	Nilgiri Langur	<i>Semnopithecus johnei</i>	Cercopithecidae	WG	VU	Sch I (Part I)
34	Nilgiri long-tailed tree mouse	<i>Vandeleuria nilagirica</i>	Muridae		EN	
35	Nilgiri Marten	<i>Martes gwatkinsii</i>	Mustelidae		VU	Sch II (Part I)
36	Nilgiri striped squirrel	<i>Funambulus sublineatus</i>	Sciuridae		VU	
37	Nilgiri tahr	<i>Nilgiritragus hylocrius</i>	Bovidae	WG	EN	Sch I (Part I)
38	Palm Civet	<i>Paradoxurus hermaphroditus</i>	Viverridae		LC	Sch II (Part I)
39	Ruddy mongoose	<i>Herpestes smithii</i>	Herpestidae		LC	Sch II (Part I)
40	Rufous horseshoe bat	<i>Rhinolophus rouxi</i>	Rhinolophidae		LC	
41	Sambar deer	<i>Rusa unicolor</i>	Cervidae		VU	
42	Servant Mouse	<i>Mus famulus</i>	Muridae		EN	
43	Sloth Bear	<i>Ursus ursinus</i>	Ursidae		VU	Sch I (Part I)
44	Small Indian Civet	<i>Viverricula indica</i>	Viverridae		LC	Sch II (Part I)
45	Striped Necked Mongoose	<i>Herpestes vitticollis</i>	Herpestidae		LC	Sch II (Part I)
46	Tiger	<i>Panthera tigris</i>	Felidae		EN	Sch I (Part I)
47	White Bellied Rat	<i>Niviventer niviventer</i>	Muridae		LC	Sch IV
48	Wild boar	<i>Sus scrofa</i>	Suidae		LC	

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Checklist of Amphibians recorded in Eravikulam National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN
1	Anamallai Night Frog	<i>Nyctibatrachus anamallaiensis</i>	Nyctibatrachidae	WG	NE
2	Anil's Bush Frog	<i>Raorchestes anili</i>	Rhacophoridae	WG	LC
3	Beddome's Bush Frog	<i>Raorchestes beddomii</i>	Rhacophoridae	WG	NT
4	Black Microhylid Frog	<i>Melanobatrachus indicus</i>	Microhylidae	WG	EN
5	Black-bellied Torrent Frog	<i>Micrixalus nigraventris</i>	Micrixalidae	WG	NE
6	Boulenger's Leaping Frog	<i>Walkerana leptodactyla</i>	Ranixalidae	WG	EN
7	Caecilian	<i>Uraeotyphlus species</i>			
8	Cold Stream Torrent Frog	<i>Micrixalus frigidus</i>	Micrixalidae	WG	NE
9	Common Indian Toad	<i>Duttaphrynus melanostictus</i>	Bufonidae		LC
10	Deccan night frog	<i>Nyctibatrachus deccanensis</i>	Nyctibatrachidae	WG	VU
11	Ghat Tree Frog	<i>Ghatixalus asterops</i>	Rhacophoridae	WG	DD
12	Green Tree Frog	<i>Ghatixalus magnus</i>	Rhacophoridae	WG	DD
13	Green-eyed Bush Frog	<i>Raorchestes chlorosomma</i>	Rhacophoridae	WG	CR
14	Griet Bush Frog	<i>Raorchestes griet</i>	Rhacophoridae	WG	CR
15	Jayaram's Bush Frog	<i>Raorchestes jayarami</i>	Rhacophoridae	WG	NE
16	Jerdon's Ramanella	<i>Ramanella montana</i>	Microhylidae	KER	NT
17	Kadalar Bush Frog	<i>Raorchestes kadalarensis</i>	Rhacophoridae	KER	NE
18	Kadalar Swamp Frog	<i>Beddomixalus bijui</i>	Rhacophoridae	KER	NE
19	Kalakad Tree Frog	<i>Rhacophorus calcadensis</i>	Rhacophoridae	WG	EN
20	Kodaikanal Bush Frog	<i>Raorchestes dubois</i>	Rhacophoridae	WG	VU
21	Malabar False Tree frog	<i>Rhacophorus pseudomalabaricus</i>	Rhacophoridae	WG	CR
22	Meowing Night Frog	<i>Nyctibatrachus poocha</i>	Nyctibatrachidae	WG	NE
23	Munnar Bush Frog	<i>Raorchestes munnarensis</i>	Rhacophoridae	WG	CR
24	Munnar Torrent Frog	<i>Micrixalus adonis</i>	Micrixalidae	KER	NE
25	Ochlandrae Reed Bush Frog	<i>Raorchestes ochlandrae</i>	Rhacophoridae	WG	DD
26	Pleasant Bush Frog	<i>Raorchestes blandus</i>	Rhacophoridae	WG	NE
27	Purple Frog	<i>Nasikabatrachus sahyadrensis</i>	Sooglossidae	WG	EN
28	Resplendent Shrub Frog	<i>Raorchestes resplendens</i>	Rhacophoridae	WG	CR
29	Short-webbed Frog	<i>Zakerana brevipalmata</i>	Dicroglossidae	WG	DD
30	Small-eared Toad	<i>Duttaphrynus microtympanum</i>	Bufonidae	WG	VU

31	Spinular Night Frog	<i>Nyctibatrachus acanthodermis</i>	Nyctibatrachidae	KER	NE
32	Sushil's Bush Frog	<i>Raorchestes sushili</i>	Rhacophoridae	WG	CR
33	Toad skinned Leaping Frog	<i>Walkerana phrynoderma</i>	Ranixalidae	WG	CR
34	Uthaman's Reed Bush Frog	<i>Raorchestes uthamani</i>	Rhacophoridae	KER	NE
35	Water Drop Frog	<i>Raorchestes nerostagona</i>	Rhacophoridae	WG	EN
36	Yellow-bellied Bush Frog	<i>Raorchestes flaviventris</i>	Rhacophoridae	WG	DD

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Annexure 8

Checklist of Butterflies recorded in Eravikulam National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Angled Castor	<i>Ariadne ariadne</i>	Nymphalidae		LC	
2	Bamboo Tree Brown	<i>Lethe europa</i>	Nymphalidae		LC	
3	Banded Blue Pierrot	<i>Discolampa ethion</i>	Lycaenidae		LC	
4	Black Prince	<i>Rohana parisatis</i>	Nymphalidae		LC	
5	Blank Swift	<i>Caltoris kumara</i>	Hesperiidae	WG	LC	
6	Blue Admiral	<i>Kaniska canace</i>	Nymphalidae		LC	
7	Blue Mormon	<i>Papilio polymnestor</i>	Papilionidae		LC	
8	Blue Pansy	<i>Junonia orithya</i>	Nymphalidae		LC	
9	Blue Tiger	<i>Tirumala limniace</i>	Nymphalidae		LC	
10	Bright Babul Blue	<i>Azanus ubaldus</i>	Lycaenidae		LC	
11	Chocolate Pansy	<i>Junonia iphita</i>	Nymphalidae		LC	
12	Ciliate blue	<i>Anthene emolus</i>	Lycaenidae		LC	
13	Commander	<i>Limenitis procris</i>	Nymphalidae		LC	
14	Common Albatross	<i>Appias albina</i>	Pieridae		LC	
15	Common Banded Awl	<i>Hasora chromus</i>	Hesperiidae		LC	
16	Common Banded Demon	<i>Notocrypta paralysos</i>	Hesperiidae		LC	
17	Common Blue Bottle	<i>Graphium sarpedon</i>	Papilionidae		LC	
18	Common Cerulean	<i>Jamides celeno</i>	Lycaenidae		LC	
19	Common Emigrant	<i>Catopsilia pomona</i>	Pieridae		LC	
20	Common Evening Brown	<i>Melanitis leda</i>	Nymphalidae		LC	
21	Common Grass Yellow	<i>Eurema hecabe</i>	Pieridae		LC	
22	Common Gull	<i>Cepora nerissa</i>	Pieridae		LC	
23	Common Hedge Blue	<i>Actolepis puspa</i>	Lycaenidae		LC	
24	Common Indian Crow	<i>Euploea core</i>	Nymphalidae		LC	

25	Common Jezebel	<i>Delias eucharis</i>	Pieridae		LC	
26	Common Leopard	<i>Phalanta phalantha</i>	Nymphalidae		LC	
27	Common Line Blue	<i>Prosotas nora</i>	Lycaenidae		LC	
28	Common Map	<i>Cyrestis thyodamas</i>	Nymphalidae		LC	
29	Common Mime	<i>Papilio clytia</i>	Papilionidae		LC	
30	Common Mormon	<i>Papilio polytes</i>	Papilionidae		LC	
31	Common Pierrot	<i>Castalius rosimon</i>	Lycaenidae		LC	Sch I (Part IV)
32	Common Rose	<i>Pachliopta aristolochiae</i>	Papilionidae		LC	
33	Common Sailor	<i>Neptis hylas</i>	Nymphalidae		LC	
34	Common Spotted Flat	<i>Celaenorrhinus leucocera</i>	Hesperiidae		LC	
35	Common Tiger	<i>Danaus genutia</i>	Nymphalidae		LC	
36	Common Tree Brown	<i>Lethe rohria</i>	Nymphalidae		LC	
37	Crimson Rose	<i>Pachliopta hector</i>	Papilionidae		LC	Sch I (Part IV)
38	Danaid Egg Fly	<i>Hypolimnas misippus</i>	Nymphalidae		LC	
39	Dark Blue Tiger	<i>Tirumala septentrionis</i>	Nymphalidae		LC	
40	Dark Cerulean	<i>Jamides bochus</i>	Lycaenidae		LC	
41	Dark Evening Brown	<i>Melanitis phedima</i>	Nymphalidae		LC	
42	Dark Grass Blue	<i>Zizeeria karsandra</i>	Lycaenidae		LC	
43	Forget-Me-Not	<i>Catochrysops strabo</i>	Lycaenidae		LC	
44	Fulvous Pied Flat	<i>Psuedocoladenia dan</i>	Hesperiidae		LC	
45	Glassy Tiger	<i>Parantica aglea</i>	Nymphalidae		LC	
46	Gram Blue	<i>Euchrysops cnejus</i>	Lycaenidae		LC	
47	Grass Demon	<i>Udaspes folus</i>	Hesperiidae		LC	
48	Great Egg Fly	<i>Hypolimnas bolina</i>	Nymphalidae		LC	
49	Great Evening Brown	<i>Melanitis zitenius</i>	Nymphalidae		LC	
50	Great Orange Tip	<i>Hebomoia glaucippe</i>	Pieridae		LC	
51	Indian Awl King	<i>Choaspes benjaminii</i>	Hesperiidae		LC	
52	Indian Cabbage White	<i>Pieris canidia</i>	Pieridae		LC	
53	Indian Cupid	<i>Everes lacturnus</i>	Lycaenidae		LC	
54	Indian Fritillary	<i>Argyreus hyperbius</i>	Nymphalidae		LC	
55	Indian Red Admiral	<i>Vanessa indica</i>	Nymphalidae		LC	
56	Large four Line Blue	<i>Nacaduba pactolus</i>	Lycaenidae		LC	
57	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae		LC	
58	Lesser Grass Blue	<i>Zizina otis</i>	Lycaenidae		LC	
59	Lime butterfly	<i>Papilio demoleus</i>	Papilionidae		LC	
60	Malabar Raven	<i>Papilio dravidarum</i>	Papilionidae	WG	LC	
61	Metallic Cerulean	<i>Jamides alecto</i>	Lycaenidae		LC	
62	Mottled Emigrant	<i>Catopsilia pyranthe</i>	Pieridae		LC	

63	Nilgiri Clouded Yellow	<i>Colias nilgiriensis</i>	Pieridae	WG	LC	
64	Nilgiri Grass Yellow	<i>Eurema nilgiriensis</i>	Pieridae	WG	LC	
65	Nilgiri Tiger	<i>Parantica nilgiriensis</i>	Nymphalidae	WG	LC	
66	Painted Lady	<i>Cynthia cardui</i>	Nymphalidae		LC	
67	Pale four Line Blue	<i>Nacaduba hermus</i>	Lycaenidae		LC	
68	Pale Grass Blue	<i>Psuedozeeria maha</i>	Lycaenidae		LC	
69	Palni Bush Brown	<i>Mycalesis davisoni</i>	Nymphalidae		LC	
70	Palni Dart	<i>Potanthus palnia</i>	Hesperiidae		LC	
71	Palni Fourring	<i>Ypthima ypthimoides</i>	Nymphalidae	WG	LC	
72	Paris Peacock	<i>Papilio paris</i>	Papilionidae		LC	
73	Pea Blue	<i>Lampides boeticus</i>	Lycaenidae		LC	
74	Peacock Pansy	<i>Junonia almana</i>	Nymphalidae		LC	
75	Pioneer or Caper White	<i>Anaphaeis aurota</i>	Pieridae		LC	
76	Plain Puffin	<i>Appias indra</i>	Pieridae		LC	
77	Plain Tiger	<i>Danaus chrysippus</i>	Nymphalidae		LC	
78	Plains Cupid	<i>Chilades pandava</i>	Lycaenidae		LC	
79	Red Disk Bush Brown	<i>Mycalesis oculus</i>	Nymphalidae	WG	LC	
80	Red Helen	<i>Papilio helenus</i>	Papilionidae		LC	
81	Red Pierrot	<i>Talicauda nyseus</i>	Lycaenidae		LC	
82	Red Spot Duke	<i>Dolpha evelina</i>	Nymphalidae		LC	
83	Rice Swift	<i>Borbo cinnara</i>	Hesperiidae		LC	
84	Rustic	<i>Cupha erymanthis</i>	Nymphalidae		LC	
85	Small Grass Yellow	<i>Eurema brigitta</i>	Pieridae		LC	
86	Southern Birdwing	<i>Troides minos</i>	Papilionidae	WG	LC	
87	Spotted Puffin	<i>Appias lalage</i>	Pieridae		LC	
88	Tailed Jay	<i>Graphium agamemnon</i>	Papilionidae		LC	
89	Tamil Dartlet	<i>Oriens concinna</i>	Hesperiidae	WG	LC	
90	Tamil Grass Dart	<i>Taractrocera ceramas</i>	Hesperiidae		LC	
91	Tamil Tree Brown	<i>Lethe drypetis</i>	Nymphalidae		LC	
92	Tamil Yeoman	<i>Cirrochroa thais</i>	Nymphalidae		LC	
93	Tawny Coster	<i>Acraea violae</i>	Nymphalidae		LC	
94	Tiny Grass Blue	<i>Zizula hylax</i>	Lycaenidae		LC	
95	Water Snow Flat	<i>Tagiades litigiosa</i>	Hesperiidae		LC	
96	White Banded Awl	<i>Hasora taminatus</i>	Hesperiidae		LC	
97	White Disc Hedge Blue	<i>Celatoxia albidisca</i>	Lycaenidae	WG	LC	
98	White Hedge Blue	<i>Udara akasa</i>	Lycaenidae		LC	
99	Whitebar Bush Brown	<i>Mycalesis anaxias</i>	Nymphalidae		LC	
100	Yellow Pansy	<i>Junonia hierta</i>	Nymphalidae		LC	
101	Zebra Blue	<i>Leptotes plinius</i>	Lycaenidae		LC	

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Annexure 9

Checklist of birds recorded in Chinnar Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Alpine Swift	<i>Tachymarptis melba</i>	Apodidae		LC	
2	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae		LC	Sch IV
3	Ashy Prinia	<i>Prinia socialis</i>	Cisticolidae		LC	Sch IV
4	Ashy Woodswallow	<i>Artamus fuscus</i>	Artamidae		LC	
5	Ashy-crowned Sparrow-lark	<i>Eremopterix griseus</i>	Alaudidae		LC	Sch IV
6	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	Muscicapidae		LC	Sch IV
7	Asian Fairy-bluebird	<i>Irena puella</i>	Irenidae		LC	Sch IV
8	Asian koel	<i>Eudynamis scolopaceus</i>	Cuculidae		LC	Sch IV
9	Asian Palm-swift	<i>Cypsiurus balasiensis</i>	Apodidae		LC	
10	Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	Cuculidae		LC	Sch IV
11	Barn Swallow	<i>Hirundo rustica</i>	Hirundinidae		LC	
12	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	Vangidae		LC	Sch IV
13	Bay-backed Shrike	<i>Lanius vittatus</i>	Laniidae		LC	
14	Besra	<i>Accipiter virgatus</i>	Accipitridae		LC	Sch I
15	Black Baza	<i>Aviceda leuphotes</i>	Accipitridae		LC	Sch I
16	Black Bulbul	<i>Hypsipetes leucocephalus</i>	Pycnonotidae		LC	Sch IV
17	Black Drongo	<i>Dicrurus macrocercus</i>	Dicruridae		LC	Sch IV
18	Black Eagle	<i>Ictinaetus malayensis</i>	Accipitridae		LC	Sch I
19	Black naped oriole	<i>Oriolus chinensis</i>	Oriolidae		LC	Sch IV
20	Black-and-orange Flycatcher	<i>Cyornis rubeculoides</i>	Muscicapidae		LC	Sch IV
21	Black-capped Bulbul	<i>Pycnonotus melanicterus</i>	Pycnonotidae		LC	Sch IV
22	Black-headed Cuckooshrike	<i>Lalage melanoptera</i>	Campephagidae		LC	Sch IV
23	Black-hooded Oriole	<i>Oriolus xanthornus</i>	Oriolidae		LC	Sch IV
24	Black-lored Tit	<i>Machlolophus xanthogenys</i>	Paridae		LC	Sch IV
25	Black-naped Monarch	<i>Hypothymis azurea</i>	Monarchidae		LC	Sch IV
26	Black-nest swiftlet	<i>Aerodramus maximus</i>	Apodidae		LC	
27	Black-rumped Flameback	<i>Dinopium benghalense</i>	Picidae		LC	Sch IV
28	Black-rumped Flameback	<i>Dinopium benghalense</i>	Picidae		LC	Sch IV
29	Black-throated Munia	<i>Lonchura kelaarti</i>	Estrildidae		LC	Sch IV
30	Black-winged Kite	<i>Elanus caeruleus</i>	Accipitridae		LC	Sch I
31	Blue-bearded Bee-eater	<i>Nyctyornis athertoni</i>	Meropidae		LC	

32	Blue-capped Rock-thrush	<i>Monticola cinclorhyncha</i>	Muscicapidae		LC	Sch IV
33	Blue-faced Malkoha	<i>Phaenicophaeus viridirostris</i>	Cuculidae		LC	Sch IV
34	Blu throated blue flycatcher	<i>Cyornis rubeculoides</i>	Muscicapidae		LC	Sch IV
35	Blyth's Reed-warbler	<i>Acrocephalus dumetorum</i>	Acrocephalidae		LC	Sch IV
36	Bonelli's Eagle	<i>Aquila fasciata</i>	Accipitridae		LC	Sch I
37	Booted Warbler	<i>Iduna caligata</i>	Acrocephalidae		LC	Sch IV
38	Brahminy Starling	<i>Sturnia pagodarum</i>	Sturnidae		LC	Sch IV
39	Broad-tailed Grassbird	<i>Schoenicola platyura</i>	Locustellidae	WG	VU	Sch IV
40	Bronzed Drongo	<i>Dicrurus aeneus</i>	Dicruridae		LC	Sch IV
41	Brown Fish-owl	<i>Ketupa zeylonensis</i>	Strigidae		LC	Sch IV
42	Brown Shrike	<i>Lanius cristatus</i>	Laniidae		LC	
43	Brown-backed Needletail	<i>Hirundapus giganteus</i>	Apodidae		LC	
44	Brown-breasted Flycatcher	<i>Muscicapa muttui</i>	Muscicapidae		LC	Sch IV
45	Brown-cheeked Fulvetta	<i>Alcippe poiocephala</i>	Alcippeidae		LC	Sch IV
46	Brown-headed Barbet	<i>Psilopogon zeylanicus</i>	Megalaimidae		LC	Sch IV
47	Buff-spotted Flameback	<i>Chrysocolaptes lucidus</i>	Picidae		LC	Sch IV
48	Changeable Hawk-Eagle	<i>Nisaetus cirrhatus</i>	Accipitridae		LC	Sch I
49	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	Meropidae		LC	
50	Chestnut-shouldered Bush-sparrow	<i>Gymnoris xanthocollis</i>	Passeridae		LC	Sch IV
51	Chestnut-tailed Starling	<i>Sturnia malabarica</i>	Sturnidae		LC	Sch IV
52	Clamorous Reed-warbler	<i>Acrocephalus stentoreus</i>	Acrocephalidae		LC	Sch IV
53	Common Flameback	<i>Dinopium javanense</i>	Picidae		LC	Sch IV
54	Common Hawk-Cuckoo	<i>Hierococcyx varius</i>	Cuculidae		LC	Sch IV
55	Common Iora	<i>Aegithina tiphia</i>	Aegithinidae		LC	Sch IV
56	Common Kestrel	<i>Falco tinnunculus</i>	Falconidae		LC	Sch IV
57	Common Kingfisher	<i>Alcedo atthis</i>	Alcedinidae		LC	Sch IV
58	common myna	<i>Acridotheres tristis</i>	Sturnidae		LC	Sch IV
59	Common Rosefinch	<i>Carpodacus erythrinus</i>	Fringillidae		LC	Sch IV
60	Common Sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae		LC	Sch IV
61	Common Tailorbird	<i>Orthotomus sutorius</i>	Cisticolidae		LC	Sch IV
62	Common Woodshrike	<i>Tephrodornis pondicerianus</i>	Vangidae		LC	Sch IV
63	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	Megalaimidae		LC	Sch IV

64	Crested Serpent-eagle	<i>Spilornis cheela</i>	Accipitridae		LC	Sch I
65	Crested Treeswift	<i>Hemiprogne coronata</i>	Hemiprocnidae		LC	
66	Crimson-backed Sunbird	<i>Leptocoma minima</i>	Nectariniidae	WG	LC	Sch IV
67	Crimson-fronted barbet	<i>Megalaima rubricapillus</i>	Megalaimidae		LC	Sch IV
68	Dark-fronted Babbler	<i>Rhopocichla atriceps</i>	Timaliidae		LC	Sch IV
69	Dusky Crag Martin	<i>Hirundo concolor</i>	Hirundinidae		LC	
70	Eurasian Blackbird	<i>Turdus merula</i>	Turdidae		LC	Sch IV
71	Eurasian Buzzard	<i>Buteo</i>	Accipitridae		LC	Sch I
72	Eurasian Collared-dove	<i>Streptopelia decaocto</i>	Columbidae		LC	Sch IV
73	Eurasian Eagle-owl	<i>Bubo bubo</i>	Strigidae		LC	Sch IV
74	Eurasian Golden Oriole	<i>Oriolus oriolus</i>	Oriolidae		LC	Sch IV
75	Eurasian hoopoe	<i>Upupa epops</i>	Upupidae		LC	Sch IV
76	Eurasian Sparrowhawk	<i>Accipiter nisus</i>	Accipitridae		LC	Sch I
77	European Roller	<i>Coracias garrulus</i>	Coraciidae		LC	Sch IV
78	Forest Wagtail	<i>Dendronanthus indicus</i>	Motacillidae		LC	Sch IV
79	Golden-fronted leafbird	<i>Chloropsis aurifrons</i>	Chloropseidae		LC	Sch IV
80	Great Eared-nightjar	<i>Lyncornis macrotis</i>	Caprimulgidae		LC	Sch IV
81	Great Tit	<i>Parus major</i>	Paridae		LC	Sch IV
82	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae		LC	Sch IV
83	Greater Racquet-tailed Drongo	<i>Dicrurus paradiseus</i>	Dicruridae		LC	Sch IV
84	Greater Short-toed Lark	<i>Calandrella brachydactyla</i>	Alaudidae		LC	Sch IV
85	Green Bee-eater	<i>Merops orientalis</i>	Meropidae		LC	
86	Green Imperial-pigeon	<i>Ducula aenea</i>	Columbidae		LC	Sch IV
87	Green Sandpiper	<i>Tringa ochropus</i>	Scolopacidae		LC	Sch IV
88	Green-billed malkoha	<i>Phaenicophaeus tristis</i>	Cuculidae		LC	Sch IV
89	Greenish Warbler	<i>Phylloscopus trochiloides</i>	Phylloscopidae		LC	Sch IV
90	Grey Junglefowl	<i>Gallus sonneratii</i>	Phasianidae		LC	Sch II
91	Grey Wagtail	<i>Motacilla cinerea</i>	Motacillidae		LC	Sch IV
92	Grey-bellied Cuckoo	<i>Cacomantis passerinus</i>	Cuculidae		LC	Sch IV
93	Grey-breasted Prinia	<i>Prinia hodgsonii</i>	Cisticolidae		LC	Sch IV
94	Grey-capped Emerald Dove	<i>Chalcophaps indica</i>	Columbidae		LC	Sch IV
95	Grey-headed Bulbul	<i>Brachypodius priocephalus</i>	Pycnonotidae	WG	NT	Sch IV
96	Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	Muscicapidae		LC	Sch IV
97	Hair-crested Drongo	<i>Dicrurus hottentottus</i>	Dicruridae		LC	Sch IV

98	House Crow	<i>Corvus splendens</i>	Corvidae		LC	Sch IV
99	House Sparrow	<i>Passer domesticus</i>	Passeridae		LC	Sch IV
100	House swift	<i>Apus nipalensis</i>	Apodidae		LC	
101	Indian Blue Robin	<i>Larvivora brunnea</i>	Muscicapidae		LC	Sch IV
102	Indian Cuckooshrike	<i>Coracina macei</i>	Campephagidae		LC	Sch IV
103	Indian Nightjar	<i>Caprimulgus asiaticus</i>	Caprimulgidae		LC	Sch IV
104	Indian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	Monarchidae		LC	Sch IV
105	Indian Pitta	<i>Pitta brachyura</i>	Pittidae		LC	Sch IV
106	Indian Pond-Heron	<i>Ardeola grayii</i>	Ardeidae		LC	Sch IV
107	Indian Pygmy Woodpecker	<i>Yungipicus nanus</i>	Picidae		LC	Sch IV
108	Indian Robin	<i>Copsychus fulicatus</i>	Muscicapidae		LC	Sch IV
109	Indian Roller	<i>Coracias benghalensis</i>	Coraciidae		LC	Sch IV
110	Indian Rufous Babbler	<i>Turdoides subrufus</i>	Leiotherichidae	WG	LC	Sch IV
111	Indian Scimitar-babbler	<i>Pomatorhinus horsfieldii</i>	Timaliidae		LC	Sch IV
112	Indian Scops-owl	<i>Otus bakkamoena</i>	Strigidae		LC	Sch IV
113	Indian Swiftlet	<i>Aerodramus unicolor</i>	Apodidae		LC	Sch I (Part III)
114	Jacobin Cuckoo	<i>Clamator jacobinus</i>	Cuculidae		LC	Sch IV
115	Javan Leafbird	<i>Chloropsis cochinchinensis</i>	Chloropseidae		LC	Sch IV
116	Jerdon's Nightjar	<i>Caprimulgus atripennis</i>	Caprimulgidae		LC	Sch IV
117	Jungle Babbler	<i>Argya striata</i>	Leiotherichidae		LC	Sch IV
118	Jungle Myna	<i>Acridotheres fuscus</i>	Sturnidae		LC	Sch IV
119	Jungle Nightjar	<i>Caprimulgus indicus</i>	Caprimulgidae		LC	Sch IV
120	Jungle Owlet	<i>Glaucidium radiatum</i>	Strigidae		LC	Sch IV
121	Jungle Prinia	<i>Prinia syloatica</i>	Cisticolidae		LC	Sch IV
122	Large hawk-cuckoo	<i>Hierococyx sparverioides</i>	Cuculidae		LC	Sch IV
123	Large Woodshrike	<i>Tephrodornis virgatus</i>	Vangidae		LC	Sch IV
124	Large-billed Crow	<i>Corvus macrorhynchos</i>	Corvidae		LC	Sch IV
125	Large-billed Leaf-warbler	<i>Phylloscopus magnirostris</i>	Phylloscopidae		LC	Sch IV
126	Laughing Dove	<i>Spilopelia senegalensis</i>	Columbidae		VU	Sch IV
127	Lesser coucal	<i>Centropus bengalensis</i>	Cuculidae		LC	Sch IV
128	Lesser Whitethroat	<i>Curruca curruca</i>	Sylviidae		LC	Sch IV
129	Lesser Yellownape	<i>Picus chlorolophus</i>	Picidae		LC	Sch IV
130	Little Egret	<i>Egretta garzetta</i>	Ardeidae		LC	Sch IV
131	Little Spiderhunter	<i>Arachnothera longirostra</i>	Nectariniidae		LC	Sch IV
132	Little Swift	<i>Apus affinis</i>	Apodidae		LC	
133	Long-tailed nightjar	<i>Caprimulgus climacurus</i>	Caprimulgidae		LC	Sch IV
134	Long-tailed Shrike	<i>Lanius schach</i>	Laniidae		LC	
135	Loten's Sunbird	<i>Cinnyris lotenius</i>	Nectariniidae		LC	Sch IV
136	Malabar Grey Hornbill	<i>Ocyrceros griseus</i>	Bucerotidae	WG	LC	Sch I
137	Malabar Parakeet	<i>Psittacula columboides</i>	Psittaculidae	WG	LC	Sch IV

138	Malabar Whistling-thrush	<i>Myophonus horsfieldii</i>	Muscicapidae		LC	Sch IV
139	Malay Night-heron	<i>Gorsachius melanolophus</i>	Ardeidae		LC	Sch IV
140	Mountain Imperial-pigeon	<i>Ducula badia</i>	Columbidae		LC	Sch IV
141	Nilgiri Flowerpecker	<i>Dicaeum concolor</i>	Dicaeidae		LC	Sch IV
142	Nilgiri Flycatcher	<i>Eumyias albicaudatus</i>	Muscicapidae	WG	NT	Sch IV
143	Nilgiri Pipit	<i>Anthus nilghiriensis</i>	Motacillidae	WG	VU	Sch IV
144	Nilgiri Woodpigeon	<i>Columba elphinstonii</i>	Columbidae	WG	VU	Sch IV
145	Northern House Martin	<i>Delichon urbicum</i>	Hirundinidae		LC	
146	Olive-backed Pipit	<i>Anthus hodgsoni</i>	Motacillidae		LC	Sch IV
147	Orange-headed Thrush	<i>Geokichla citrina</i>	Turdidae		LC	Sch IV
148	Oriental honey-buzzard	<i>Pernis ptilorhynchus</i>	Accipitridae		LC	Sch I
149	Oriental Magpie-robin	<i>Copsychus saularis</i>	Muscicapidae		LC	Sch IV
150	Oriental Scops-owl	<i>Otus sunia</i>	Strigidae		LC	Sch IV
151	Oriental White-eye	<i>Zosterops palpebrosus</i>	Zosteropidae		LC	Sch IV
152	Paddyfield Pipit	<i>Anthus rufulus</i>	Motacillidae		LC	Sch IV
153	Palani laughingthrush	<i>Montecincla fairbanki</i>	Leiotherichidae	WG	LC	Sch IV
154	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchus</i>	Dicaeidae		LC	Sch IV
155	Peregrine Falcon	<i>Falco peregrinus</i>	Falconidae		LC	Sch I (Part III)
156	Pied Bushchat	<i>Saxicola caprata</i>	Muscicapidae		LC	Sch IV
157	Plain Prinia	<i>Prinia inornata</i>	Cisticolidae		LC	Sch IV
158	Plaintive cuckoo	<i>Cacomantis merulinus</i>	Cuculidae		LC	Sch IV
159	Plum-headed Parakeet	<i>Psittacula cyanocephala</i>	Psittaculidae		LC	Sch IV
160	Puff-throated Babbler	<i>Pellorneum ruficeps</i>	Pellorneidae		LC	Sch IV
161	Purple Sunbird	<i>Cinnyris asiaticus</i>	Nectariniidae		LC	Sch IV
162	Purple-rumped Sunbird	<i>Leptocoma zeylonica</i>	Nectariniidae		LC	Sch IV
163	Red collared dove	<i>Streptopelia tranquebarica</i>	Columbidae		LC	Sch IV
164	Red Spurfowl	<i>Galloperdix spadicea</i>	Phasianidae		LC	Sch IV
165	Red-rumped Swallow	<i>Cecropis daurica</i>	Hirundinidae		LC	
166	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae		LC	Sch IV
167	Red-wattled Lapwing	<i>Vanellus indicus</i>	Charadriidae		LC	Sch IV
168	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Pycnonotidae		LC	Sch IV
169	Rock Dove	<i>Columba livia</i>	Columbidae		LC	Sch IV

170	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Psittaculidae		LC	Sch IV
171	Rosy starling	<i>Pastor roseus</i>	Sturnidae		LC	Sch IV
172	Rufous Treepie	<i>Dendrocitta vagabunda</i>	Corvidae		LC	Sch IV
173	Rufous Woodpecker	<i>Micropternus brachyurus</i>	Picidae		LC	Sch IV
174	Rufous-bellied eagle	<i>Lophotriorchis kienerii</i>	Accipitridae		NT	Sch I
175	Rusty-tailed Flycatcher	<i>Ficedula ruficauda</i>	Muscicapidae		LC	Sch IV
176	Savanna Nightjar	<i>Caprimulgus affinis</i>	Caprimulgidae		LC	Sch IV
177	Scaly-breasted Munia	<i>Lonchura punctulata</i>	Estrildidae		LC	Sch IV
178	Scarlet Minivet	<i>Pericrocotus flammeus</i>	Campephagidae		LC	Sch IV
179	Short-toed Snake-eagle	<i>Circaetus gallicus</i>	Accipitridae		LC	Sch I
180	Sirkeer Malkoha	<i>Taccocua leschenaultii</i>	Cuculidae		LC	Sch IV
181	Small Minivet	<i>Pericrocotus cinnamomeus</i>	Campephagidae		LC	Sch IV
182	Southern Hill Myna	<i>Gracula indica</i>	Sturnidae		LC	Sch IV
183	Speckled Piculet	<i>Picumnus innominatus</i>	Picidae		LC	Sch IV
184	Spotted Dove	<i>Spilopelia chinensis</i>	Columbidae		LC	Sch IV
185	Square-tailed Drongo-cuckoo	<i>Surniculus lugubris</i>	Cuculidae		LC	Sch IV
186	Sri Lanka Green-pigeon	<i>Treron pompadora</i>	Columbidae		LC	Sch IV
187	Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	Alcedinidae		LC	Sch IV
188	Streak-throated Swallow	<i>Petrochelidon fluvicola</i>	Hirundinidae		LC	
189	Streak-throated Woodpecker	<i>Picus xanthopygaeus</i>	Picidae		LC	Sch IV
190	Tahiti Swallow	<i>Hirundo tahitica</i>	Hirundinidae		LC	
191	Tawny-bellied Babbler	<i>Dumetia hyperythra</i>	Timaliidae		LC	Sch IV
192	Thick-billed Flowerpecker	<i>Dicaeum agile</i>	Dicaeidae		LC	Sch IV
193	Thick-billed Warbler	<i>Acrocephalus aedon</i>	Acrocephalidae		LC	Sch IV
194	Tickell's Blue-flycatcher	<i>Cyornis tickelliae</i>	Muscicapidae		LC	Sch IV
195	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Sturnidae		LC	Sch IV
196	Verditer Flycatcher	<i>Eumyias thalassinus</i>	Muscicapidae		LC	Sch IV
197	Vernal Hanging-Parrot	<i>Loriculus vernalis</i>	Psittaculidae		LC	Sch IV
198	Western Crowned Leaf-warbler	<i>Phylloscopus occipitalis</i>	Phylloscopidae		LC	Sch IV
199	Western Orphean Warbler	<i>Curruca hortensis</i>	Sylviidae		LC	Sch IV
200	Western Yellow Wagtail	<i>Motacilla flava</i>	Motacillidae		LC	Sch IV

201	White-bellied Blue-flycatcher	<i>Cyornis pallidipes</i>	Muscicapidae	WG	LC	Sch IV
202	White-bellied Drongo	<i>Dicrurus caerulescens</i>	Dicruridae		LC	Sch IV
203	White-bellied Treepie	<i>Dendrocitta leucogastra</i>	Corvidae		LC	Sch IV
204	White-bellied Woodpecker	<i>Dryocopus javensis</i>	Picidae		LC	Sch IV
205	White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae		LC	Sch IV
206	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Rallidae		LC	Sch IV
207	White-browed Bulbul	<i>Pycnonotus luteolus</i>	Pycnonotidae		LC	Sch IV
208	White-browed Fantail	<i>Rhipidura aureola</i>	Rhipiduridae		LC	Sch IV
209	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	Motacillidae		LC	Sch IV
210	White-cheeked Barbet	<i>Psilopogon viridis</i>	Megalaimidae		LC	Sch IV
211	White-eyed Buzzard	<i>Butastur teesa</i>	Accipitridae		LC	Sch I
212	White-rumped Munia	<i>Lonchura striata</i>	Estrildidae		LC	Sch IV
213	White-rumped Shama	<i>Copsychus malabaricus</i>	Muscicapidae		LC	Sch IV
214	White-rumped Spinetail	<i>Zoonavena sylvatica</i>	Apodidae		LC	
215	White-throated Fantail	<i>Rhipidura albicollis</i>	Rhipiduridae		LC	Sch IV
216	Wire-tailed swallow	<i>Hirundo smithii</i>	Hirundinidae		LC	
217	Wood Sandpiper	<i>Tringa glareola</i>	Scolopacidae		LC	Sch IV
218	Wynaad Laughingthrush	<i>Pterorhinus delesserti</i>	Leiothrichidae	WG	LC	Sch IV
219	Yellow-billed Babbler	<i>Turdoides affinis</i>	Leiothrichidae		LC	Sch IV
220	Yellow-browed Bulbul	<i>Acritillas indica</i>	Pycnonotidae		LC	Sch IV
221	Yellow-crowned Woodpecker	<i>Leiopicus mahrattensis</i>	Picidae		LC	Sch IV
222	Yellow-eyed Babbler	<i>Chrysomma sinense</i>	Paradoxornithidae		LC	Sch IV
223	Yellow-footed Green-pigeon	<i>Treron phoenicoptera</i>	Columbidae		LC	Sch IV
224	Yellow-legged buttonquail	<i>Turnix tanki</i>	Turnicidae		LC	Sch IV
225	Yellow-throated Bulbul	<i>Pycnonotus xantholaemus</i>	Pycnonotidae		VU	Sch IV

WG = Western Ghats; IUCN = International Union for Conservation of Nature; NE = Not Evaluated; CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LC = Least Concern; NT = Near Threatened; WPA = Wildlife Protection Act; Sch. = Schedule

Checklist of Butterflies recorded in Chinnar Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IU CN	WPA
1	African Babul Blue	<i>Azanus jesous</i>	Lycaenidae		LC	
2	African Mallow/ Marbled Skipper	<i>Gomalia elma</i>	Hesperiidae		LC	
3	Angled Caster	<i>Ariadne ariadne</i>	Nymphalidae		LC	
4	Angled Flat	<i>Tapena twaitthesi</i>	Hesperiidae		LC	
5	Angled Pierrot	<i>Caleta caleta</i>	Lycaenidae		LC	
6	Bamboo Treebrown	<i>Lethe europa</i>	Nymphalidae		LC	
7	Banded Blue Pierrot	<i>Discolampa ethion</i>	Lycaenidae		LC	
8	Blue - Spotted Arab	<i>Colotis phisadia</i>	Pieridae		LC	
9	Blue Admiral	<i>Kaniska canace</i>	Nymphalidae		LC	
10	Blue Mormon	<i>Papilio polymnestor</i>	Papilionidae		LC	
11	Blue Pansy	<i>Junonia orithiya</i>	Nymphalidae		LC	
12	Blue Tiger	<i>Tirumala limniace</i>	Nymphalidae		LC	
13	Bright Babul Blue	<i>Azanus ubaldus</i>	Lycaenidae		LC	
14	Brown Awl	<i>Badamia exclamationis</i>	Hesperiidae		LC	
15	Chestnut Bob	<i>Lambrix salsala</i>	Hesperiidae		LC	
16	Chocolate Pansy	<i>Junonia iphita</i>	Nymphalidae		LC	
17	Ciliate Blue	<i>Anthene emolus</i>	Lycaenidae		LC	
18	Commander	<i>Limenitis procris</i>	Nymphalidae		LC	
19	Common Acacia Blue	<i>Surendra quercetorum</i>	Lycaenidae		LC	
20	Common Albatross	<i>Appias albina</i>	Pieridae		LC	
21	Common Banded Awl	<i>Hasora chromus</i>	Hesperiidae		LC	
22	Common Banded Demon	<i>Notocrypta paralysos</i>	Hesperiidae		LC	
23	Common Banded Peacock	<i>Papilio crino</i>	Papilionidae		LC	
24	Common Baron	<i>Euthalia aconthea</i>	Nymphalidae		LC	
25	Common Beak	<i>Libythea lepita</i>	Nymphalidae		LC	
26	Common Bluebottle	<i>Graphium sarpedon</i>	Papilionidae		LC	
27	Common Bushbrown	<i>Mycalesis perseus</i>	Nymphalidae		LC	
28	Common Castor	<i>Aridne merione</i>	Nymphalidae		LC	
29	Common Cerulean	<i>Jamides celeno</i>	Lycaenidae		LC	
30	Common Emigrant	<i>Catopsilia pomona</i>	Pieridae		LC	
31	Common Evening Brown	<i>Melanitis leda</i>	Nymphalidae		LC	
32	Common Five-ring	<i>Ypthima baldus</i>	Nymphalidae		LC	
33	Common Four-ring	<i>Ypthima huebneri</i>	Nymphalidae		LC	

34	Common Grass Dart	<i>Taractrocera maeivius</i>	Hesperiidae		LC	
35	Common Grass Yellow	<i>Eurema hecabe</i>	Pieridae		LC	
36	Common Guava Blue	<i>Virachola isocrates</i>	Lycaenidae		LC	
37	Common Gull	<i>Cepora nerissa</i>	Pieridae		LC	
38	Common Hedge Blue	<i>Acytolepis puspa</i>	Lycaenidae		LC	
39	Common Indian Crow	<i>Euploea core</i>	Nymphalidae		LC	
40	Common Jay	<i>Graphium doson</i>	Papilionidae		LC	
41	Common jezebel	<i>Delias eucharis</i>	Pieridae		LC	
42	Common Lascar	<i>Pantoporia hordonia</i>	Nymphalidae		LC	
43	Common Leopard	<i>Phalanta phalantha</i>	Nymphalidae		LC	
44	Common Line Blue	<i>Prosotas nora</i>	Lycaenidae		LC	
45	Common Map	<i>Cyrestis thyodamas</i>	Nymphalidae		LC	
46	Common mime	<i>Papilio clytia</i>	Papilionidae		LC	
47	Common Mormon	<i>Papilio polytes</i>	Papilionidae		LC	
48	Common Nawab	<i>Polyura athamas</i>	Nymphalidae		LC	
49	Common Palmfly	<i>Elymnias hypermnestra</i>	Nymphalidae		LC	
50	Common Pierrot	<i>Castalius rosimon</i>	Lycaenidae		LC	
51	Common Rose	<i>Pachliopta aristolochiae</i>	Papilionidae		LC	
52	Common Sailor	<i>Neptis hylas</i>	Nymphalidae		LC	
53	Common Silver line	<i>Spindasis vulcanus</i>	Lycaenidae		LC	
54	Common Snow Flat	<i>Tagiades japetus</i>	Hesperiidae		LC	
55	Common Spotted Flat	<i>Celaenorrhinus leucocera</i>	Hesperiidae		LC	
56	Common Treebrown	<i>Lethe rohria</i>	Nymphalidae		LC	
57	Common Wanderer	<i>Pareronia valeria</i>	Nymphalidae		LC	
58	Crimson Rose	<i>Pachliopta hector</i>	Papilionidae		LC	
59	Crimson Tip	<i>Colotis danae</i>	Pieridae		LC	
60	Danaid Eggfly	<i>Hypolimnas misippus</i>	Nymphalidae		LC	
61	Dark Banded Bushbrown	<i>Mycalesis mineus</i>	Nymphalidae		LC	
62	Dark Blue Tiger	<i>Tirumala septentrionis</i>	Nymphalidae		LC	
63	Dark Cerulean	<i>Jamides bochus</i>	Lycaenidae		LC	
64	Dark Grass Blue	<i>Zizeeria karsandra</i>	Lycaenidae		LC	
65	Double Banded Crow	<i>Euploea sylvester</i>	Nymphalidae		LC	
66	Forget-Me-Not	<i>Catochrysops strabo</i>	Lycaenidae		LC	
67	Fulvous Pied Flat	<i>Pseudocoladenia dan</i>	Hesperiidae		LC	
68	Glad Eye Bushbrown	<i>Mycalesis patnia</i>	Nymphalidae		LC	
69	Glassy Tiger	<i>Parantica aglea</i>	Nymphalidae		LC	
70	Golden Angle	<i>Caprona ransonnetti</i>	Hesperiidae		LC	
71	Gram Blue	<i>Euchrysops cnejus</i>	Lycaenidae		LC	Sch II (Part II)

72	Grass Demon	<i>Udaspes folus</i>	Hesperiidae		LC	
73	Grass Jewel	<i>Freyeria trochylus</i>	Lycaenidae		LC	
74	Great Eggfly	<i>Hypolimnas bolina</i>	Nymphalidae		LC	
75	Great Evening Brown	<i>Melanitis zitenius</i>	Nymphalidae		LC	
76	Grey Count	<i>Tanaecia lepidea</i>	Nymphalidae		LC	
77	Grey Pansy	<i>Junonia atlites</i>	Nymphalidae		LC	
78	Immaculate/Large/Suffused Snow Flat	<i>Tagiades gana</i>	Hesperiidae		LC	
79	Indian cabbage white	<i>Pieris canidia</i>	Pieridae		LC	
80	Indian Cupid	<i>Chilades pandava</i>	Lycaenidae		LC	
81	Indian Fritillary	<i>Argynnis hyperbius</i>	Nymphalidae		LC	
82	Indian Grizzled / Indian Skipper	<i>Spialia galba</i>	Hesperiidae		LC	
83	Indian Palm Bob	<i>Suastus gremius</i>	Hesperiidae		LC	
84	Indian Red Admiral	<i>Vanessa indica</i>	Nymphalidae		LC	
85	Indian Red Flash	<i>Rapala iarbus</i>	Lycaenidae		LC	
86	Indian Sunbeam	<i>Curetis thetis</i>	Lycaenidae		LC	
87	Indian/Common Dartlet	<i>Oriens goloides</i>	Hesperiidae		LC	
88	Large Salmon Arab	<i>Colotis fausta</i>	Pieridae		LC	
89	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae		LC	
90	Lesser Albatross	<i>Appias wardi</i>	Pieridae	WG	LC	Sch II (Part II)
91	Lesser Grass Blue	<i>Zizina otis</i>	Lycaenidae		LC	
92	Lime Blue	<i>Chilades lajus</i>	Lycaenidae		LC	
93	Lime Butterfly	<i>Papilio demoleus</i>	Papilionidae		LC	
94	Malabar Spotted Flat	<i>Celaenorrhinus ambareesa</i>	Hesperiidae		LC	
95	Metallic Cerulean	<i>Jamides alecto</i>	Lycaenidae		LC	
96	Monkey Puzzle	<i>Rathinda amor</i>	Lycaenidae		LC	
97	Mottled Emigrant	<i>Catopsilia pyranthe</i>	Pieridae		LC	
98	Nigger	<i>Orsotriaena medus</i>	Nymphalidae		LC	
99	Nilgiri Clouded Yellow	<i>Colias nilgiriensis</i>	Pieridae	WG	LC	
100	Nilgiri Grass Yellow	<i>Eurema nilgiriens</i>	Pieridae	WG	LC	
101	Nilgiri Tiger	<i>Parantica nilgiriensis</i>	Nymphalidae	WG	LC	
102	Nilgiri Tit	<i>Chliaria nilgirica</i>	Lycaenidae		LC	
103	Painted Lady	<i>Vanessa cardui</i>	Nymphalidae		LC	
104	Painted Sawtooth	<i>Prioneris sita</i>	Pieridae		LC	
105	Palani Bushbrown	<i>Mycalesis mamerata</i>	Nymphalidae	WG	LC	
106	Pale Grass Blue	<i>Pseudozizeeria maha</i>	Lycaenidae		LC	
107	Palni Four-ring	<i>Ypthima ypthimoides</i>	Nymphalidae	WG	LC	
108	Paris Peacock	<i>Papilio paris</i>	Papilionidae		LC	

109	Pea Blue	<i>Lampides boeticus</i>	Lycaenidae		LC	Sch II (Part II)
110	Peacock pansy	<i>Junonia almana</i>	Nymphalidae		LC	
111	Pioneer or Caper White	<i>Belenois aurota</i>	Pieridae		LC	
112	Plain Orange Tip	<i>Colotis eucharis</i>	Pieridae		LC	
113	Plain Puffin	<i>Appias indra</i>	Pieridae		LC	Sch II (Part II)
114	Plain Tiger	<i>Danaus chrysippus</i>	Nymphalidae		LC	
115	Plains Cupid	<i>Chilades pandava</i>	Lycaenidae		LC	
116	Plum Judy	<i>Abisara echerius</i>	Lycaenidae		LC	
117	Psyche	<i>Leptosia nina</i>	Pieridae		LC	
118	Quaker	<i>Neopithecops zalmora</i>	Lycaenidae		LC	
119	Red Helen	<i>Papilio helenus</i>	Papilionidae		LC	
120	Red Pierrot	<i>Talicauda nyseus</i>	Lycaenidae		LC	
121	Red-Disk Bushbrown	<i>Mycalesis oculus</i>	Nymphalidae	WG	LC	
122	Restricted Demon	<i>Notocrypta curvifascia</i>	Hesperiidae		LC	
123	Rice Swift	<i>Borbo cinnara</i>	Hesperiidae		LC	
124	Rustic	<i>Cupha erymanthis</i>	Nymphalidae		LC	
125	Shortbanded Sailor	<i>Phaedyma columella</i>	Nymphalidae		LC	
126	Slate Flash	<i>Rapala manea</i>	Lycaenidae		LC	
127	Small Grass Yellow	<i>Eurema brigitta</i>	Pieridae		LC	
128	Small Orange Tip	<i>Colotis etrida</i>	Pieridae		LC	
129	Southern Bird wing	<i>Troides minos</i>	Papilionidae	WG	LC	
130	Spot Puffin	<i>Appias lalage</i>	Pieridae		LC	
131	Spot Swordtail	<i>Graphium nomius</i>	Papilionidae		LC	
132	Spotless Grass Yellow	<i>Spotless Grass Yellow</i>	Pieridae		LC	
133	Stripped or Common Tiger	<i>Danaus genutia</i>	Nymphalidae		LC	
134	Tailed Jay	<i>Graphium agamemnon</i>	Papilionidae		LC	
135	Tamil Cats eye	<i>Zipaetis saitis</i>	Nymphalidae	WG	LC	
136	Tamil Dart let	<i>Oriens concinna</i>	Hesperiidae	WG	LC	
137	Tamil Grass Dart	<i>Taractroceras ceramas</i>	Hesperiidae		LC	
138	Tamil Lacewing	<i>Cethosia nietneri</i>	Nymphalidae		LC	
139	Tamil Yeoman	<i>Cirrochroa thais</i>	Nymphalidae		LC	
140	Tawny Coster	<i>Acraea terpsicore</i>	Nymphalidae		LC	
141	Tawny Rajah	<i>Charaxes bernardus</i>	Nymphalidae		LC	
142	Three Spot Grass Yellow	<i>Eurema blanda</i>	Pieridae		LC	
143	Tiny Grass Blue	<i>Zizula hylax</i>	Lycaenidae		LC	
144	Water Snow Flat	<i>Tagiades litigiosa</i>	Hesperiidae		LC	
145	Western Centaur Oak Blue	<i>Arhopala pseudocentaurus</i>	Lycaenidae		LC	

146	White Banded Awl	<i>Hasora taminatus</i>	Hesperiidae		LC	
147	White bar Bushbrown	<i>Mycalesis anaxias</i>	Nymphalidae		LC	
148	White Disc Hedge Blue	<i>Celatoxia albidisca</i>	Lycaenidae	WG	LC	
149	White Hedge blue	<i>Udara akasa</i>	Lycaenidae		LC	
150	White or Ceylon Four Ring	<i>Ypthima ceylonica</i>	Nymphalidae		LC	
151	White Orange Tip	<i>Ixias marianne</i>	Pieridae		LC	
152	Yellow Orange Tip	<i>Ixias pyrene</i>	Pieridae		LC	
153	Yellow Pansy	<i>Junonia hierta</i>	Nymphalidae		LC	
154	Zebra Blue	<i>Tarucus plinius</i>	Lycaenidae		LC	

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Annexure11

Checklist of Odonates recorded in Chinnar Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Asiatic blood tail	<i>Lathrecista asiatica</i>	Libellulidae		LC	
2	Black Bamboo Tail	<i>Prodasineura verticalis</i>	Platycenemididae		LC	
3	Black marsh totter	<i>Tramea limbata</i>	Libellulidae		LC	
4	Black Torrent Dart	<i>Dysphaea ethela</i>	Euphaeidae		DD	
5	Black-tipped Forest Glory	<i>Vestalis apicalis</i>	Calopterygidae		LC	
6	Black-tipped Ground Skimmer	<i>Diplacodes nebulosa</i>	Libellulidae		LC	
7	Blue Darner	<i>Anax immaculifrons</i>	Aeshnidae		LC	
8	Blue Grass Dartlet	<i>Pseudagrion microcephalum</i>	Coenagrionidae		LC	
9	Blue marsh hawk	<i>Orthetrum glaucum</i>	Libellulidae		LC	
10	Blue-tailed Green Darner	<i>Anax guttatus</i>	Aeshnidae		LC	
11	Brown backed red marsh hawk	<i>Orthetrum chrysis</i>	Libellulidae		LC	
12	Brown Darner	<i>Gynacantha dravida</i>	Aeshnidae		DD	
13	Brown dusk hawk	<i>Zyxomma petiolatum</i>	Libellulidae		LC	
14	Clear-winged Forest Glory	<i>Vestalis glacilis</i>	Calopterygidae		NT	
15	Clubtail	<i>Gomphidia sp.</i>	Gomphidae		LC	
16	Common Clubtail	<i>Ictinogomphus rapax</i>	Gomphidae		LC	
17	common picture wing	<i>Rhyothemis variegata</i>	Libellulidae		LC	

18	Coral tailed cloud wing	<i>Tholymis tillarga</i>	Libellulidae		LC	
19	Coromandel Marsh Dart	<i>Ceriagrion coromandelianum</i>	Coenagrionidae		LC	
20	Crimson marsh glider	<i>Trithemis aurora</i>	Libellulidae		LC	
21	Crimson tricolored marsh hawk	<i>Orthetrum pruinosum</i>	Libellulidae		LC	
22	Ditch Jewel	<i>Brachythemis contaminata</i>	Libellulidae		LC	
23	Fulvous Forest Skimmer	<i>Neurothemis fulvia</i>	Libellulidae		LC	
24	Golden Dartlet	<i>Ischnura aurora</i>	Coenagrionidae		LC	
25	Granite Ghost	<i>Bradinopyga geminata</i>	Libellulidae		LC	
26	Green marsh hawk	<i>Orthetrum sabina</i>	Libellulidae		LC	
27	Ground Skimmer	<i>Diplacodes trivialis</i>	Libellulidae		LC	
28	Little Marsh Hawk	<i>Brachydiplax sobrina</i>	Libellulidae		LC	
29	Long legged marsh glider	<i>Trithemis pallidineróis</i>	Libellulidae		LC	
30	Orange-tailed Marsh Dart	<i>Ceriagrion cerinorubellum</i>	Coenagrionidae		LC	
31	Parakeet Darner	<i>Gynacantha bayadera</i>	Aeshnidae		LC	
32	Pied Paddy Skimmer	<i>Neurothemis tullia</i>	Libellulidae		LC	
33	Pied Reed Tail	<i>Protosticta gravelyi</i>	Platystictidae	WG	LC	
34	Pigmy Dartlet	<i>Agriocnemis pygmaea</i>	Coenagrionidae		LC	
35	Pigmy skimmer	<i>Tetrathemis platyptera</i>	Libellulidae		LC	
36	River Heliodor	<i>Libellago lineata</i>	Chlorocyphidae		LC	
37	Rufous marsh glider	<i>Rhodothemis rufa</i>	Libellulidae		LC	
38	Rufous-backed Marsh Hawk	<i>Brachydiplax chalybea</i>	Libellulidae		LC	
39	Saffron-faced Blue Dart	<i>Pseudagrion rubriceps</i>	Coenagrionidae		LC	
40	Scarlet Marsh Hawk	<i>Aethriamanta brevipennis</i>	Libellulidae		LC	
41	Stream Glory	<i>Neurobasis chinensis</i>	Calopterygidae		LC	
42	Stream Ruby	<i>Heliocypha bisignata</i>	Chlorocyphidae		LC	
43	Travancore Bamboo Tail	<i>Esme mudiensis</i>	Platycenemididae	WG	DD	
44	Tricolored marsh hawk	<i>Orthetrum luzonicum</i>	Libellulidae		LC	
45	Trumpet Tail	<i>Acisoma panorpoides</i>	Libellulidae		LC	
46	Violet Striped Slender Dartlet	<i>Aciagrion hisopa</i>	Coenagrionidae		LC	
47	wandering glider	<i>pantala flavescens</i>	Libellulidae		LC	
48	Yellow Bush Dart	<i>Copera marginipes</i>	Platycenemididae		LC	

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Annexure12

Checklist of Amphibians recorded in Chinnar Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN
1	Asian bullfrog	<i>Hoplobatrachus tigerinus</i>	Dicroglossidae		LC
2	Beddome's bubble-nest frog	<i>Raorchestes beddomii</i>	Rhacophoridae	WG	NT
3	Beddome's leaping frog	<i>Indirana beddomii</i>	Ranixalidae		LC
4	Bronzed frog	<i>Indosylvirana temporalis</i>	Ranidae		NT
5	Common tree frog	<i>Polypedates leucomystax</i>	Rhacophoridae		LC
6	Indian green frog	<i>Euphlyctis hexadactylus</i>	Dicroglossidae		LC
7	Indian toad	<i>Duttaphrynus parietalis</i>	Bufonidae	WG	NT
8	Kerala wart(y) frog	<i>Zakerana keralensis</i>	Dicroglossidae	WG	LC
9	Malabar gliding frog	<i>Rhacophorus malabaricus</i>	Rhacophoridae	WG	LC
10	Malabar night frog	<i>Nyctibatrachus major</i>	Nyctibatrachidae	WG	VU
11	Malabar tropical frog	<i>Micrixalus saxicola</i>	Micrixalidae	WG	VU
12	Ornate narrow-mouthed frog	<i>Microhyla ornata</i>	Microhylidae		LC
13	Southeast Asian toad	<i>Duttaphrynus melanostictus</i>	Bufonidae		LC
14	Southern hill toad	<i>Duttaphrynus microtympanum</i>	Bufonidae	WG	VU

Annexure 13

Checklist of Reptiles recorded in Chinnar Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Banded kukri snake	<i>Oligodon arnensis</i>	Colubridae			Sch IV
2	Bibron's skink	<i>Eutropis bibronii</i>	Scincidae		LC	
3	Blanford's rock agama	<i>Psammophilus blanfordanus</i>	Agamidae			
4	Brahminy blind snake	<i>Indotyphlops braminus</i>	Typhlopidae			Sch IV
5	Bronze grass skink	<i>Eutropis macularia</i>	Scincidae			
6	Buff striped keelback	<i>Amphiesma stolatum</i>	Colubridae			Sch IV
7	Checkered keelback	<i>Xenochrophis piscator</i>	Colubridae			Sch IV
8	Common cat snake	<i>Boiga trigonata</i>	Colubridae			Sch IV
9	Common dotted garden skink	<i>Lygosoma punctata</i>	Scincidae			
10	Common house gecko	<i>Hemidactylus frenatus</i>	Gekkonidae		LC	
11	Common Indian monitor	<i>Varanus bengalensis</i>	Varanidae		LC	Sch I
12	Common krait	<i>Bungarus caeruleus</i>	Elapidae		NE	Sch IV
13	Common vine snake	<i>Ahaetulla nasuta</i>	Colubridae			Sch IV

14	Common wolf snake	<i>Lycodon aulicus</i>	Colubridae			Sch IV
15	Daudin's bronzeback	<i>Dendrelaphis tristis</i>	Colubridae			Sch IV
16	Elliot's earth snake	<i>Uropeltis ellioti</i>	Uropeltidae		LC	Sch IV
17	Green keelback	<i>Rhabdophis plumbicolor</i>	Colubridae			Sch IV
18	Gunther's vine snake	<i>Ahaetulla dispar</i>	Colubridae	WG	NT	Sch IV
19	Indian black turtle	<i>Melanochelys trijuga</i>	Geoemydidae		LC	
20	Indian chameleon	<i>Chamaeleo zeylanicus</i>	Chamaeleonidae		LC	Sch II
21	Indian cobra	<i>Naja</i>	Elapidae		NE	Sch II
22	Indian flying lizard	<i>Draco dussumieri</i>	Agamidae		LC	
23	Indian python	<i>Python molurus</i>	Pythonidae		LC	Sch I
24	Indian saw-scaled viper	<i>Echis carinatus</i>	Viperidae			
25	Indian star tortoise	<i>Geochelone elegans</i>	Testudinidae		VU	Sch II
26	Jerdon's gecko	<i>Hemidactylus subtriedrus</i>	Gekkonidae		LC	
27	Kandy Day Gecko	<i>Cnemaspis kandiana</i>	Gekkonidae		LC	
28	Keeled Indian mabuya	<i>Eutropis carinata</i>	Scincidae		LC	
29	Kollegal ground gecko	<i>Cyrtodactylus kollegalensis</i>	Gekkonidae		LC	
30	large-scaled pitviper	<i>Trimeresurus macrolepis</i>	Viperidae	WG	NT	Sch IV
31	Leschenault's leaf-toed gecko	<i>Hemidactylus leschenaultii</i>	Gekkonidae		LC	
32	Leschenault's snake-eye	<i>Ophisops leschenaultii</i>	Lacertidae			
33	Long-nosed worm snake	<i>Myriopholis macrorhyncha</i>	Leptotyphlopidae			
34	Malabar pit viper	<i>Trimeresurus malabaricus</i>	Viperidae	WG	LC	Sch IV
35	Mugger crocodile	<i>Crocodylus palustris</i>	Crocodylidae		VU	Sch I
36	Nilgiri keelback	<i>Hebius beddomei</i>	Colubridae	WG		Sch IV
37	Oriental garden lizard	<i>Calotes versicolor</i>	Agamidae			
38	Ornate flying snake	<i>Chrysopelea ornata</i>	Colubridae			Sch IV
39	Peninsular rock agama	<i>Psammophilus dorsalis</i>	Agamidae			
40	Rurk's ristella	<i>Ristella rurkii</i>	Scincidae			
41	Russell's boa	<i>Gongylophis conicus</i>	Boidae			
42	Russell's viper	<i>Daboia russelii</i>	Viperidae			
43	Slender Day Gecko	<i>Cnemaspis gracilis</i>	Gekkonidae			
44	Slender worm snake	<i>Indotyphlops porrectus</i>	Typhlopidae			
45	Southwestern blackhead snake	<i>Tantilla hobartsmithi</i>	Colubridae		LC	
46	Streaked Kukri Snake	<i>Oligodon taeniolatus</i>	Colubridae			Sch IV
47	Termite hill gecko	<i>Hemidactylus triedrus</i>	Gekkonidae		LC	
48	Thurston's worm snake	<i>Typhlops thurstoni</i>	Gerrhopilidae			
49	Trinket snake	<i>Coelognathus helenus</i>	Colubridae			Sch IV
50	Western rat snake	<i>Pantherophis obsoletus</i>	Colubridae			Sch IV

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Annexure 14

Checklist of Mammals recorded in Chinnar Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Asian palm civet	<i>Paradoxurus hermaphroditus</i>	Viverridae		LC	Schedule 2
2	Black-naped hare	<i>Lepus nigricollis</i>	Leporidae		LC	Schedule 4
3	Bonnet macaque	<i>Macaca radiata</i>	Cercopithecidae		VU	Schedule 2
4	Chital	<i>Axis</i>	Cervidae		LC	Schedule 3
5	Common giant flying squirrel	<i>Petaurista petaurista</i>	Sciuridae		LC	Schedule 2
6	Common mongoose	<i>Herpestes edwardsii</i>	Herpestidae		LC	Schedule 4
7	Common otter	<i>Lutra lutra</i>	Mustelidae		LC	Schedule 2
8	Dhole	<i>Cuon alpinus</i>	Canidae		EN	Schedule 2
9	Elephant	<i>Elephas maximus</i>	Elephantidae		EN	Schedule 1
10	Gaur	<i>Bos gaurus</i>	Bovidae		VU	Schedule 1
11	Golden jackal	<i>Canis aureus</i>	Canidae		LC	Schedule 2
12	Grizzled giant squirrel	<i>Ratufa macroura</i>	Sciuridae	WG	EN	Schedule 1
13	Hanuman langur	<i>Semnopithecus priam</i>	Cercopithecidae		LC	Schedule 2
14	Indian crested porcupine	<i>Hystrix indica</i>	Hystricidae		LC	Schedule 2
15	Indian giant squirrel	<i>Ratufa indica</i>	Sciuridae		NT	Schedule 2
16	Indian wild boar	<i>Sus scrofa</i>	Suidae		LC	Schedule 3
17	Jungle cat	<i>Felis chaus</i>	Felidae		LC	Schedule 2
18	Leopard	<i>Panthera pardus</i>	Felidae		NT	Schedule 2
19	Leopard cat	<i>Prionailurus bengalensis</i>	Felidae		LC	Schedule 1
20	Nilgiri marten	<i>Martes gwatkinsii</i>	Mustelidae	WG	VU	Schedule 4
21	Nilgiri tahr	<i>Hemitragus hylocrius</i>	Bovidae	WG	EN	Schedule 1
22	Ruddy mongoose	<i>Herpestes smithii</i>	Herpestidae		LC	Schedule 4
23	Rusty spotted cat	<i>Prionailurus rubiginosus</i>	Felidae		VU	Schedule 1
24	Sambar	<i>Cervus unicolor</i>	Cervidae		VU	Schedule 3
25	Slender loris	<i>Loris lydekkerianus lydekkerianus</i>	Lorisidae		LC	Schedule 1
26	Sloth bear	<i>Melursus ursinus</i>	Ursidae		VU	Schedule 2
27	Small Indian civet	<i>Viverricula indica</i>	Viverridae		LC	Schedule 2
28	Southern red muntjac	<i>Muntiacus muntjak</i>	Cervidae		LC	Schedule 3
29	Stripe-necked mongoose	<i>Herpestes vitticollis</i>	Herpestidae		LC	Schedule 4
30	Thick-tailed pangolin	<i>Manis crassicaudata</i>	Manidae		NT	Schedule 1
31	Tiger	<i>Panthera tigris</i>	Felidae		EN	Schedule 1
32	White spotted chevrotain	<i>Tragululus meminna</i>	Tragulidae		LC	Schedule 1

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Checklist of Birds recorded in Kurinjimala Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae		LC	Sch IV
2	Asian Brown Flycatcher	<i>Muscicapa daurica</i>	Muscicapinae		LC	Sch IV
3	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	Vangidae		LC	Sch IV
4	Black Bulbul	<i>Hypsipetes leucocephalus</i>	Pycnonotidae		LC	Sch IV
5	Black Eagle	<i>Ictinaetus malayensis</i>	Accipitridae		LC	Sch I
6	Black-and-orange Flycatcher	<i>Ficedula nigrorufa</i>	Muscicapinae	WG	NT	Sch IV
7	Black-rumped Flameback	<i>Dinopium benghalense</i>	Picidae		LC	Sch IV
8	Blyth's Reed-warbler	<i>Acrocephalus dumetorum</i>	Acrocephalidae		LC	Sch IV
9	Brown-breasted Flycatcher	<i>Muscicapa muttui</i>	Muscicapidae		LC	Sch IV
10	Brown-capped pygmy woodpecker	<i>Dendrocopos nanus</i>	Picidae		LC	Sch IV
11	Brown-cheeked Fulvetta	<i>Alcippe poioicephala</i>	Alcippeidae		LC	Sch IV
12	Buff-spotted Flameback	<i>Chrysocolaptes lucidus</i>	Picidae		LC	Sch IV
13	Cattle Egret	<i>Bubulcus ibis</i>	Ardeidae		LC	Sch IV
14	Changeable Hawk-Eagle	<i>Nisaetus cirrhatus</i>	Accipitridae		LC	Sch I
15	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	Meropidae		LC	
16	common emerald dove	<i>Chalcophaps indica</i>	Columbidae		LC	Sch IV
17	Common Hill Myna	<i>Gracula religiosa</i>	Sturnidae		LC	Sch IV
18	Common iora	<i>Aegithina tiphia</i>	Aegithinidae		LC	Sch IV
19	Common Rosefinch	<i>Carpodacus erythrinus</i>	Fringillidae		LC	Sch IV
20	common sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae		LC	Sch IV
21	Crimson-backed Sunbird	<i>Leptocoma minima</i>	Nectariniidae	WG	LC	Sch IV
22	crimson-fronted barbet	<i>Megalaima rubricapillus</i>	Megalaimidae		LC	Sch IV
23	Dark-fronted Babbler	<i>Rhopocichla atriceps</i>	Timaliidae		LC	Sch IV
24	Eurasian Blackbird	<i>Turdus merula</i>	Turdidae		LC	Sch IV
25	Eurasian Golden Oriole	<i>Oriolus oriolus</i>	Oriolidae		LC	Sch IV
26	Golden-fronted leafbird	<i>Chloropsis aurifrons</i>	Chloropseidae		LC	Sch IV
27	Great Tit	<i>Parus major</i>	Paridae		LC	Sch IV
28	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae		LC	Sch IV
29	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	Dicruridae		LC	Sch IV
30	Greenish Warbler	<i>Phylloscopus trochiloides</i>	Phylloscopidae		LC	Sch IV
31	Grey Junglefowl	<i>Gallus sonneratii</i>	Phasianidae		LC	Sch IV

32	Grey Wagtail	<i>Motacilla cinerea</i>	Motacillidae		LC	Sch IV
33	Grey-breasted Prinia (Franklin's Wren- Warbler)	<i>Prinia hodgsonii</i>	Phylloscopidae		LC	Sch IV
34	Grey-fronted Green Pigeon	<i>Treron affinis</i>	Columbidae		LC	Sch IV
35	Grey-headed Canary- flycatcher	<i>Culicicapa ceylonensis</i>	Muscicapinae		LC	Sch IV
36	Himalayan blacklored tit	<i>Parus xanthogenys</i>	Paridae		LC	Sch IV
37	Indian Blue Robin	<i>Larvivora brunnea</i>	Muscicapidae		LC	Sch IV
38	Indian Pond-Heron	<i>Ardeola grayii</i>	Ardeidae		LC	Sch IV
39	Indian Scimitar-babbler	<i>Pomatorhinus horsfieldii</i>	Timaliidae		LC	Sch IV
40	Indian Swiftlet	<i>Aerodramus unicolor</i>	Apodidae		LC	Sch I (Part III)
41	Jungle Myna	<i>Acridotheres fuscus</i>	Sturnidae		LC	Sch IV
42	large woodshrike	<i>Tephrodornis gularis</i>	Vangidae		LC	Sch IV
43	Large-billed Crow	<i>Corvus macrorhynchos</i>	Corvidae		LC	Sch IV
44	Large-billed Leaf-warbler	<i>Phylloscopus magnirostris</i>	Phylloscopidae		LC	Sch IV
45	Little Spiderhunter	<i>Arachnothera longirostra</i>	Nectariniidae		LC	Sch IV
46	Long-tailed Shrike	<i>Lanius schach</i>	Laniidae		LC	Sch IV
47	Malabar Parakeet	<i>Psittacula columboides</i>	Psittaculidae	WG	LC	Sch IV
48	Malabar Trogon	<i>Harpactes fasciatus</i>	Trogonidae		LC	Sch IV
49	Malabar whistling thrush	<i>Myophonus horsfieldii</i>	Muscicapinae		LC	Sch IV
50	Mountain Imperial- pigeon	<i>Ducula badia</i>	Columbidae		LC	Sch IV
51	Nilgiri Flowerpecker	<i>Dicaeum concolor</i>	Dicaeidae		LC	Sch IV
52	Nilgiri Flycatcher	<i>Eumyias albicaudatus</i>	Muscicapinae	WG	NT	Sch IV
53	Nilgiri Pipit	<i>Anthus nilghiriensis</i>	Motacillidae	WG	VU	Sch IV
54	Nilgiri Woodpigeon	<i>Columba elphinstonii</i>	Columbidae	WG	VU	Sch IV
55	Oriental Magpie-robin	<i>Copsychus saularis</i>	Muscicapidae		LC	Sch IV
56	Oriental White-eye	<i>Zosterops palpebrosus</i>	Zosteropidae		LC	Sch IV
57	Palani laughingthrush	<i>Montecincla fairbanki</i>	Leiothrichidae	WG	VU	Sch IV
58	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>	Dicaeidae		LC	Sch IV
59	Pied Bushchat	<i>Saxicola caprata</i>	Muscicapidae		LC	Sch IV
60	Red-rumped swallow	<i>Hirundo daurica</i>	Hirundinidae		LC	Sch IV
61	Red-wattled Lapwing	<i>Vanellus indicus</i>	Charadriidae		LC	Sch IV
62	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Pycnonotidae		LC	Sch IV
63	Scarlet Minivet	<i>Pericrocotus flammeus</i>	Campephagida e		LC	Sch IV
64	Sparrowhawk sp	<i>Accipiter sp</i>	Accipitridae		LC	Sch I
65	spotted dove	<i>Spilopelia chinensis</i>	Columbidae		LC	Sch IV

66	Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>	Muscicapinae		LC	Sch IV
67	Tickell's Leaf-warbler	<i>Phylloscopus affinis</i>	Phylloscopidae		LC	Sch IV
68	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Sturnidae		LC	Sch IV
69	Verditer Flycatcher	<i>Eumyias thalassinus</i>	Muscicapinae		LC	Sch IV
70	Vernal Hanging-Parrot	<i>Loriculus vernalis</i>	Psittaculidae		LC	Sch IV
71	Western Crowned Leaf-warbler	<i>Phylloscopus occipitalis</i>	Phylloscopidae		LC	Sch IV
72	White-bellied Blue-flycatcher	<i>Cyornis pallidipes</i>	Muscicapinae	WG	LC	Sch IV
73	White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae		LC	Sch IV
74	White-cheeked Barbet	<i>Psilopogon viridis</i>	Megalaimidae		LC	Sch IV
75	Yellow-browed Bulbul	<i>Acritillas indica</i>	Pycnonotidae		LC	Sch IV

WG = Western Ghats; IUCN = International Union for Conservation of Nature; NE = Not Evaluated; CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LC = Least Concern; NT = Near Threatened; WPA = Wildlife Protection Act; Sch. = Schedule

Annexure 16

Checklist of Butterflies recorded in Kurinjimala Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	African Migrant	<i>Catopsilia florella</i>	Pieridae		LC	
2	Baby Fivering	<i>Ypthima philomela</i>	Nymphalidae		LC	
3	Blue Admiral	<i>Kaniska canace</i>	Nymphalidae		LC	
4	Blue Mormon	<i>Papilio polymnestor</i>	Papilionidae		LC	
5	Blue Tiger	<i>Tirumala limniace</i>	Nymphalidae		LC	
6	Brown Pansy	<i>Junonia stygia</i>	Nymphalidae		LC	
7	Chestnut-Streaked Sailer	<i>Neptis jumbah</i>	Nymphalidae		LC	
8	Chocolate Pansy	<i>Junonia iphita</i>	Nymphalidae		LC	
9	Club Beak	<i>Libythea myrrha</i>	Nymphalidae		LC	
10	Colour Sergeant	<i>Athyma nefte</i>	Nymphalidae		LC	
11	Commander	<i>Moduza procris</i>	Nymphalidae		LC	
12	Common Beak	<i>Libythea lepita</i>	Nymphalidae		LC	sch II (part II)
13	Common Beak	<i>Libythea lepita</i>	Nymphalidae		LC	
14	Common Bluebottle	<i>Graphium sarpedon</i>	Papilionidae		LC	
15	Common Castor	<i>Ariadne merione</i>	Nymphalidae		LC	
16	Common Cerulean	<i>Jamides celeno</i>	Lycaenidae		LC	Schedule I, Part IV
17	Common Crow	<i>Euploea core</i>	Nymphalidae		LC	

18	Common Emigrant	<i>Catopsilia pomona</i>	Pieridae		LC	
19	Common Evening Brown	<i>Melanitis leda</i>	Nymphalidae		LC	
20	Common Grass Yellow	<i>Eurema hecabe</i>	Pieridae		LC	
21	Common Hedge Blue	<i>Acytolepis puspa</i>	Lycaenidae		LC	
22	Common Jezebel	<i>Delias eucharis</i>	Pieridae		LC	
23	Common Leopard	<i>Phalanta phalantha</i>	Nymphalidae		LC	
24	Common Lineblue	<i>Prosotas nora</i>	Lycaenidae		LC	
25	Common Map	<i>Cyrestis thyodamas</i>	Nymphalidae		LC	
26	Common Mime	<i>Papilio clytia</i>	Papilionidae		LC	
27	Common Mormon	<i>Papilio polytes</i>	Papilionidae		LC	
28	Common Pierrot	<i>Castalius rosimon</i>	Lycaenidae		LC	
29	Common Sailor	<i>Neptis hylas</i>	Nymphalidae		LC	
30	Common Spotted Flat	<i>Celaenorrhinus leucocera</i>	Hesperiidae		LC	
31	Common Tiger	<i>Danaus genutia</i>	Nymphalidae		LC	
32	Common Treebrown	<i>Lethe rohria</i>	Nymphalidae		LC	
33	Danaid Eggfly	<i>Hypolimnias missipus</i>	Nymphalidae		LC	
34	Dark Blue Tiger	<i>Tirumala septentrionis</i>	Nymphalidae		LC	
35	Dark Cerulean	<i>Jamides bochus</i>	Lycaenidae		LC	
36	Dark Grass Blue	<i>Zizeeria karsandra</i>	Lycaenidae		LC	
37	Dark Palm Dart	<i>Telicota ancilla</i>	Hesperiidae		LC	
38	Eastern Pale Clouded Yellow	<i>Colias erate</i>	Pieridae		LC	
39	European Beak	<i>Libythea celtis</i>	Nymphalidae		LC	
40	Forget-Me-Not	<i>Catochrysops strabo</i>	Pieridae		LC	
41	Gaudy Baron	<i>Euthalia lubentina</i>	Nymphalidae		LC	Schedule IV
42	Grass Demon	<i>Udaspes folus</i>	Hesperiidae		LC	
43	Great Eggfly	<i>Hypolimnias bolina</i>	Nymphalidae		LC	
44	Himalayan Blackvein Sergeant	<i>Athyma ranga</i>	Nymphalidae		LC	
45	Indian Awlking	<i>Choaspes benjaminii</i>	Hesperiidae		LC	
46	Indian Cabbage White	<i>Artogeia canidia indica</i>	Pieridae		LC	
47	Indian Fritillary	<i>Argynnis hyperbius</i>	Nymphalidae		LC	
48	Indian Red Admiral	<i>Vanessa indica</i>	Nymphalidae		LC	
49	Indian Sunbeam	<i>Curetis thetis</i>	Lycaenidae		LC	
50	Jewel Fourring	<i>Ypthima avanta</i>	Nymphalidae		LC	
51	Large Salmon Arab	<i>Colotis fausta</i>	Pieridae		LC	
52	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae		LC	

53	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae		LC	
54	Lime Butterfly	<i>Papilio demoleus</i>	Papilionidae		LC	
55	Metallic Cerulean	<i>Jamides alecto</i>	Lycaenidae		LC	
56	Moore's Ace	<i>Halpe porus</i>	Hesperiidae		LC	
57	Mottled Emigrant	<i>Catopsilia pyranthe</i>	Pieridae		LC	
58	Nilgiri Clouded Yellow	<i>Colias nilagiriensis</i>	Pieridae		LC	
59	Nilgiri Fourring	<i>Ypthima chenu</i>	Nymphalidae		LC	
60	Nilgiri Tiger	<i>Parantica nilgiriensis</i>	Nymphalidae	WG	NT	
61	Oriental Common Sergeant	<i>Athyma perius</i>	Nymphalidae		LC	Schedule II (Part II)
62	Oriental Giant Redeye	<i>Gangara thyrsis</i>	Hesperiidae		LC	
63	Painted Lady	<i>Cynthia cardui</i>	Nymphalidae		LC	
64	Palni Dart	<i>Potanthus palnia</i>	Hesperiidae		LC	
65	Palni Fourring	<i>Ypthima ypthimoides</i>	Nymphalidae		LC	
66	Paris Peacock	<i>Papilio paris</i>	Papilionidae		LC	
67	Pava Dart Or Yellow Dart	<i>Potanthus pava</i>	Hesperiidae		LC	
68	Peacock Pansy	<i>Junonia almana</i>	Nymphalidae		LC	
69	Pioneer White	<i>Belenois aurota</i>	Pieridae		LC	Schedule II
70	Plain Hedge Blue	<i>Celastrina lavendularis</i>	Pieridae		LC	
71	Plain Puffin	<i>Appias indira</i>	Pieridae		LC	
72	Plain Tiger	<i>Danaus chrysipus</i>	Nymphalidae		LC	
73	Plum Judy	<i>Abisara echerius</i>	Riodinidae		LC	
74	Pygmy Scrub-Hopper	<i>Aeromachus pygmaeus</i>	Hesperiidae		LC	
75	Red Helen	<i>Papilio helenus</i>	Papilionidae		LC	
76	Red-Disk Bushbrown	<i>Mycalesis oculus</i>	Nymphalidae	WG	LC	
77	Rustic	<i>Cupha erymanthis</i>	Nymphalidae		LC	
78	Sahyadri Black Prince	<i>Rohana parisatis</i>	Nymphalidae		LC	
79	Sahyadri Plain Puffin	<i>Appias indra shiva</i>	Pieridae		LC	Schedule IV
80	Singalese Hedge Blue	<i>Udara singalensis</i>	Lycaenidae		LC	
81	Small Grass Yellow	<i>Eurema brigitta</i>	Pieridae		LC	
82	Southern Bird Wing	<i>Troides minos</i>	Papilionidae	WG	LC	
83	Spotless Grass Yellow	<i>Eurema laeta</i>	Pieridae		LC	
84	Staudinger's Nawab	<i>Polyura alphius</i>	Nymphalidae		LC	
85	Striped Albatross	<i>Appias libythea</i>	Pieridae		LC	Schedule II (Part II)
86	Tailed Palmfly	<i>Elymnias caudata</i>	Nymphalidae		LC	

87	Tamil Treebrown	<i>Lethe drypetis</i>	Nymphalidae		LC	
88	Tamil Yeoman	<i>Cirrochroa thais</i>	Nymphalidae		LC	
89	Three-Spot Grass Yellow	<i>Eurema blanda</i>	Pieridae		LC	
90	Tiny Grass Blue	<i>Zizula hylax</i>	Lycaenidae		LC	
91	Tricolour Pied Flat	<i>Coladenia indrani</i>	Hesperiidae		LC	
92	White Hedge Blue	<i>Udara akasa</i>	Pieridae		LC	
93	White Or Ceylon Four Ring	<i>Ypthima ceylonica</i>	Nymphalidae		LC	
94	Yellow Pansy	<i>Junonia heirta</i>	Nymphalidae		LC	

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Annexure 17

Checklist of Amphibians recorded in Kurinjimala Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Common toad	<i>Bufo melanostictus</i>	Bufoidea		LC	
2	Indirana sp.		Ranixalidae	WG		
3	Koadaikanal bush frog	<i>Raorchestes dubois</i>	Rhacophoridae	WG	VU	

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Annexe 18

Checklist of Reptiles recorded in Kurinjimala Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Anaimalai spiny lizard	<i>Salea anamallayana</i>	Agamidae	LC	WG	
2	Elliot's Sheildtail	<i>Uropeltis ellioti</i>	Uropeltidae	LC		
3	Palani ground skink	<i>Kaestlea palnicum</i>	Scincidae	EN	WG	
4	Side Spotted Ground Skink	<i>Kaestlea laterimaculata</i>	Scincidae	VU		
5	Southern Ghats slender gecko	<i>Hemiphyllodactylus aurantiacus</i>	Gekkonidae	LC	WG	

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Annexure 19

Checklist of Mammals recorded in Kurinjimala Wildlife Sanctuaries

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Asian Elephant	<i>Elephas maximus</i>	Elephantidae	EN		Sch I (Part I)
2	Indian bison	<i>Bos gaurus</i>	Bovidae	VU		Sch I (Part I)
3	Indian Wild Dog or Dhole	<i>Cuon alpinus alpinus</i>	Canidae	EN		Sch II (Part I)
4	Leopard	<i>Panthera pardus</i>	Felidae	VU		Sch I (Part I)
5	Lion Tailed Macaque	<i>Macaca silenus</i>	Cercopithecidae	EN	WG	Sch I (Part I)
6	Malabar giant squirrel	<i>Ratufa indica</i>	Sciuridae	LC		Sch II (Part I)
7	Nilgiri Langur	<i>Semnopithecus johni</i>	Cercopithecidae	VU	WG	Sch I (Part I)
8	Palm Civet	<i>Paradoxurus hermaphroditus</i>	Viverridae	LC		Sch II (Part I)
9	Sambar deer	<i>Rusa unicolor</i>	Cervidae	VU		
10	Tiger	<i>Panthera tigris</i>	Felidae	EN		Sch I (Part I)

WG = Western Ghats; IUCN = International Union for Conservation of Nature; NE = Not Evaluated; CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LC = Least Concern; NT = Near Threatened; WPA = Wildlife Protection Act; Sch. = Schedule

Annexure 20

Checklist of Birds recorded in Pampadum Shola National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae		LC	Sch. IV
2	Asian Emerald Dove	<i>Chalcophaps indica</i>	Columbidae		LC	Sch. IV
3	Black Eagle	<i>Ictinaetus malayensis</i>	Accipitridae		LC	Sch. I
4	Black-and-orange Flycatcher	<i>Cyornis rubeculoides</i>	Muscicapinae		LC	Sch. IV
5	Black-capped Bulbul	<i>Pycnonotus melanicterus</i>	Pycnonotidae		LC	Sch. IV
6	Black-rumped flameback	<i>Dinopium benghalense</i>	Picidae		LC	Sch. IV
7	Bronzed Drongo	<i>Dicrurus aeneus</i>	Dicruridae		LC	Sch. IV
8	Brown-breasted Flycatcher	<i>Muscicapa muttui</i>	Muscicapidae		LC	Sch. IV
9	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	Meropidae		LC	
10	Common buzzard	<i>Buteo buteo</i>	Accipitridae		LC	Sch. IV

11	Common Hill Myna	<i>Gracula religiosa</i>	Sturnidae		LC	Sch. IV
12	Common iora	<i>Aegithina tiphia</i>	Aegithinidae		LC	Sch. IV
13	Common Rosefinch	<i>Carpodacus erythrinus</i>	Fringillidae		LC	Sch. IV
14	common sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae		LC	Sch. IV
15	Common Tailorbird	<i>Orthotomus sutorius</i>	Cisticolidae		LC	Sch. IV
16	Crested Serpent-eagle	<i>Spilornis cheela</i>	Accipitridae		LC	Sch. I
17	Crimson-backed Sunbird	<i>Leptocoma minima</i>	Nectariniidae	WG	LC	Sch. IV
18	Eurasian Blackbird	<i>Turdus merula</i>	Turdidae		LC	Sch. IV
19	Eurasian Golden Oriole	<i>Oriolus oriolus</i>	Oriolidae		LC	Sch. IV
20	Forest Wagtail	<i>Dendronanthus indicus</i>	Motacillidae		LC	Sch. IV
21	Great Tit	<i>Parus major</i>	Paridae		LC	Sch. IV
22	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae		LC	Sch. IV
23	Grey Junglefowl	<i>Gallus sonneratii</i>	Phasianidae		LC	Sch. IV
24	Grey Wagtail	<i>Motacilla cinerea</i>	Motacillidae		LC	Sch. IV
25	Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	Muscicapinae		LC	Sch. IV
26	House Crow	<i>Corvus splendens</i>	Corvidae		LC	Sch. IV
27	Indian paradise flycatcher	<i>Terpsiphone paradisi</i>	Monarchidae		LC	Sch. IV
28	Indian Pond-Heron	<i>Ardeola grayii</i>	Ardeidae		LC	Sch. I
29	Indian Scimitar-babbler	<i>Pomatorhinus horsfieldii</i>	Timaliidae		LC	Sch. IV
30	Indian Swiftlet	<i>Aerodramus unicolor</i>	Apodidae		LC	Sch I
31	Indian yellow tit	<i>Machlolophus aplonotus</i>	Paridae		LC	Sch. IV
32	Jungle Myna	<i>Acridotheres fuscus</i>	Sturnidae		LC	Sch. IV
33	Large Pied Wagtail	<i>Motacilla maderaspatensis</i>	Motacillidae		LC	Sch. IV
34	Large-billed Crow	<i>Corvus macrorhynchos</i>	Corvidae		LC	Sch. IV
35	Long-tailed Shrike	<i>Lanius schach</i>	Laniidae		LC	Sch. IV
36	Malabar Grey Hornbill	<i>Ocyrceros griseus</i>	Bucerotidae	WG	LC	Sch. IV
37	Malabar Trogon	<i>Harpactes fasciatus</i>	Trogonidae		LC	Sch I
38	Malabar Whistling-thrush	<i>Myophonus horsfieldii</i>	Muscicapidae		LC	Sch. IV
39	Mountain Imperial-pigeon	<i>Ducula badia</i>	Columbidae		LC	Sch. IV
40	Nilgiri Flowerpecker	<i>Dicaeum concolor</i>	Dicaeidae		LC	Sch. IV
41	Nilgiri Flycatcher	<i>Eumyias albicaudatus</i>	Muscicapinae	WG	NT	Sch. IV
42	Nilgiri laughingthrush	<i>Montecincla cachinnans</i>	Leiothrichidae	WG	EN	Sch. IV
43	Nilgiri Woodpigeon	<i>Columba elphinstonii</i>	Columbidae	WG	VU	Sch. IV
44	Oriental Magpie-robin	<i>Copsychus saularis</i>	Muscicapidae		LC	Sch. IV
45	Oriental White-eye	<i>Zosterops palpebrosus</i>	Zosteropidae		LC	Sch. IV
46	Palani laughingthrush	<i>Montecincla fairbanki</i>	Leiothrichidae	WG	LC	Sch. IV
47	Pied Bushchat	<i>Saxicola caprata</i>	Muscicapidae		LC	Sch. IV
48	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Pycnonotidae		LC	Sch. IV

49	Rusty-tailed Flycatcher	<i>Ficedula ruficauda</i>	Muscicapinae		LC	Sch. IV
50	Scarlet Minivet	<i>Pericrocotus speciosus</i>	Campephagidae		LC	Sch. IV
51	Shikra	<i>Accipiter badius</i>	Accipitridae		LC	Sch. I
52	Small minivet	<i>Pericrocotus cinnamomeus</i>	Campephagidae		LC	Sch. IV
53	Spotted Dove	<i>Spilopelia chinensis</i>	Columbidae		LC	Sch. IV
54	Tickell's Blue-flycatcher	<i>Cyornis tickelliae</i>	Muscicapinae		LC	Sch. IV
55	Tickell's flowerpecker	<i>Dicaeum erythrorhynchos</i>	Dicaeidae		LC	Sch. IV
56	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Sturnidae		LC	Sch. IV
57	Western Yellow Wagtail	<i>Motacilla flava</i>	Motacillidae		LC	Sch. IV
58	White-bellied Blue-flycatcher	<i>Cyornis pallidipes</i>	Muscicapinae	WG	LC	Sch. IV
59	White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae		LC	Sch. IV
60	White-cheeked Barbet	<i>Psilopogon viridis</i>	Megalaimidae		LC	Sch. IV
61	White-throated Fantail	<i>Rhipidura albicollis</i>	Rhipiduridae		LC	Sch. IV
62	Yellow Whiskered Bulbul	<i>Eurillas latirostris</i>	Pycnonotidae		LC	Sch. IV

Annexure 21

Checklist of Butterflies recorded in Pampadum Shola National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	African migrant	<i>Catopsilia florella</i> Fb.	Pieridae			
2	Athyma nefte	<i>Athyma nefte</i> Doubleday	Nymphalidae			
3	Baby fourring	<i>Ypthima philomela</i> (Linnaeus)	Nymphalidae			
4	Black prince	<i>Rohana parisatis</i> Cram.	Nymphalidae			
5	Blackvein sergeant	<i>Athyma ranga</i> Moore	Nymphalidae			Schedule II, Part II
6	Blue admiral	<i>Kaniska canace</i> Moore	Nymphalidae			
7	Blue moon butterfly	<i>Hypolimnas bolina</i> (Linnaeus)	Nymphalidae			
8	Blue Mormon	<i>Papilio polymnestor parinda</i> Moore	Papilionidae	WG		
9	Blue tiger	<i>Tirumala limniace</i> Cram.	Nymphalidae			
10	Brown pansy	<i>Junonia stygia</i>	Nymphalidae			
11	Caper white	<i>Anaphaeis aurota</i> Fb.	Pieridae			
12	Chestnut-streaked sailer	<i>Neptis jumbah</i> Moore	Nymphalidae			Schedule I, Part IV
13	Chocolate pansy	<i>Junonia iphita</i> Cram.	Nymphalidae			
14	Clouded yellow	<i>Colias erate</i> (Esper)	Pieridae			
15	Club Beak	<i>Libythea myrrha</i> Godart	Nymphalidae			

16	Colour sergeant	<i>Athyma nefte</i> Doubleday	Nymphalidae			
17	Commander	<i>Moduza procris</i> Cram.	Nymphalidae			
18	Common beak	<i>Libythea celtis leptoides</i> Moore	Nymphalidae			
19	Common bluebottle	<i>Graphium sarpedon teredon</i> Feld.	Papilionidae			
20	Common castor	<i>Ariadne merione</i> (Cram.)	Nymphalidae			
21	Common cerulean	<i>Jamides celeno</i> (Cram.)	Lycaenidae			
22	Common crow	<i>Euploea core core</i> Cramer	Nymphalidae			Schedule IV
23	Common emigrant	<i>Catopsilia pomona</i> Fb.	Pieridae			
24	Common evening brown	<i>Melanitis leda</i> Lin.	Nymphalidae			
25	Common grass yellow	<i>Eurema hecabe</i> Lin.	Pieridae			
26	Common hedge blue	<i>Acytolepis puspa</i> (Horsfield)	Lycaenidae			
27	Common Jezebel	<i>Delias eucharis</i> Drury	Pieridae	WG		
28	Common lineblue	<i>Prosotas nora</i> Felder	Lycaenidae			
29	Common mapwing	<i>Cyrestis thyodamas</i> Kollar	Nymphalidae			
30	Common mime	<i>Papilio clytia</i> Linnaeus	Papilionidae			Schedule I, Part IV
31	Common mormon	<i>Papilio polytes</i> Lin.	Papilionidae			
32	Common mormon	<i>Papilio polytes</i> Linnaeus	Papilionidae			
33	Common Nawab	<i>Eriboea athamas</i> Moore	Nymphalidae			Schedule II, Part II
34	Common Pierrot	<i>Castalius rosimon</i> (Fb.)	Lycaenidae			Schedule I, Part IV
35	Common sailor	<i>Neptis hylas</i> Moore	Nymphalidae			
36	Common sergeant	<i>Athyma perius</i> Lin.	Nymphalidae			
37	Common spotted flat	<i>Celaenorrhinus leucocera</i> Fb.	Hesperiidae			
38	Common tiger	<i>Danaus genuita genuita</i> Cram.	Nymphalidae			
39	Dakhan Common Treebrown	<i>Lethe nilgiriensis</i> Guerin	Nymphalidae			
40	Danaid eggfly	<i>Hypolimnas missipus</i> Lin.	Nymphalidae	WG		Schedule II, Part II
41	Dark Blue Tiger	<i>Tirumala septentrionis</i> Butler	Nymphalidae			
42	Dark cerulean	<i>Jamides bochus</i> Cram.	Lycaenidae			
43	Dark grass blue	<i>Zizeeria karsandra</i> Moore	Lycaenidae			
44	Dark palm dart	<i>Telicota ancilla</i> Lin.	Hesperiidae			
45	Forget-me-not	<i>Catochrysops strabo</i>	Lycaenidae			
46	Gaudy baron	<i>Euthalia lubentina</i> Cram.	Nymphalidae			Schedule IV
47	Giant reeye	<i>Gangara thyrsis</i> Moore	Hesperiidae			
48	Grass demon	<i>Udaspes folus</i> Cram.	Hesperiidae			

49	Himalayan Common Beak	<i>Libythea lepita</i> (Moore)	Nymphalidae			Schedule II, Part II
50	Indian awlking	<i>Choaspes benjaminii</i> (Guérin-Méneville)	Hesperiidae			
51	Indian cabbage white	<i>Pieris canidia</i> Sparrman	Pieridae			
52	Indian fritillary	<i>Argynnis hyperbius</i> Johannsen	Nymphalidae			
53	Indian red admiral	<i>Vanessa indica</i> (Herbst)	Nymphalidae			
54	Indian sunbeam	<i>Curetis thetis</i> Drury	Lycaenidae	WG		
55	Jewel fourring	<i>Ypthima avanta</i> Moore	Nymphalidae			
56	Large salmon Arab	<i>Colotis fausta</i> Oliv.	Pieridae			
57	Lemon pansy	<i>Junonia lemonias</i> Frust.	Nymphalidae			
58	Lemon pansy	<i>Junonia lemonias</i> vaisya Fruhstorfer	Nymphalidae			
59	Lime butterfly	<i>Papilio demoleus</i> Lin.	Papilionidae			
60	Metallic cerulean	<i>Jamides alecto</i> (Cram.)	Lycaenidae			
61	Moore's ace	<i>Halpe porus</i> (Mabille)	Hesperiidae			
62	Mottled emigrant	<i>Catopsilia pyranthe</i> (Lin.)	Pieridae			
63	Nilgiri clouded yellow	<i>Colias nilagiriensis</i>	Pieridae	WG		
64	Nilgiri fourring	<i>Ypthima chenui</i> (Guérin-Méneville)	Nymphalidae	WG		
65	Nilgiri tiger	<i>Parantica nilgiriensis</i> Moore	Nymphalidae	WG	NT	
66	Nilgiri tit	<i>Hypolycaena nilagirica</i>	Lycaenidae			
67	Painted lady	<i>Cynthia cardui</i> Lin.	Nymphalidae			
68	Palni dart	<i>Potanthus palnia</i> (Evans)	Hesperiidae			
69	Palni fourring	<i>Ypthima ypthimoides</i> Moore	Nymphalidae	WG		
70	Pava dart	<i>Potanthus pava</i> Evans	Hesperiidae			
71	Peacock Pansy	<i>Junonia almana</i> Lin.	Nymphalidae			
72	Plain hedge blue	<i>Celastrina lavendularis</i> Moore	Lycaenidae			
73	Plain puffin	<i>Appias indira</i> Moore	Pieridae			Schedule II, Part II
74	Plain Tiger	<i>Danaus chrysipus</i> Lin.	Nymphalidae			
75	Plum Judy	<i>Abisara echerius</i> Stoll	Lycaenidae			
76	Pygmy scrub-hopper	<i>Aeromachus pygmaeus</i>	Hesperiidae	WG		
77	Red Helen	<i>Papilio helenus</i> Lin.	Papilionidae			
78	Red-disc bushbrown	<i>Mycalesis oculus</i> Mar.	Nymphalidae	WG		
79	Rustic	<i>Cupha erymanthis</i> Drury	Nymphalidae			
80	Sahyadri Plain Puffin	<i>Appias indra</i> shiva Moore	Pieridae			Schedule II,
81	Singalese hedge blue	<i>Udara singalensis</i> Horsfield	Lycaenidae			
82	Small grass yellow	<i>Eurema brigitta</i> Stoll	Pieridae			
83	Southern birdwing	<i>Troides minos</i> Cramer	Papilionidae			
84	Spotless grass	<i>Eurema laeta</i> Boisduval	Pieridae			

	yellow					
85	Spotted rustic	<i>Phalanta phalantha</i> Drury	Nymphalidae			
86	Striped albatross	<i>Appias libythea</i> Fb.	Pieridae			Schedule IV
87	Tailed palmfly	<i>Elymnias caudata</i> Butler	Nymphalidae			
88	Tamil catseye	<i>Zipoetis saitis</i> Hewit.	Nymphalidae	WG		
89	Tamil peacock	<i>Papilio paris tamilana</i> Moore	Papilionidae			
90	Tamil treebrown	<i>Lethe drypetis</i> Moore	Nymphalidae	WG		
91	Tamil yeoman	<i>Cirrochroa thais</i> Fb.	Nymphalidae	WG		
92	Three-spot grass yellow	<i>Eurema blanda</i> Boisd.	Pieridae			
93	Tiny grass blue	<i>Zizula hylax</i> Fb.	Lycaenidae			
94	Tricolour pied flat	<i>Coladenia indrani</i> (Moore)	Hesperiidae			
95	White fourring	<i>Ypthima ceylonica</i> Hewit.	Nymphalidae	WG		
96	White hedge blue	<i>Udara akasa</i> Horsfield	Lycaenidae			
97	Yellow pansy	<i>Junonia heirta</i> Fb.	Nymphalidae			

Annexure 22

Checklist of Moths recorded in Pampadum Shola National Park

Sl. No	Scientific name	Family
1	<i>Abraxas etridoides</i> Hamp.	Geometridae
2	<i>Abraxas latizonata</i> Hamp.	Geometridae
3	<i>Abraxas poliaria</i> Swinhoe	Geometridae
4	<i>Actias luna</i> Lin.	Saturnidae
5	<i>Aplochloa vivilaca</i> Wlk.	Geometridae
6	<i>Asura nebulosa</i> Moore	Pyralidae
7	<i>Asura</i> sp.	Arctiidae
8	<i>Atacira caesia</i> Roepke	Noctuidae
9	<i>Atacira pala</i> Holloway	Noctuidae
10	<i>Attacus atlas</i> Lin.	Saturnidae
11	<i>Aulacodes peribocalis</i> Wlk.	Pyralidae
12	<i>Aulacodes</i> sp.	Pyralidae
13	<i>Bocchoris onychinalis</i> Guen.	Pyralidae
14	<i>Bradina</i> sp.	Pyralidae
15	<i>Buzura suppressaria</i> Guen.	Geometridae
16	<i>Ceryx</i> sp.	Syntomidae
17	<i>Chalcosia affinis</i> Guer.	Zygaenidae
18	<i>Chilo</i> sp.1	Pyralidae
19	<i>Chilo</i> sp.2	Pyralidae
20	<i>Chionaema peregrina</i> Wlk.	Geometridae
21	<i>Cidaria perficita</i> Wlk.	Geometridae

22	<i>Clorea ?alienaria</i> Wlk.	Geometridae
23	<i>Clorea</i> sp.	Geometridae
24	<i>Comibaena integranota</i> Hamp.	Geometridae
25	<i>Condria</i> sp.	Noctuidae
26	<i>Corgatha semiparata</i> Wlk.	Pyralidae
27	<i>Corymica arnearea</i> Wlk.	Geometridae
28	<i>Cossus</i> sp.	Cossidae
29	<i>Craspedia intensata</i> Moore	Geometridae
30	<i>Cusiala raptaria</i> Wlk.	Geometridae
31	<i>Cyme gratiosa</i> Guerin-Meneville	Arctiidae
32	<i>Diasemia</i> sp.	Pyralidae
33	<i>Dichocrocis surusalis</i> Wlk.	Pyralidae
34	<i>Dirades</i> sp.	Geometridae
35	<i>Eclitoptera subapicalis</i> Hamp.	Geometridae
36	<i>Endotrichia</i> sp.	Pyralidae
37	<i>Endotrichia</i> sp.	Pyralidae
38	<i>Euclasta</i> sp.	Pyralidae
39	<i>Euproctis diagramma</i> Guer.	Lymantriidae
40	<i>Euproctis guttata</i> Wlk.	Lymantriidae
41	<i>Euproctis</i> sp.1	Lymantriidae
42	<i>Eupterote flavidomre</i> Moore	Lymantriidae
43	<i>Eupterote hibisci</i> Fb.	Lymantriidae
44	<i>Eupterote mollis</i> Moore	Lymantriidae
45	<i>Eupterote</i> sp.2	Lymantriidae
46	<i>Eupydna testacea</i> Swinhoe	Notodontidae
47	<i>Glyphodes caesalis</i> Wlk.	Pyralidae
48	<i>Glyphodes laticostalis</i> Guen.	Pyralidae
49	<i>Gnamptoloma aventiaria</i> (Guen.)	Geometridae
50	<i>Hadena pannosa</i> Moore	Noctuidae
51	<i>Helicoverpa armigera</i> Hubn.	Noctuidae
52	<i>Histia nilgira</i> Moore	Zygaenidae
53	<i>Hypochrosis abstractaria</i> Wlk.	Geometridae
54	<i>Hypochrosis festivaria</i> Fb.	Geometridae
55	<i>Hypomecis pallida</i> Hamp.	Geometridae
56	<i>Hypomecis</i> sp.	Geometridae
57	<i>Hypomecis</i> sp.	Geometridae
58	<i>Hypomecis</i> sp.	Geometridae
59	<i>Lantanophaga pusillidactyla</i> Wlk.	Pterophoridae
60	<i>Larentia flavistrigata</i> Warr.	Geometridae
61	<i>Lemyra</i> sp.	Arctiidae
62	<i>Macotasa nubecula</i> Moore	Arctiidae
63	<i>Maliatha erecta</i> Moore	Noctuidae

64	<i>Maruca testulalis</i> Geyer	Pyralidae
65	<i>Mixochlora vittata</i> Moore	Geometridae
66	<i>Mocis frugalis</i> Fb.	Noctuidae
67	<i>Mocis undata</i> Fb.	Noctuidae
68	<i>Myelopsis</i> sp.	Pyralidae
69	<i>Neochera dominio</i> Cram.	Arctiidae
70	<i>Nephopterix</i> sp.	Pyralidae
71	<i>Nymphula depunctalis</i> Snel.	Pyralidae
72	<i>Nymphula fluctuosalis</i> Zell.	Pyralidae
73	<i>Ophiusa dotata</i> Wlk.	Noctuidae
74	<i>Ourapteryx marginata</i> Hamp.	Geometridae
75	<i>Paraplastis hampsoni</i> Swinhoe	Arctiidae
76	<i>Paraplastis</i> sp.	Arctiidae
77	<i>Patissa</i> sp.	Pyralidae
78	<i>Phlyctaenodes nudalis</i> Hubn.	Pyralidae
79	<i>Pingasa</i> sp.	Geometridae
80	<i>Polynesia sunandava</i> Wlk.	Geometridae
81	<i>Psara</i> sp.1	Pyralidae
82	<i>Psara</i> sp.2	Pyralidae
83	<i>Pycnarmon caberalis</i> Guen.	Pyralidae
84	<i>Pyrausta</i> sp.1	Pyralidae
85	<i>Racotis</i> sp.	Geometridae
86	<i>Rahica rosea</i> Hamp.	Lymantriidae
87	<i>Sabaria costimaculata</i> Moore	Geometridae
88	<i>Sabaria rondelaria</i> Fb.	Geometridae
89	<i>Sahyadrases malabaricus</i> Moore	Hepialidae
90	<i>Sangatissa subcurvifera</i> Wlk.	Lymantriidae
91	<i>Scopula opicata</i> Fb.	Geometridae
92	<i>Scopula</i> sp.	Geometridae
93	<i>Scopula</i> sp.2	Geometridae
94	<i>Scopula</i> sp.5	Geometridae
95	<i>Semiothisa eleonora</i> Stoll	Geometridae
96	<i>Semiothisa emersaria</i> Wlk.	Geometridae
97	<i>Semiothisa epicharis</i> Wehrli	Geometridae
98	<i>Siccia taprobanis</i> Wlk.	Arctiidae
99	<i>Spatulifimbria castaneiceps</i> Hamp.	Limacodidae
100	<i>Spilosoma bifasciatum</i> Hamp.	Arctiidae
101	<i>Spilosoma casignetum</i> Kollar	Arctiidae
102	<i>Spilosoma stigmata</i> Moore	Arctiidae
103	<i>Symitha</i> sp.	Pyralidae
104	<i>Sylepta</i> sp.	Pyralidae
105	<i>Syngamia abruptalis</i> Wlk.	Pyralidae
106	<i>Syngamia abruptalis</i> Wlk.	Pyralidae
107	<i>Talanga sexpunctalis</i> Moore	Pyralidae
108	<i>Teldinia specca</i> Wilk.	Geometridae
109	<i>Thosea lutea</i> Heylaerts	Limacodidae
110	<i>Timandra responsaria</i> Moore	Geometridae

Annexure 23

Checklist of Mammals recorded in Pampadum Shola National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Indian bison	<i>Bos gaurus</i>	Bovidae		VU	Sch I (Part I)
2	Indian Wild Dog or Dhole	<i>Cuon alpinus alpinus</i>	Canidae		EN	Sch II (Part I)
3	Asian Elephant	<i>Elephas maximus</i>	Elephantidae		EN	Sch I (Part I)
4	Lion Tailed Macaque	<i>Macaca silenus</i>	Cercopithecidae	WG	EN	Sch I (Part I)
5	Nilgiri marten	<i>Martes gwatkinsii</i>	Mustelidae	WG	VU	Sch II (Part I)
6	Leopard	<i>Panthera pardus</i>	Felidae		VU	Sch I (Part I)
7	Palm Civet	<i>Paradoxurus hermaphroditus</i>	Viverridae		LC	Sch II (Part I)
8	Malabar giant squirrel	<i>Ratufa indica</i>	Sciuridae		LC	Sch II (Part I)
9	Sambar deer	<i>Rusa unicolor</i>	Cervidae		VU	
10	Nilgiri Langur	<i>Semnopithecus johnei</i>	Cercopithecidae	WG	VU	Sch I (Part I)

Annexure 24

Checklist of Birds recorded in Anamudi Shola National Park

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae		LC	Sch. IV
2	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	Muscicapidae		LC	Sch IV
3	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	Vangidae		LC	Sch. IV
4	Black Eagle	<i>Ictinaetus malayensis</i>	Accipitridae		LC	Sch. I
5	Black-and-orange Flycatcher	<i>Cyornis rubeculoides</i>	Muscicapidae		LC	Sch IV
6	Black-capped Bulbul	<i>Pycnonotus melanicterus</i>	Pycnonotidae		LC	Sch. IV
7	Black-lored Tit	<i>Machlolophus xanthogenys</i>	Paridae		LC	Sch. IV
8	Black-rumped Flameback	<i>Dinopium benghalense</i>	Picidae		LC	Sch. IV
9	Blyth's Reed-warbler	<i>Acrocephalus dumetorum</i>	Acrocephalidae		LC	Sch IV
10	Brown-breasted Flycatcher	<i>Muscicapa muttui</i>	Muscicapidae		LC	Sch IV
11	Brown-capped Pigmy Woodpecker	<i>Dendrocopos nanus</i>	Picidae		LC	Sch. IV

12	Brown-cheeked Fulvetta	<i>Alcippe poioicephala</i>	Alcippeidae		LC	Sch IV
13	Cattle Egret	<i>Bubulcus ibis</i>	Ardeidae		LC	Sch. IV
14	Changeable Hawk-Eagle	<i>Nisaetus cirrhatus</i>	Accipitridae		LC	Sch. I
15	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	Meropidae		LC	
16	Common Iora	<i>Aegithina tiphia</i>	Aegithinidae		LC	Sch. IV
17	Common Rosefinch	<i>Carpodacus erythrinus</i>	Fringillidae		LC	Sch. IV
18	Common Sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae		LC	Sch IV
19	Crimson-backed Sunbird	<i>Leptocoma minima</i>	Nectariniidae	WG	LC	Sch. IV
20	Crimson-fronted barbet	<i>Megalaima rubricapillus</i>	Megalaimidae		LC	Sch IV
21	Dark-fronted Babbler (Black-headed Babbler)	<i>Dumetia atriceps</i>	Timaliidae		LC	Sch. IV
22	Eurasian Blackbird	<i>Turdus merula</i>	Turdidae		LC	Sch. IV
23	Eurasian Golden Oriole	<i>Oriolus oriolus</i>	Oriolidae		LC	Sch. IV
24	Eurasian Sparrowhawk	<i>Accipiter nisus</i>	Accipitridae		LC	Sch. I
25	Golden-fronted leafbird	<i>Chloropsis aurifrons</i>	Chloropseidae		LC	Sch. IV
26	Great Tit	<i>Parus major</i>	Paridae		LC	Sch. IV
27	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae		LC	Sch. IV
28	Greater flameback	<i>Chrysocolaptes guttacristatus</i>	Picidae		LC	Sch. IV
29	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	Dicruridae		LC	Sch. IV
30	Greenish Warbler	<i>Phylloscopus trochiloides</i>	Phylloscopidae		LC	Sch IV
31	Grey Junglefowl	<i>Gallus sonneratii</i>	Phasianidae		LC	Sch. IV
32	Grey Wagtail	<i>Motacilla cinerea</i>	Motacillidae		LC	Sch. IV
33	Grey-breasted Prinia (Franklin's Wren-Warbler)	<i>Prinia hodgsonii</i>	Cisticolidae		LC	Sch IV
34	Grey-capped Emerald Dove	<i>Chalcophaps indica</i>	Columbidae		LC	Sch. IV
35	Grey-fronted Green-Pigeon	<i>Treron affinis</i>	Columbidae		LC	Sch IV
36	Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	Muscicapidae		LC	Sch IV
37	Hill Myna	<i>Gracula religiosa</i>	Sturnidae		LC	Sch. IV
38	Indian Blue Robin	<i>Larvivora brunnea</i>	Muscicapidae		LC	Sch. IV
39	Indian Pond-Heron	<i>Ardeola grayii</i>	Ardeidae		LC	Sch. I
40	Indian Scimitar-babbler	<i>Pomatorhinus horsfieldii</i>	Timaliidae		LC	Sch. IV
41	Indian Swiftlet	<i>Aerodramus unicolor</i>	Apodidae		LC	Sch I (Part III)
42	Jungle Myna	<i>Acridotheres fuscus</i>	Sturnidae		LC	Sch. IV
43	Large Woodshrike (Lalabar Wood-Shrike)	<i>Tephrodornis gularis</i>	Vangidae		LC	Sch. IV
44	Large-billed Leaf-warbler	<i>Phylloscopus magnirostris</i>	Phylloscopidae		LC	Sch IV
45	Little Spiderhunter	<i>Arachnothera longirostra</i>	Nectariniidae		LC	Sch. IV
46	Long-tailed Shrike	<i>Lanius schach</i>	Laniidae		LC	Sch. IV

47	Malabar Parakeet	<i>Psittacula columboides</i>	Psittaculidae	WG	LC	Sch. IV
48	Malabar Trogon	<i>Harpactes fasciatus</i>	Trogonidae		LC	Sch. IV
49	Malabar Whistling-thrush	<i>Myophonus horsfieldii</i>	Muscicapidae		LC	Sch. IV
50	Mountain Imperial-pigeon	<i>Ducula badia</i>	Columbidae		LC	Sch. IV
51	Nilgiri Flowerpecker	<i>Dicaeum concolor</i>	Dicaeidae		LC	Sch. IV
52	Nilgiri Flycatcher	<i>Eumyias albicaudatus</i>	Muscicapidae	WG	NT	Sch. IV
53	Nilgiri Pipit	<i>Anthus nilghiriensis</i>	Motacillidae	WG	VU	Sch. IV
54	Nilgiri Woodpigeon	<i>Columba elphinstonii</i>	Columbidae	WG	VU	Sch. IV
55	Oriental Magpie-robin	<i>Copsychus saularis</i>	Muscicapidae		LC	Sch. IV
56	Oriental White-eye	<i>Zosterops palpebrosus</i>	Zosteropidae		LC	Sch. IV
57	Palani laughingthrush	<i>Montecincla fairbanki</i>	Leiothrichidae	WG	LC	Sch. IV
58	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>	Dicaeidae		LC	Sch. IV
59	Pied Bushchat	<i>Saxicola caprata</i>	Muscicapidae		LC	Sch. IV
60	Red-rumped Swallow	<i>Cecropis daurica</i>	Hirundinidae		LC	
61	Red-wattled Lapwing	<i>Vanellus indicus</i>	Charadriidae		LC	Sch. IV
62	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Pycnonotidae		LC	Sch. IV
63	Scarlet Minivet	<i>Pericrocotus flammeus</i>	Campephagidae		LC	Sch. IV
64	Tickell's Blue-flycatcher	<i>Cyornis tickelliae</i>	Muscicapidae		LC	Sch. IV
65	Tickell's Leaf-warbler	<i>Phylloscopus affinis</i>	Phylloscopidae		LC	Sch. IV
66	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Sturnidae		LC	Sch. IV
67	Verditer Flycatcher	<i>Eumyias thalassinus</i>	Muscicapidae		LC	Sch. IV
68	Vernal Hanging-Parrot	<i>Loriculus vernalis</i>	Psittaculidae		LC	Sch. IV
69	Western Crowned Leaf-warbler	<i>Phylloscopus occipitalis</i>	Phylloscopidae		LC	Sch. IV
70	Western Spotted Dove	<i>Spilopelia suratensis</i>	Columbidae		LC	Sch. IV
71	White-bellied Blue-flycatcher	<i>Cyornis pallidipes</i>	Muscicapidae	WG	LC	Sch. IV
72	White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae		LC	Sch. IV
73	White-cheeked Barbet	<i>Psilopogon viridis</i>	Megalaimidae		LC	Sch. IV
74	Yellow-browed Bulbul	<i>Acritillas indica</i>	Pycnonotidae		LC	Sch. IV

Annexure 25

Checklist of Moths recorded in Anamudi Shola National Park

Sl. No	Scientific name	Family
1	<i>Abraxas etridoides</i> Hamp.	Geometridae
2	<i>Abraxes latizonata</i> Hamp.	Geometridae
3	<i>Abraxes poliaria</i> Swinhoe	Geometridae
4	<i>Actias luna</i> Lin.	Saturnidae
5	<i>Aplochloa vivilaca</i> Wlk.	Geometridae
6	<i>Asura nebulosa</i> Moore	Pyralidae

7	<i>Asura</i> sp.	Arctiidae
8	<i>Atacira caesia</i> Roepke	Noctuidae
9	<i>Atacira pala</i> Holloway	Noctuidae
10	<i>Attacus atlas</i> Lin.	Saturnidae
11	<i>Aulacodes peribocalis</i> Wlk.	Pyralidae
12	<i>Aulacodes</i> sp.	Pyralidae
13	<i>Bocchoris onychinalis</i> Guen.	Pyralidae
14	<i>Bradina</i> sp.	Pyralidae
15	<i>Buzura suppressaria</i> Guen.	Geometridae
16	<i>Ceryx</i> sp.	Syntomidae
17	<i>Chalcosia affinis</i> Guer.	Zygaenidae
18	<i>Chilo</i> sp.1	Pyralidae
19	<i>Chilo</i> sp.2	Pyralidae
20	<i>Chionaema peregrina</i> Wlk.	Geometridae
21	<i>Cidaria perficita</i> Wlk.	Geometridae
22	<i>Clorea ?alienaria</i> Wlk.	Geometridae
23	<i>Clorea</i> sp.	Geometridae
24	<i>Comibaena integranota</i> Hamp.	Geometridae
25	<i>Condria</i> sp.	Noctuidae
26	<i>Corgatha semiparata</i> Wlk.	Pyralidae
27	<i>Corymica arnearea</i> Wlk.	Geometridae
28	<i>Cossus</i> sp.	Cossidae
29	<i>Craspedia intensata</i> Moore	Geometridae
30	<i>Cusiala raptaria</i> Wlk.	Geometridae
31	<i>Cyme gratiosa</i> Guerin-Meneville	Arctiidae
32	<i>Diasemia</i> sp.	Pyralidae
33	<i>Dichocrocis surusalis</i> Wlk.	Pyralidae
34	<i>Dirades</i> sp.	Geometridae
35	<i>Eclitoptera subapicalis</i> Hamp.	Geometridae
36	<i>Endotrichia</i> sp.	Pyralidae
37	<i>Endotrichia</i> sp.	Pyralidae
38	<i>Euclasta</i> sp.	Pyralidae
39	<i>Euproctis diagramma</i> Guer.	Lymantriidae
40	<i>Euproctis guttata</i> Wlk.	Lymantriidae
41	<i>Euproctis</i> sp.1	Lymantriidae
42	<i>Eupterote flavidomre</i> Moore	Lymantriidae
43	<i>Eupterote hibisci</i> Fb.	Lymantriidae
44	<i>Eupterote mollis</i> Moore	Lymantriidae
45	<i>Eupterote</i> sp.2	Lymantriidae
46	<i>Eupydna testacea</i> Swinhoe	Notodontidae
47	<i>Glyphodes caesalis</i> Wlk.	Pyralidae
48	<i>Glyphodes laticostalis</i> Guen.	Pyralidae
49	<i>Gnamptoloma aventiaria</i> (Guen.)	Geometridae
50	<i>Hadena pannosa</i> Moore	Noctuidae

51	<i>Helicoverpa armigera</i> Hubn.	Noctuidae
52	<i>Histia nilgira</i> Moore	Zygaenidae
53	<i>Hypochrosis abstractaria</i> Wlk.	Geometridae
54	<i>Hypochrosis festivaria</i> Fb.	Geometridae
55	<i>Hypomecis pallida</i> Hamp.	Geometridae
56	<i>Hypomecis</i> sp.	Geometridae
57	<i>Hypomecis</i> sp.	Geometridae
58	<i>Hypomecis</i> sp.	Geometridae
59	<i>Lantanophaga pusillidactyla</i> Wlk.	Pterophoridae
60	<i>Larentia flavistrigata</i> Warr.	Geometridae
61	<i>Lemyra</i> sp.	Arctiidae
62	<i>Macotasa nubecula</i> Moore	Arctiidae
63	<i>Maliatha erecta</i> Moore	Noctuidae
64	<i>Maruca testulalis</i> Geyer	Pyralidae
65	<i>Mixochlora vittata</i> Moore	Geometridae
66	<i>Mocis frugalis</i> Fb.	Noctuidae
67	<i>Mocis undata</i> Fb.	Noctuidae
68	<i>Myelopsis</i> sp.	Pyralidae
69	<i>Neochera dominio</i> Cram.	Arctiidae
70	<i>Nephopterix</i> sp.	Pyralidae
71	<i>Nymphula depunctalis</i> Snel.	Pyralidae
72	<i>Nymphula fluctuosalis</i> Zell.	Pyralidae
73	<i>Ophiusa dotata</i> Wlk.	Noctuidae
74	<i>Ourapteryx marginata</i> Hamp.	Geometridae
75	<i>Paraplastis hampsoni</i> Swinhoe	Arctiidae
76	<i>Paraplastis</i> sp.	Arctiidae
77	<i>Patissa</i> sp.	Pyralidae
78	<i>Phlyctaenodes nudalis</i> Hubn.	Pyralidae
79	<i>Pingasa</i> sp.	Geometridae
80	<i>Polynesia sunandava</i> Wlk.	Geometridae
81	<i>Psara</i> sp.1	Pyralidae
82	<i>Psara</i> sp.2	Pyralidae
83	<i>Pycnarmon caberalis</i> Guen.	Pyralidae
84	<i>Pyrausta</i> sp.1	Pyralidae
85	<i>Racotis</i> sp.	Geometridae
86	<i>Rahica rosea</i> Hamp.	Lymantriidae
87	<i>Sabaria costimaculata</i> Moore	Geometridae
88	<i>Sabaria rondelaria</i> Fb.	Geometridae
89	<i>Sahyadrases malabaricus</i> Moore	Hepialidae
90	<i>Sangatissa subcurvifera</i> Wlk.	Lymantriidae
91	<i>Scopula opicata</i> Fb.	Geometridae
92	<i>Scopula</i> sp.	Geometridae
93	<i>Scopula</i> sp.2	Geometridae
94	<i>Scopula</i> sp.5	Geometridae

95	<i>Semiothisa eleonora</i> Stoll	Geometridae
96	<i>Semiothisa emersaria</i> Wlk.	Geometridae
97	<i>Semiothisa epicharis</i> Wehrli	Geometridae
98	<i>Siccia taprobanis</i> Wlk.	Arctiidae
99	<i>Spatulifimbria castaneiceps</i> Hamp.	Limacodidae
100	<i>Spilosoma bifasciatum</i> Hamp.	Arctiidae
101	<i>Spilosoma casignetum</i> Kollar	Arctiidae
102	<i>Spilosoma stigmata</i> Moore	Arctiidae
103	<i>Symitha</i> sp.	Pyralidae
104	<i>Sylepta</i> sp.	Pyralidae
105	<i>Syngamia abruptalis</i> Wlk.	Pyralidae
106	<i>Syngamia abruptalis</i> Wlk.	Pyralidae
107	<i>Talanga sexpunctalis</i> Moore	Pyralidae
108	<i>Teldinia specca</i> Wilk.	Geometridae
109	<i>Thosea lutea</i> Heylaerts	Limacodidae
110	<i>Timandra responsaria</i> Moore	Geometridae

Annexure 26

Checklist of Birds recorded in Thattekkad Bird Sanctuary

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Alpine Swift	<i>Tachymarptis melba</i>	Apodidae		LC	Sch. IV
2	Amur Falcon	<i>Falco amurensis</i>	Falconidae		LC	Sch. IV
3	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae		LC	Sch. IV
4	Ashy Prinia	<i>Prinia socialis</i>	Cisticolidae		LC	Sch. IV
5	Ashy Woodswallow	<i>Artamus fuscus</i>	Artamidae		LC	
6	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	Muscicapinae		LC	Sch. IV
7	Asian Emerald Dove	<i>Chalcophaps indica</i>	Columbidae		LC	Sch. IV
8	Asian Fairy-bluebird	<i>Irena puella</i>	Irenidae		LC	Sch. IV
9	Asian koel	<i>Eudynamys scolopaceus</i>	Cuculidae		LC	Sch. IV
10	Asian Openbill	<i>Anastomus oscitans</i>	Ciconiidae		LC	Sch. IV
11	Asian Palm-Swift	<i>Cypsiurus balasiensis</i>	Apodidae		LC	Sch. I
12	Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	Cuculidae		LC	Sch. IV
13	Barn Swallow	<i>Hirundo rustica</i>	Hirundinidae		LC	
14	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	Vangidae		LC	Sch. IV
15	besra sparrowhawk	<i>Accipiter virgatus</i>	Accipitridae		LC	
16	Black baza	<i>Aviceda leuphotes</i>	Accipitridae		LC	Sch. I
17	Black Drongo	<i>Dicrurus macrocercus</i>	Dicruridae		LC	Sch. IV
18	Black Eagle	<i>Ictinaetus malayensis</i>	Accipitridae		LC	Sch. I
19	Black Kite	<i>Milvus migrans</i>	Accipitridae		LC	

20	Black naped oriole	<i>Oriolus chinensis</i>	Oriolidae		LC	Sch. IV
21	Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	Ardeidae		LC	Sch. IV
22	Black-headed Cuckooshrike	<i>Lalage melanoptera</i>	Campephagidae		LC	Sch. IV
23	Black-hooded Oriole	<i>Oriolus xanthornus</i>	Oriolidae		LC	Sch. IV
24	Black-naped Monarch	<i>Hypothymis azurea</i>	Monarchidae		LC	Sch. IV
25	Black-rumped Flameback	<i>Dinopium benghalense</i>	Picidae		LC	Sch. IV
26	Black-throated munia	<i>Lonchura kelaarti</i>	Estrildidae		LC	Sch. IV
27	Black-winged Kite	<i>Elanus caeruleus</i>	Accipitridae		LC	Sch. I
28	Blue-bearded Bee-eater	<i>Nyctyornis athertoni</i>	Meropidae		LC	
29	Blue-capped Rock-Thrush	<i>Monticola cinclorhyncha</i>	Muscicapidae		LC	Sch. II
30	Blue-eared Kingfisher	<i>Alcedo meninting</i>	Alcedinidae		LC	Sch. IV
31	Blue-faced Malkoha	<i>Phaenicophaeus viridirostris</i>	Cuculidae		LC	Sch. IV
32	Blue-tailed Bee-eater	<i>Merops philippinus</i>	Meropidae		LC	
33	Blyth's Reed-warbler	<i>Acrocephalus dumetorum</i>	Acrocephalidae		LC	Sch. IV
34	Brahminy Kite	<i>Haliastur indus</i>	Accipitridae		LC	Sch I (Part III)
35	Brahminy Starling	<i>Sturnia pagodarum</i>	Sturnidae		LC	Sch. I
36	Bronzed Drongo	<i>Dicrurus aeneus</i>	Dicruridae		LC	Sch. IV
37	Bronze-winged Jacana	<i>Metopidius indicus</i>	Jacanidae		LC	Sch. IV
38	Brown Fish-owl	<i>Ketupa zeylonensis</i>	Strigidae		LC	Sch. IV
39	Brown Hawk-Owl	<i>Ninox scutulata</i>	Strigidae		LC	Sch. I
40	Brown Shrike	<i>Lanius cristatus</i>	Laniidae		LC	
41	Brown Wood-Owl	<i>Strix leptogrammica</i>	Strigidae		LC	Sch. I
42	Brown-backed Needletail	<i>Hirundapus giganteus</i>	Apodidae		LC	
43	Brown-breasted Flycatcher	<i>Muscicapa muttui</i>	Muscicapidae		LC	Sch. IV
44	Brown-cheeked Fulvetta	<i>Alcippe poioicephala</i>	Alcippeidae		LC	Sch. IV
45	Cattle Egret	<i>Bubulcus ibis</i>	Ardeidae		LC	Sch. IV
46	Changeable Hawk-Eagle	<i>Nisaetus cirrhatus</i>	Accipitridae		LC	Sch. IV
47	Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	Meropidae		LC	
48	Chestnut-tailed Starling	<i>Sturnia malabarica</i>	Sturnidae		LC	Sch. I

49	Chestnut-winged Cuckoo	<i>Clamator coromandus</i>	Cuculidae		LC	Sch. IV
50	Cinereous Tit	<i>Parus cinereus</i>	Paridae		LC	Sch. IV
51	Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	Ardeidae		LC	Sch. IV
52	Common Cuckoo	<i>Cuculus canorus</i>	Cuculidae		LC	Sch. IV
53	Common Flameback	<i>Dinopium javanense</i>	Picidae		LC	Sch. IV
54	Common Hawk-Cuckoo	<i>Hierococcyx varius</i>	Cuculidae		LC	Sch. IV
55	Common Iora	<i>Aegithina tiphia</i>	Aegithinidae		LC	Sch. IV
56	common kestrel	<i>Falco tinnunculus</i>	Falconidae		LC	Sch. IV
57	common kingfisher	<i>Alcedo atthis</i>	Alcedinidae		LC	Sch. IV
58	common myna	<i>Acridotheres tristis</i>	Sturnidae		LC	Sch. IV
59	Common Sandpiper	<i>Actitis hypoleucos</i>	Scolopacidae		LC	Sch. IV
60	Common Tailorbird	<i>Orthotomus sutorius</i>	Cisticolidae		LC	Sch. IV
61	Common Woodshrike	<i>Tephrodornis pondicerianus</i>	Vangidae		LC	Sch. IV
62	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	Megalaimidae		LC	Sch. IV
63	Cotton Pygmy-Goose	<i>Nettapus coromandelianus</i>	Anatidae		LC	Sch. IV
64	Crested Goshawk	<i>Accipiter trivirgatus</i>	Accipitridae		LC	Sch. I
65	Crested Serpent-eagle	<i>Spilornis cheela</i>	Accipitridae		LC	Sch. I
66	Crested Treeswift	<i>Hemiprocyne coronata</i>	Hemiprocnidae		LC	Sch. IV
67	Crimson-backed Sunbird	<i>Leptocoma minima</i>	Nectariniidae	WG	LC	Sch. IV
68	Dark-fronted Babbler	<i>Rhopocichla atriceps</i>	Timaliidae		LC	Sch. IV
69	Dusky Crag Martin	<i>Hirundo concolor</i>	Hirundinidae		LC	
70	Eurasian hoopoe	<i>Upupa epops</i>	Upupidae		LC	
71	Forest Wagtail	<i>Dendronanthus indicus</i>	Motacillidae		LC	Sch. IV
72	Fork-tailed Drongo-Cuckoo	<i>Surniculus dicruroides</i>	Cuculidae		LC	Sch. IV
73	Golden-fronted leafbird	<i>Chloropsis aurifrons</i>	Chloropseidae		LC	Sch. IV
74	Great Cormorant	<i>Phalacrocorax carbo</i>	Phalacrocoracidae		LC	Sch. IV
75	Great Eared-nightjar	<i>Lyncornis macrotis</i>	Caprimulgidae		LC	Sch. IV
76	Great Egret	<i>Ardea alba</i>	Ardeidae		LC	Sch. IV
77	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae		LC	Sch. IV
78	Greater flameback	<i>Chrysocolaptes guttacristatus</i>	Picidae		LC	Sch. I
79	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	Dicruridae		LC	Sch. IV
80	Green Bee-eater	<i>Merops orientalis</i>	Meropidae		LC	
81	Green Imperial-pigeon	<i>Ducula aenea</i>	Columbidae		LC	Sch. IV

82	Green Sandpiper	<i>Tringa ochropus</i>	Scolopacidae		LC	Sch. IV
83	Greenish Warbler	<i>Phylloscopus trochiloides</i>	Phylloscopidae		LC	Sch. IV
84	Grey Heron	<i>Ardea cinerea</i>	Ardeidae		LC	Sch. IV
85	Grey Junglefowl	<i>Gallus sonneratii</i>	Phasianidae		LC	Sch. IV
86	Grey Wagtail	<i>Motacilla cinerea</i>	Motacillidae		LC	Sch. IV
87	Grey-bellied Cuckoo	<i>Cacomantis passerinus</i>	Cuculidae		LC	Sch. IV
88	Grey-breasted Prinia	<i>Prinia hodgsonii</i>	Cisticolidae		LC	Sch. IV
89	Grey-fronted Green-Pigeon	<i>Treron affinis</i>	Columbidae		LC	Sch. IV
90	Grey-headed Canary-Flycatcher	<i>Culicicapa ceylonensis</i>	Stenostiridae		LC	Sch. IV
91	Grey-headed Fish-Eagle	<i>Haliaeetus ichthyaetus</i>	Accipitridae		NT	
92	Grey-headed Swampphen	<i>Porphyrio poliocephalus</i>	Rallidae		LC	Sch. IV
93	Hair-crested Drongo	<i>Dicrurus hottentottus</i>	Dicruridae		LC	Sch. IV
94	Heart-spotted Woodpecker	<i>Hemicircus canente</i>	Picidae		LC	Sch. IV
95	House Crow	<i>Corvus splendens</i>	Corvidae		LC	Sch. IV
96	House Sparrow	<i>Passer domesticus</i>	Passeridae		LC	Sch. IV
97	Indian blackbird	<i>Turdus simillimus</i>	Turdidae		NE	Sch. IV
98	Indian black-lored tit	<i>Machlolophus aplonotus</i>	Paridae		LC	Sch. IV
99	Indian Blue Robin	<i>Larvivora brunnea</i>	Muscicapidae		LC	Sch. I
100	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	Phalacrocoracidae		LC	Sch. IV
101	Indian Golden Oriole	<i>Oriolus kundoo</i>	Oriolidae		LC	Sch. IV
102	Indian Nightjar	<i>Caprimulgus asiaticus</i>	Caprimulgidae		LC	Sch. IV
103	Indian Paradise-Flycatcher	<i>Terpsiphone paradisi</i>	Monarchidae		LC	Sch. IV
104	Indian Peafowl	<i>Pavo cristatus</i>	Phasianidae		LC	Sch. IV
105	Indian Pitta	<i>Pitta brachyura</i>	Pittidae		LC	Sch. IV
106	Indian Pond-Heron	<i>Ardeola grayii</i>	Ardeidae		LC	Sch. I
107	Indian Pygmy Woodpecker	<i>Yungipicus nanus</i>	Picidae		LC	Sch. IV
108	Indian river tern	<i>Sterna aurantia</i>	Laridae		NT	Sch. IV
109	Indian Robin	<i>Copsychus fulicatus</i>	Muscicapidae		LC	Sch. IV
110	Indian Roller	<i>Coracias benghalensis</i>	Coraciidae		LC	Sch. IV
111	Indian Scimitar-babbler	<i>Pomatorhinus horsfieldii</i>	Timaliidae		LC	Sch. IV
112	Indian Scops-Owl	<i>Otus bakkamoena</i>	Strigidae		LC	Sch. IV
113	Indian Swiftlet	<i>Aerodramus unicolor</i>	Apodidae		LC	Sch. IV
114	Intermediate Egret	<i>Ardea intermedia</i>	Ardeidae		LC	Sch. IV
115	Jacobin Cuckoo	<i>Clamator jacobinus</i>	Cuculidae		LC	Sch. IV
116	Jerdon's Leafbird	<i>Chloropsis jerdoni</i>	Chloropseidae		LC	Sch. IV

117	Jerdon's Nightjar	<i>Caprimulgus atripennis</i>	Caprimulgidae		LC	Sch. IV
118	Jungle Babbler	<i>Argya striata</i>	Leiothrichidae		LC	Sch. IV
119	Jungle Bush-Quail	<i>Perdicula asiatica</i>	Phasianidae		LC	Sch. IV
120	Jungle Myna	<i>Acridotheres fuscus</i>	Sturnidae		LC	Sch. IV
121	Jungle Nightjar	<i>Caprimulgus indicus</i>	Caprimulgidae		LC	Sch. IV
122	Jungle Owlet	<i>Glaucidium radiatum</i>	Strigidae		LC	Sch. IV
123	Large Cuckooshrike	<i>Coracina macei</i>	Campephagidae		LC	Sch. IV
124	Large Hawk-Cuckoo	<i>Hierococcyx sparverioides</i>	Cuculidae		LC	Sch. IV
125	Large Woodshrike	<i>Tephrodornis virgatus</i>	Vangidae		LC	Sch. IV
126	Large-billed Crow	<i>Corvus macrorhynchos</i>	Corvidae		LC	Sch. IV
127	Large-billed Leaf-warbler	<i>Phylloscopus magnirostris</i>	Phylloscopidae		LC	Sch. IV
128	Legge's Hawk-Eagle	<i>Nisaetus kelaarti</i>	Accipitridae		LC	Sch. IV
129	Lesser Fish-Eagle	<i>Haliaeetus humilis</i>	Accipitridae		NT	
130	lesser Whistling-Duck	<i>Dendrocygna javanica</i>	Anatidae		LC	Sch. IV
131	Lesser Yellownappe	<i>Picus chlorolophus</i>	Picidae		LC	Sch. IV
132	Little Cormorant	<i>Microcarbo niger</i>	Phalacrocoracidae		LC	Sch. IV
133	Little Egret	<i>Egretta garzetta</i>	Ardeidae		LC	Sch. IV
134	Little Grebe	<i>Tachybaptus ruficollis</i>	Podicipedidae		LC	Sch. IV
135	Little Spiderhunter	<i>Arachnothera longirostra</i>	Nectariniidae		LC	Sch. IV
136	Little Swift	<i>Apus affinis</i>	Apodidae		LC	Sch. IV
137	Long-tailed Shrike	<i>Lanius schach</i>	Laniidae		LC	
138	Loten's Sunbird	<i>Cinnyris lotenius</i>	Nectariniidae		LC	Sch. IV
139	Malabar barbet	<i>Psilopogon malabaricus</i>	Megalaimidae	WG	LC	Sch. IV
140	Malabar Grey Hornbill	<i>Ocyrceros griseus</i>	Bucerotidae	WG	LC	Sch. IV
141	Malabar Parakeet	<i>Psittacula columboides</i>	Psittaculidae	WG	LC	Sch. IV
142	Malabar Pied-Hornbill	<i>Anthracoceros coronatus</i>	Bucerotidae		NT	Sch. IV
143	Malabar Starling	<i>Sturnia blythii</i>	Sturnidae		LC	Sch. IV
144	Malabar Trogon	<i>Harpactes fasciatus</i>	Trogonidae		LC	Sch. I
145	Malabar Whistling-thrush	<i>Myophonus horsfieldii</i>	Muscicapidae		LC	Sch. IV
146	Malabar Woodshrike	<i>Tephrodornis sylvicola</i>	Vangidae		LC	Sch. IV
147	Malay Night-heron	<i>Gorsachius melanolophus</i>	Ardeidae		LC	Sch. IV
148	Mottled Wood-Owl	<i>Strix ocellata</i>	Strigidae		LC	Sch. IV
149	Mountain Imperial-pigeon	<i>Ducula badia</i>	Columbidae		LC	Sch. IV
150	Nilgiri Flowerpecker	<i>Dicaeum concolor</i>	Dicaeidae		LC	Sch. IV
151	Nilgiri Flycatcher	<i>Eumyias albicaudatus</i>	Muscicapinae	WG	NT	Sch. IV
152	Nilgiri Thrush	<i>Zoothera neilgherriensis</i>	Turdidae	WG	LC	Sch. IV
153	Nilgiri Woodpigeon	<i>Columba elphinstonii</i>	Columbidae	WG	VU	Sch. IV
154	Orange Minivet	<i>Pericrocotus flammeus</i>	Campephagidae		LC	Sch. IV
155	Orange-headed T	<i>Geokichla citrina</i>	Turdidae		LC	Sch. IV

156	Oriental Darter	<i>Anhinga melanogaster</i>	Anhingidae		NT	Sch. IV
157	Oriental Dollarbird	<i>Eurystomus orientalis</i>	Coraciidae		LC	Sch. I
158	Oriental dwarf kingfisher	<i>Ceyx erithaca</i>	Alcedinidae		LC	Sch. IV
159	Oriental honey-buzzard	<i>Pernis ptilorhynchus</i>	Accipitridae		LC	Sch. I
160	Oriental Magpie-robin	<i>Copsychus saularis</i>	Muscicapidae		LC	Sch. IV
161	Oriental Scops-Owl	<i>Otus sunia</i>	Strigidae		LC	Sch. IV
162	Oriental White-eye	<i>Zosterops palpebrosus</i>	Zosteropidae		LC	Sch. I
163	Paddyfield Pipit	<i>Anthus rufulus</i>	Motacillidae		LC	Sch. IV
164	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>	Dicaeidae		LC	Sch. IV
165	Peregrine Falcon	<i>Falco peregrinus</i>	Falconidae		LC	Sch. IV
166	Pied Kingfisher	<i>Ceryle rudis</i>	Alcedinidae		LC	Sch. IV
167	Plain Prinia	<i>Prinia inornata</i>	Cisticolidae		LC	Sch. IV
168	Plum-headed Parakeet	<i>Psittacula cyanocephala</i>	Psittaculidae		LC	Sch. IV
169	Puff-throated Babbler	<i>Pellorneum ruficeps</i>	Pellorneidae		LC	Sch. IV
170	Purple Heron	<i>Ardea purpurea</i>	Ardeidae		LC	Sch. IV
171	Purple Sunbird	<i>Cinnyris asiaticus</i>	Nectariniidae		LC	Sch. IV
172	Purple-rumped Sunbird	<i>Leptocoma zeylonica</i>	Nectariniidae		LC	Sch. IV
173	Red Spurfowl	<i>Galloperdix spadicea</i>	Phasianidae		LC	Sch. IV
174	Red-rumped Swallow	<i>Cecropis daurica</i>	Hirundinidae		LC	
175	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae		LC	Sch. IV
176	Red-wattled Lapwing	<i>Vanellus indicus</i>	Charadriidae		LC	Sch. IV
177	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Pycnonotidae		LC	Sch. IV
178	Rock pigeon	<i>Columba livia domestica</i>	Columbidae		LC	Sch. IV
179	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Psittaculidae		LC	Sch. IV
180	Rosy Starling	<i>Pastor roseus</i>	Sturnidae		LC	Sch. I
181	Rufous Babbler	<i>Argya subrufa</i>	Leiothrichidae	WG	LC	Sch. IV
182	Rufous Treepie	<i>Dendrocitta vagabunda</i>	Corvidae		LC	
183	Rufous Woodpecker	<i>Micropternus brachyurus</i>	Picidae		LC	Sch. IV
184	Rufous-bellied Eagle	<i>Lophotriorchis kienerii</i>	Accipitridae		NT	Sch. IV
185	Rusty-tailed Flycatcher	<i>Ficedula ruficauda</i>	Muscicapidae		LC	Sch. IV
186	Savanna Nightjar	<i>Caprimulgus affinis</i>	Caprimulgidae		LC	Sch. IV
187	Scaly-breasted Munia	<i>Lonchura punctulata</i>	Estrildidae		LC	Sch. IV
188	Shikra	<i>Accipiter badius</i>	Accipitridae		LC	Sch. I

189	Slaty-breasted Rail	<i>Lewinia striata</i>	Rallidae		LC	Sch. IV
190	Slaty-legged Crake	<i>Rallina eurizonoides</i>	Rallidae		LC	Sch. IV
191	Small Minivet	<i>Pericrocotus cinnamomeus</i>	Campephagidae		LC	Sch. IV
192	Small Pratincole	<i>Glareola lactea</i>	Glareolidae		LC	
193	Southern Hill Myna	<i>Gracula indica</i>	Sturnidae		LC	Sch. IV
194	Speckled Piculet	<i>Picumnus innominatus</i>	Picidae		LC	Sch. IV
195	Spot-bellied Eagle-Owl	<i>Bubo nipalensis</i>	Strigidae		LC	Sch. IV
196	Spotted Dove	<i>Spilopelia chinensis</i>	Columbidae		LC	Sch. IV
197	Spotted Owlet	<i>Athene brama</i>	Strigidae		LC	
198	Square-tailed Bulbul	<i>Hypsipetes ganeesa</i>	Pycnonotidae		LC	Sch. IV
199	Sri Lanka Bay-Owl	<i>Phodilus assimilis</i>	Tytonidae		LC	Sch. I
200	Sri Lanka Frogmouth	<i>Batrachostomus moniliger</i>	Podargidae		LC	Sch. IV
201	Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	Alcedinidae		LC	Sch. IV
202	Streak-throated Woodpecker	<i>Picus xanthopygaeus</i>	Picidae		LC	Sch. IV
203	striated heron	<i>Butorides striata</i>	Ardeidae		LC	Sch. IV
204	Taiga Flycatcher	<i>Ficedula albicilla</i>	Muscicapidae		LC	Sch. IV
205	Thick-billed Flowerpecker	<i>Dicaeum agile</i>	Dicaeidae		LC	Sch. IV
206	Thick-billed Warbler	<i>Acrocephalus aedon</i>	Acrocephalidae		LC	
207	Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>	Muscicapidae		LC	Sch. IV
208	Tricolored Munia	<i>Lonchura malacca</i>	Estrildidae		LC	Sch. IV
209	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Sturnidae		LC	Sch. IV
210	Verditer Flycatcher	<i>Eumyias thalassinus</i>	Muscicapinae		LC	Sch. IV
211	Vernal Hanging-Parrot	<i>Loriculus vernalis</i>	Psittaculidae		LC	Sch. IV
212	Wayanad Laughingthrush	<i>Pterorhinus delesserti</i>	Leiotherichidae	WG	LC	Sch. IV
213	Western Crowned Leaf-warbler	<i>Phylloscopus occipitalis</i>	Phylloscopidae		LC	Sch. IV
214	Western Yellow Wagtail	<i>Motacilla flava</i>	Motacillidae		LC	Sch. IV
215	Whiskered Tern	<i>Chlidonias hybrida</i>	Laridae		LC	Sch. IV
216	White Wagtail	<i>Motacilla alba</i>	Motacillidae		LC	Sch. IV
217	White-bellied Blue Flycatcher	<i>Cyornis pallidipes</i>	Muscicapidae	WG	LC	Sch. IV
218	White-bellied Drongo	<i>Dicrurus caerulescens</i>	Dicruridae		LC	Sch. IV
219	White-bellied	<i>Dendrocitta leucogastra</i>	Corvidae	WG	LC	Sch. IV

	Treepie					
220	White-bellied Woodpecker	<i>Dryocopus javensis</i>	Picidae		LC	Sch. IV
221	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Rallidae		LC	Sch. IV
222	White-browed Bulbul	<i>Pycnonotus luteolus</i>	Pycnonotidae		LC	
223	White-browed Fantail	<i>Rhipidura aureola</i>	Rhipiduridae		LC	Sch. I
224	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	Motacillidae		LC	Sch. IV
225	White-cheeked Barbet	<i>Psilopogon viridis</i>	Megalaimidae		LC	Sch. IV
226	White-rumped Munia	<i>Lonchura striata</i>	Estrildidae		LC	Sch. IV
227	White-rumped Needletail	<i>Zoonavena sylvatica</i>	Apodidae		LC	
228	White-rumped Shama	<i>Copsychus malabaricus</i>	Muscicapidae		LC	Sch. IV
229	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae		LC	Sch. IV
230	Wire-tailed Swallow	<i>Hirundo smithii</i>	Hirundinidae		LC	
231	Wood Sandpiper	<i>Tringa glareola</i>	Scolopacidae		LC	Sch. IV
232	Woolly-necked Stork	<i>Ciconia episcopus</i>	Ciconiidae		VU	Sch. IV
233	Yellow-billed Babbler	<i>Argya affinis</i>	Leiotherichidae		LC	Sch. IV
234	Yellow-browed Bulbul	<i>Acritillas indica</i>	Pycnonotidae		LC	Sch. IV
235	Yellow-crowned Woodpecker	<i>Leiopicus mahrattensis</i>	Picidae		LC	Sch. IV
236	Yellow-footed Green-pigeon	<i>Treron phoenicoptera</i>	Columbidae		LC	Sch. IV

Annexure 27

Checklist of Mammals recorded in Thattekkad Bird Sanctuary

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	Asian elephant	<i>Elephas maximus</i>	Elephantidae		EN	Sch I (Part I)
2	Bonnet macaque	<i>Macaca radiata</i>	Cercopithecidae		VU	Sch II (Part I)
3	Indian hare	<i>Lepus nigricollis</i>	Leporidae		LC	
4	Indian palm squirrel	<i>Funambulus palmarum</i>	Sciuridae		LC	
5	Indian pangolin	<i>Manis crassicaudata</i>	Manidae		EN	
6	Indian wild dog	<i>Cuon alpinus</i>	Canidae		EN	Sch II (Part I)
7	Jungle Cat	<i>Felis chaus</i>	Felidae		LC	Sch II (Part I)

8	Malabar giant squirrel	<i>Ratufa indica</i>	Sciuridae	WG	LC	Sch II (Part I)
9	Sambar deer	<i>Rusa unicolor</i>	Cervidae		VU	
10	Small Indian civet	<i>Viverricula indica</i>	Viverridae		LC	Sch II (Part I)
11	Spotted deer	<i>Axis</i>	Cervidae		LC	Sch III
12	Travancore flying squirrel	<i>Petinomys fuscocapillus</i>	Sciuridae	WG	LC	Sch I (Part I)
13	Wild boar	<i>Sus scrofa</i>	Suidae		LC	

Annexure 28

Thattekkad bird sanctuary

SI No	Common name	2017	2018
1	Lesser Whistling-Duck	✓	✓
2	Knob-billed Duck	✓	
3	Cotton Pygmy-Goose	✓	✓
4	Garganey	✓	✓
5	Northern Shoveler	✓	✓
6	Gadwall		✓
7	Indian Spot-billed Duck	✓	✓
8	Northern Pintail	✓	✓
9	Green-winged Teal	✓	✓
10	Indian Peafowl	✓	✓
11	Red Spurfowl	✓	✓
12	Rain Quail	✓	
13	Jungle Bush-Quail	✓	✓
14	Painted Bush-Quail	✓	✓
15	Grey Francolin	✓	✓
16	Grey Junglefowl	✓	✓
17	Greater Flamingo	✓	✓
18	Little Grebe	✓	✓
19	Rock Pigeon	✓	✓
20	Nilgiri Wood-Pigeon	✓	✓
21	Oriental Turtle-Dove	✓	
22	Red Collared-Dove	✓	✓
23	Spotted Dove	✓	✓
24	Laughing Dove	✓	✓
25	Asian Emerald Dove	✓	✓
26	Orange-breasted Pigeon	✓	
27	Grey-fronted Green-Pigeon	✓	✓
28	Yellow-footed Pigeon	✓	✓
29	Green Imperial-Pigeon	✓	✓
30	Mountain Imperial-Pigeon	✓	✓
31	Greater Coucal	✓	✓
32	Lesser Coucal	✓	✓

33	Sirkeer Malkoha		✓
34	Blue-faced Malkoha	✓	✓
35	Pied Cuckoo	✓	✓
36	Asian Koel	✓	✓
37	Banded Bay Cuckoo	✓	✓
38	Grey-bellied Cuckoo	✓	✓
39	Fork-tailed Drongo-Cuckoo	✓	
40	Common Hawk-Cuckoo	✓	✓
41	Indian Cuckoo	✓	✓
42	Common Cuckoo	✓	✓
43	Sri Lanka Frogmouth	✓	✓
44	Great Eared-Nightjar		✓
45	Jungle Nightjar	✓	✓
46	Jerdon's Nightjar	✓	✓
47	Indian Nightjar	✓	✓
48	Savanna Nightjar	✓	✓
49	White-rumped Needletail	✓	✓
50	Brown-backed Needletail	✓	✓
51	Indian Swiftlet	✓	✓
52	Alpine Swift	✓	✓
53	Little Swift	✓	✓
54	Asian Palm-Swift	✓	✓
55	Crested Treeswift	✓	✓
56	Eurasian Moorhen	✓	✓
57	Eurasian Coot	✓	✓
58	Grey-headed Swamphen	✓	✓
59	Watercock	✓	✓
60	White-breasted Waterhen	✓	✓
61	Slaty-legged Crake	✓	✓
62	Ruddy-breasted Crake	✓	✓
63	Baillon's Crake	✓	✓
64	Indian Thick-knee	✓	✓
65	Great Thick-knee		✓
66	Black-winged Stilt	✓	✓
67	Eurasian Oystercatcher	✓	✓
68	Black-bellied Plover	✓	✓
69	Pacific Golden-Plover	✓	✓
70	Yellow-wattled Lapwing	✓	✓
71	Grey-headed Lapwing	✓	
72	Red-wattled Lapwing	✓	✓
73	Lesser Sand-Plover	✓	✓
74	Greater Sand-Plover	✓	✓
75	Caspian Plover		✓
76	Kentish Plover	✓	✓
77	Common Ringed Plover	✓	
78	Little Ringed Plover	✓	✓
79	Greater Painted-Snipe	✓	✓
80	Pheasant-tailed Jacana	✓	✓

81	Bronze-winged Jacana	✓	✓
82	Whimbrel	✓	✓
83	Eurasian Curlew	✓	✓
84	Bar-tailed Godwit	✓	✓
85	Black-tailed Godwit	✓	✓
86	Ruddy Turnstone	✓	✓
87	Great Knot	✓	✓
88	Red Knot		✓
89	Ruff	✓	✓
90	Broad-billed Sandpiper	✓	✓
91	Curlew Sandpiper	✓	✓
92	Temminck's Stint	✓	✓
93	Long-toed Stint	✓	✓
94	Sanderling	✓	✓
95	Dunlin	✓	✓
96	Little Stint	✓	✓
97	Pectoral Sandpiper	✓	✓
98	Common Snipe	✓	✓
99	Pin-tailed Snipe	✓	✓
100	Terek Sandpiper	✓	✓
101	Common Sandpiper	✓	✓
102	Green Sandpiper	✓	✓
103	Spotted Redshank	✓	✓
104	Common Greenshank	✓	✓
105	Marsh Sandpiper	✓	✓
106	Wood Sandpiper	✓	✓
107	Common Redshank	✓	✓
108	Barred Buttonquail	✓	✓
109	Crab-Plover	✓	
110	Small Pratincole	✓	✓
111	Pomarine Jaeger	✓	✓
112	Parasitic Jaeger	✓	✓
113	Long-tailed Jaeger	✓	
114	Slender-billed Gull	✓	✓
115	Black-headed Gull		✓
116	Brown-headed Gull	✓	✓
117	Pallas's Gull		✓
118	Lesser Black-backed Gull	✓	✓
119	Lesser Noddy	✓	
120	Bridled Tern	✓	✓
121	Little Tern	✓	✓
122	Gull-billed Tern	✓	✓
123	Caspian Tern	✓	✓
124	White-winged Tern		✓
125	Whiskered Tern	✓	✓
126	Common Tern	✓	✓
127	River Tern	✓	✓
128	Great Crested Tern	✓	✓

129	Sandwich Tern	✓	✓
130	Lesser Crested Tern	✓	✓
131	Red-billed Tropicbird	✓	✓
132	Wilson's Storm-Petrel	✓	
133	Swinhoe's Storm-Petrel	✓	
134	Flesh-footed Shearwater	✓	
135	Asian Openbill	✓	✓
136	Woolly-necked Stork	✓	✓
137	White Stork	✓	✓
138	Painted Stork	✓	✓
139	Lesser Frigatebird	✓	
140	Masked Booby	✓	
141	Oriental Darter	✓	✓
142	Little Cormorant	✓	✓
143	Great Cormorant	✓	✓
144	Indian Cormorant	✓	✓
145	Spot-billed Pelican	✓	✓
146	Yellow Bittern	✓	✓
147	Cinnamon Bittern	✓	✓
148	Black Bittern	✓	✓
149	Grey Heron	✓	✓
150	Purple Heron	✓	✓
151	Great Egret	✓	✓
152	Intermediate Egret	✓	✓
153	Little Egret	✓	✓
154	Western Reef-Heron	✓	✓
155	Cattle Egret	✓	✓
156	Indian Pond-Heron	✓	✓
157	Striated Heron	✓	✓
158	Black-crowned Night-Heron	✓	✓
159	Glossy Ibis	✓	✓
160	Black-headed Ibis	✓	✓
161	Eurasian Spoonbill	✓	✓
162	Osprey	✓	✓
163	Black-winged Kite	✓	✓
164	Oriental Honey-buzzard	✓	✓
165	Red-headed Vulture	✓	
166	White-rumped Vulture	✓	
167	Black Baza		✓
168	Crested Serpent-Eagle	✓	✓
169	Short-toed Snake-Eagle	✓	✓
170	Crested Hawk-Eagle	✓	✓
171	Legge's Hawk-Eagle	✓	✓
172	Rufous-bellied Eagle	✓	✓
173	Black Eagle	✓	✓
174	Indian Spotted Eagle	✓	✓
175	Greater Spotted Eagle	✓	✓
176	Booted Eagle	✓	✓

177	Bonelli's Eagle		✓
178	White-eyed Buzzard	✓	✓
179	Pallid Harrier	✓	
180	Eurasian Marsh-Harrier	✓	✓
181	Crested Goshawk	✓	✓
182	Shikra	✓	✓
183	Besra	✓	
184	Eurasian Sparrowhawk	✓	
185	Black Kite	✓	✓
186	Brahminy Kite	✓	✓
187	White-bellied Sea-Eagle	✓	✓
188	Lesser Fish-Eagle	✓	✓
189	Common Buzzard	✓	✓
190	Barn Owl	✓	✓
191	Sri Lanka Bay-Owl	✓	✓
192	Indian Scops-Owl	✓	✓
193	Oriental Scops-Owl	✓	✓
194	Spot-bellied Eagle-Owl	✓	✓
195	Brown Fish-Owl	✓	✓
196	Jungle Owlet	✓	✓
197	Spotted Owlet	✓	✓
198	Mottled Wood-Owl	✓	✓
199	Brown Wood-Owl	✓	✓
200	Brown Hawk-Owl	✓	✓
201	Malabar Trogon	✓	✓
202	Eurasian Hoopoe	✓	✓
203	Great Hornbill	✓	✓
204	Indian Grey Hornbill	✓	✓
205	Malabar Grey Hornbill	✓	✓
206	Malabar Pied-Hornbill	✓	✓
207	Common Kingfisher	✓	✓
208	Blue-eared Kingfisher	✓	
209	Black-backed Dwarf-Kingfisher	✓	✓
210	Stork-billed Kingfisher	✓	✓
211	White-throated Kingfisher	✓	✓
212	Black-capped Kingfisher	✓	✓
213	Pied Kingfisher	✓	✓
214	Blue-bearded Bee-eater	✓	✓
215	Green Bee-eater	✓	✓
216	Blue-cheeked Bee-eater	✓	✓
217	Blue-tailed Bee-eater	✓	✓
218	Chestnut-headed Bee-eater	✓	✓
219	European Roller	✓	✓
220	Indian Roller	✓	✓
221	Oriental Dollarbird	✓	✓
222	Malabar Barbet	✓	✓
223	Coppersmith Barbet	✓	✓
224	Brown-headed Barbet	✓	✓

225	White-cheeked Barbet	✓	✓
226	Speckled Piculet	✓	✓
227	Heart-spotted Woodpecker	✓	✓
228	Brown-capped Pygmy Woodpecker	✓	✓
229	Yellow-crowned Woodpecker	✓	✓
230	Greater Flameback	✓	✓
231	Rufous Woodpecker	✓	✓
232	Common Flameback	✓	✓
233	Black-rumped Flameback	✓	✓
234	Lesser Yellownape	✓	✓
235	Streak-throated Woodpecker	✓	✓
236	White-bellied Woodpecker	✓	✓
237	Eurasian Kestrel	✓	✓
238	Red-necked Falcon		✓
239	Peregrine Falcon	✓	✓
240	Rose-ringed Parakeet	✓	✓
241	Plum-headed Parakeet	✓	✓
242	Malabar Parakeet	✓	✓
243	Vernal Hanging-Parrot	✓	✓
244	Indian Pitta	✓	✓
245	Malabar Woodshrike	✓	✓
246	Common Woodshrike	✓	✓
247	Bar-winged Flycatcher-shrike	✓	✓
248	Ashy Woodswallow	✓	✓
249	Common Iora	✓	✓
250	Small Minivet	✓	✓
251	Orange Minivet	✓	✓
252	Large Cuckooshrike	✓	✓
253	Black-headed Cuckooshrike	✓	✓
254	Brown Shrike	✓	✓
255	Bay-backed Shrike	✓	✓
256	Long-tailed Shrike	✓	✓
257	Indian Golden Oriole	✓	✓
258	Black-naped Oriole	✓	✓
259	Black-hooded Oriole	✓	✓
260	Black Drongo	✓	✓
261	Ashy Drongo	✓	✓
262	White-bellied Drongo	✓	✓
263	Bronzed Drongo	✓	✓
264	Hair-crested Drongo	✓	✓
265	Greater Racket-tailed Drongo	✓	✓
266	White-browed Fantail	✓	✓
267	Black-naped Monarch	✓	✓
268	Indian Paradise-Flycatcher	✓	✓
269	Rufous Treepie	✓	✓
270	White-bellied Treepie	✓	✓
271	House Crow	✓	✓
272	Large-billed Crow	✓	✓

273	Ashy-crowned Sparrow-Lark	✓	✓
274	Jerdon's Bushlark	✓	✓
275	Sykes's Short-toed Lark	✓	✓
276	Oriental Skylark	✓	✓
277	Malabar Lark	✓	✓
278	Bank Swallow	✓	✓
279	Dusky Crag-Martin	✓	✓
280	Barn Swallow	✓	✓
281	Wire-tailed Swallow	✓	✓
282	Hill Swallow	✓	✓
283	Red-rumped Swallow	✓	✓
284	Streak-throated Swallow	✓	
285	Grey-headed Canary-Flycatcher	✓	✓
286	Cinereous Tit	✓	✓
287	Indian Yellow Tit	✓	✓
288	Velvet-fronted Nuthatch	✓	✓
289	Grey-headed Bulbul	✓	✓
290	Flame-throated Bulbul	✓	✓
291	Red-vented Bulbul	✓	✓
292	Red-whiskered Bulbul	✓	✓
293	White-browed Bulbul	✓	✓
294	Yellow-browed Bulbul	✓	✓
295	Square-tailed Bulbul	✓	✓
296	Tickell's Leaf Warbler		✓
297	Tytler's Leaf Warbler	✓	
298	Green Warbler	✓	✓
299	Greenish Warbler	✓	✓
300	Large-billed Leaf Warbler	✓	✓
301	Western Crowned Warbler	✓	✓
302	Thick-billed Warbler	✓	
303	Booted Warbler	✓	✓
304	Sykes's Warbler		✓
305	Paddyfield Warbler		✓
306	Blyth's Reed Warbler	✓	✓
307	Clamorous Reed Warbler	✓	✓
308	Broad-tailed Grassbird	✓	✓
309	Pallas's Grasshopper-Warbler	✓	✓
310	Bristled Grassbird		✓
311	Common Tailorbird	✓	✓
312	Grey-breasted Prinia	✓	✓
313	Jungle Prinia	✓	✓
314	Ashy Prinia	✓	✓
315	Plain Prinia	✓	✓
316	Zitting Cisticola	✓	✓
317	Golden-headed Cisticola		✓
318	Yellow-eyed Babbler	✓	✓
319	Hume's Whitethroat	✓	
320	Eastern Orphean Warbler	✓	

321	Oriental White-eye	✓	✓
322	Tawny-bellied Babbler	✓	✓
323	Dark-fronted Babbler	✓	✓
324	Indian Scimitar-Babbler	✓	✓
325	Puff-throated Babbler	✓	✓
326	Brown-cheeked Fulvetta	✓	✓
327	Large Grey Babbler	✓	✓
328	Rufous Babbler	✓	✓
329	Jungle Babbler	✓	✓
330	Yellow-billed Babbler	✓	✓
331	Wynaad Laughingthrush	✓	✓
332	Palani Laughingthrush	✓	✓
333	Asian Fairy-bluebird	✓	✓
334	Asian Brown Flycatcher	✓	✓
335	Brown-breasted Flycatcher	✓	✓
336	Indian Robin	✓	✓
337	Oriental Magpie-Robin	✓	✓
338	White-rumped Shama	✓	✓
339	Nilgiri Sholakili		✓
340	White-bellied Sholakili	✓	✓
341	White-bellied Blue Flycatcher	✓	✓
342	Blue-throated Flycatcher		✓
343	Tickell's Blue Flycatcher	✓	✓
344	Nilgiri Flycatcher	✓	✓
345	Verditer Flycatcher	✓	✓
346	Indian Blue Robin	✓	✓
347	Malabar Whistling-Thrush	✓	✓
348	Black-and-orange Flycatcher	✓	✓
349	Rusty-tailed Flycatcher	✓	✓
350	Taiga Flycatcher	✓	
351	Blue-capped Rock-Thrush	✓	✓
352	Blue Rock-Thrush	✓	
353	Pied Bushchat	✓	✓
354	Orange-headed Thrush	✓	✓
355	Desert Wheatear	✓	
356	Isabelline Wheatear	✓	
357	Indian Blackbird	✓	✓
358	Southern Hill Myna	✓	✓
359	Rosy Starling	✓	✓
360	Daurian Starling		✓
361	Brahminy Starling	✓	✓
362	Chestnut-tailed Starling	✓	✓
363	Malabar Starling	✓	✓
364	Common Myna	✓	✓
365	Jungle Myna	✓	✓
366	Jerdon's Leafbird	✓	✓
367	Golden-fronted Leafbird	✓	✓
368	Thick-billed Flowerpecker	✓	✓

369	Pale-billed Flowerpecker	✓	✓
370	Nilgiri Flowerpecker	✓	✓
371	Purple-rumped Sunbird	✓	✓
372	Crimson-backed Sunbird	✓	✓
373	Purple Sunbird	✓	✓
374	Long-billed Sunbird	✓	✓
375	Little Spiderhunter	✓	✓
376	Forest Wagtail	✓	✓
377	Grey Wagtail	✓	✓
378	Western Yellow Wagtail	✓	✓
379	Citrine Wagtail		✓
380	White-browed Wagtail	✓	✓
381	White Wagtail	✓	✓
382	Richard's Pipit	✓	✓
383	Paddyfield Pipit	✓	✓
384	Blyth's Pipit	✓	✓
385	Tawny Pipit	✓	✓
386	Nilgiri Pipit	✓	✓
387	Olive-backed Pipit	✓	✓
388	Common Rosefinch		✓
389	Black-headed Bunting	✓	✓
390	Red-headed Bunting	✓	
391	Grey-necked Bunting	✓	
392	House Sparrow	✓	✓
393	Chestnut-shouldered Petronia	✓	✓
394	Streaked Weaver	✓	✓
395	Baya Weaver	✓	✓
396	Red Avadavat	✓	✓
397	Indian Silverbill	✓	✓
398	White-rumped Munia	✓	✓
399	Black-throated Munia	✓	✓
400	Scaly-breasted Munia	✓	✓
401	Tricolored Munia	✓	✓
	Total	379	369

Annexure 29

Algal diversity in the HRML study area, Anjunadu valley, Kerala

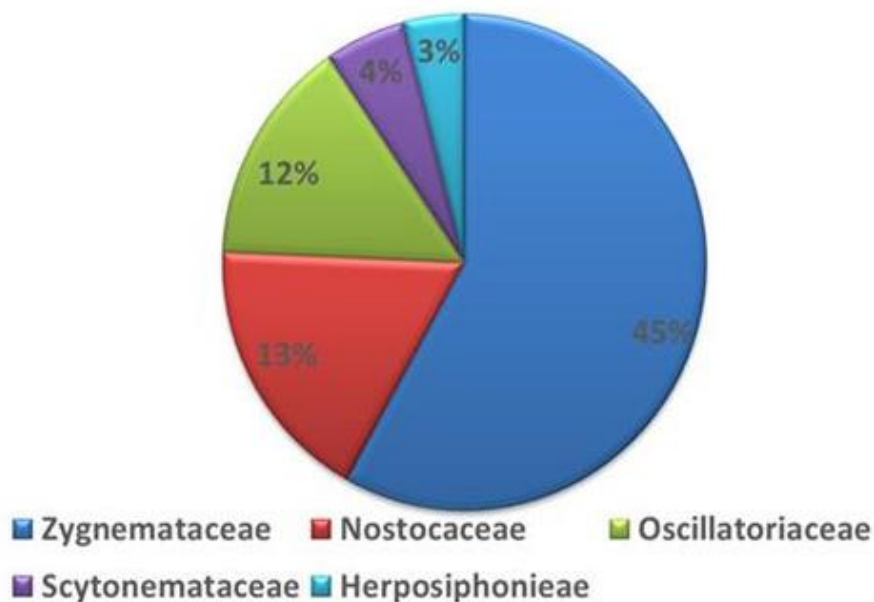
Sl.No.	Species name	Family
1	<i>Anabaena beckii</i> G.De Toni	Nostocaceae
2	<i>Anabaena iyengarii</i> Bharadwaja	Nostocaceae
3	<i>Anabaena oscillarioides</i> Bory ex Bornet & Flahault	Nostocaceae
4	<i>Anabaena torulosa</i> Lagerheim ex Bornet & Flahault	Nostocaceae
5	<i>Aphanothece stagnina</i> (Sprengel) A.Braun in Rabenhorst	Aphanothecaceae
6	<i>Aulosira fertilissima</i> S.L.Ghose	Fortieaceae

7	<i>Bambusina borreri</i> (Ralfs) Cleve	Desmidiaceae
8	<i>Calothrix fusca</i> Bornet & Flahault	Rivulariaceae
9	<i>Calothrix marchica</i> Lemmermann	Rivulariaceae
10	<i>Cephaleuros virescens</i> Kunze ex E.M.Fries	Trentepohliaceae
11	<i>Chaetomorpha antennina</i> (Bory) Kützing	Cladophoraceae
12	<i>Cladophora vagabunda</i> (Linnaeus)	Cladophoraceae
13	<i>Coleofasciculus chthonoplastes</i> (Thuret ex Gomont) M.Siegesmund, J.R.Johansen & T.Friedl	Coleofasciculaceae
14	<i>Cylindrospermum stagnale</i> Bornet & Flahault	Nostocaceae
15	<i>Geitlerinema earlei</i> (N.L.Gardner) Anagnostidis	Coleofasciculaceae
16	<i>Herposiphonia insidiosa</i> (Greville ex J.Agardh) Falkenberg	Herposiphonieae
17	<i>Herposiphonia secunda</i> (C.Agardh) Ambronn	Herposiphonieae
18	<i>Herposiphonia tenella</i> (C.Agardh) Ambronn	Herposiphonieae
19	<i>Kamptonema animale</i> (C.Agardh ex Gomont) Strunecký, Komárek & J.Smarda	Oscillatoriaceae
20	<i>Kamptonema chlorinum</i> (Kützing ex Gomont) Strunecký, Komárek & J.Smarda	Microcoleaceae
21	<i>Kamptonema jasorvense</i> (Vouk) Strunecký, Komárek & J.Smarda	Microcoleaceae
22	<i>Lynghya confervoides</i> C.Agardh ex Gomont	Oscillatoriaceae
23	<i>Microcoleus paludosus</i> Gomont	Microcoleaceae
24	<i>Microcystis smithii</i> Komárek & Anagnostidis	Microcystaceae
25	<i>Mougeotia adnata</i> M.O.P.Iyengar	Zygnemataceae
26	<i>Mougeotia cherokeana</i> Taft	Zygnemataceae
27	<i>Mougeotia parvula</i> Hassall	Zygnemataceae
28	<i>Mougeotia recurva</i> (Hassall) De Toni	Zygnemataceae
29	<i>Mougeotia tenuissima</i> (De Bary) Czurda	Zygnemataceae
30	<i>Nostoc amplissimum</i> Setchell	Nostocaceae
31	<i>Nostoc calcicola</i> Brébisson ex Bornet & Flahault	Nostocaceae
32	<i>Nostoc carneum</i> C.Agardh ex Bornet & Flahault	Nostocaceae
33	<i>Nostoc linckia</i> Bornet ex Bornet & Flahault	Nostocaceae
34	<i>Nostoc punctiforme</i> Hariot	Nostocaceae
35	<i>Nostoc sphaericum</i> Vaucher ex Bornet & Flahault	Nostocaceae
36	<i>Nostochopsis lobatus</i> H.C.Wood ex Bornet & Flahault	Nostochopsidaceae
37	<i>Oedogonium munnarensis</i> Panikkar & Ampili	Oedogoniaceae
38	<i>Oscillatoria major</i> Vaucher ex Forti	Oscillatoriaceae
39	<i>Oscillatoria ornata</i> Kützing ex Gomont	Oscillatoriaceae
40	<i>Oscillatoria princeps</i> Vaucher ex Gomont	Oscillatoriaceae
41	<i>Oscillatoria subbrevis</i> var. <i>major</i> (G.S.West) Umezaki & Watanabe	Oscillatoriaceae
42	<i>Oscillatoria tenuis</i> C.Agardh ex Gomont	Oscillatoriaceae
43	<i>Phormidesmis molle</i> (Gomont) Turicchia, Ventura, Komarkova	Oscillatoriaceae

	<i>& Kom- arek</i>	
44	<i>Phormidium acula</i> (Bruhl & Biswas) Anagnostidis & Komarek	Leptolyngbyaceae
45	<i>Phormidium lucidum</i> Kutzing ex Gomont	Oscillatoriaceae
46	<i>Phormidium stagninum</i> Anagnostidis	Oscillatoriaceae
47	<i>Scytonema guyanense</i> Bornet & Flahault	Oscillatoriaceae
48	<i>Scytonema mirabile</i> Bornet	Scytonemataceae
49	<i>Scytonema simplex</i> Bharadwaja	Scytonemataceae
50	<i>Scytonema tolypothrichoides</i> Kutzing ex Bornet & Flahault	Scytonemataceae
51	<i>Sirocladium himalayense</i> Santra & Adhya	Scytonemataceae
52	<i>Sirocladium kumaoense</i> Randhawa	Zygnemataceae
53	<i>Spirogyra ampilii</i> Ushadevi & Panikkar	Zygnemataceae
54	<i>Spirogyra baileyi</i> Schmidle	Zygnemataceae
55	<i>Spirogyra bullata</i> C.-C.Jao	Zygnemataceae
56	<i>Spirogyra crenulata</i> R.N.Singh	Zygnemataceae
57	<i>Spirogyra dictyospora</i> C.-C.Jao	Zygnemataceae
58	<i>Spirogyra flavescens</i> (Hassall) Kützing	Zygnemataceae
59	<i>Spirogyra goetzei</i> Schmidle	Zygnemataceae
60	<i>Spirogyra hymerae</i> Britton & B.H.Smith	Zygnemataceae
61	<i>Spirogyra jaoensis</i> Randhawa	Zygnemataceae
62	<i>Spirogyra jogensis</i> var. <i>minor</i> Iyengar	Zygnemataceae
63	<i>Spirogyra marchica</i> H.Krieger	Zygnemataceae
64	<i>Spirogyra minutifossa</i> C.-C.Jao	Zygnemataceae
65	<i>Spirogyra rhizobrachilis</i> C.-C.Jao	Zygnemataceae
66	<i>Spirogyra rhizopus</i> C.-C.Jao	Zygnemataceae
67	<i>Spirogyra tenuissima</i> (Hassall) Kützing	Zygnemataceae
68	<i>Spirulina labyrinthiformis</i> Gomont	Spirulinaceae
69	<i>Temnogyra punctiformis</i> (Transeau) Yamagishi	Zygnemataceae
70	<i>Tetraedron gracile</i> (Reinsch) Hansgirg	Hydrodictyaceae
71	<i>Tolypothrix magna</i> Bharadwaja	Tolypothrichaceae
72	<i>Trichormus fertilissimus</i> (C.B.Rao) Komárek & Anagnostidis	Nostocaceae
73	<i>Trichormus variabilis</i> (Kützing ex Bornet & Flahault) Komárek & Anagnostidis	Nostocaceae
74	<i>Westiellopsis prolifica</i> Janet	Hapalosiphonaceae
75	<i>Zygnema atrocoeruleum</i> West & G.S.West	Zygnemataceae
76	<i>Zygnema collinsianum</i> Transeau	Zygnemataceae
77	<i>Zygnema cruciatum</i> (Vaucher) C.Agardh	Zygnemataceae
78	<i>Zygnema cyanosporum</i> Cleve	Zygnemataceae
79	<i>Zygnema exuvielliforme</i> (C.-C.Jao) Krieger	Zygnemataceae
80	<i>Zygnema gedeanum</i> Czurda	Zygnemataceae
81	<i>Zygnema guineense</i> (Gauthier-Lièvre) Stancheva, J.D.Hall, McCourt & Sheath	Zygnemataceae
82	<i>Zygnema heydrichii</i> Schmidle	Zygnemataceae

83	<i>Zygnema himalayense</i> Randhawa	Zygnemataceae
84	<i>Zygnema quadrangulatum</i> C.-C.Jao	Zygnemataceae
85	<i>Zygnema schwabei</i> Krieger	Zygnemataceae
86	<i>Zygnema spontaneum</i> Nordstedt	Zygnemataceae
87	<i>Zygnema talguppense</i> (M.O.P.Iyengar) Krieger	Zygnemataceae
88	<i>Zygnema vaginatum</i> Klebs	Zygnemataceae
89	<i>Zygogonium arjunanii</i> Usha Devi & Panikkar.	Zygnemataceae
90	<i>Zygogonium capense</i> (Hodgetts) Transeau	Zygnemataceae
91	<i>Zygogonium ericetorum</i> Kützing	Zygnemataceae
92	<i>Zygogonium jayaii</i> Ushadevi et Panikkar	Zygnemataceae
93	<i>Zygogonium sakunthalanii</i> Ushadevi et Panikkar	Zygnemataceae
94	<i>Zygogonium sinense</i> C.-C.Jao	Zygnemataceae
95	<i>Zygogonium wilsonii</i> Ushadevi et Panikkar	Zygnemataceae

Major families of Algal species



Checklist of Butterflies recorded in Thattekkad Bird Sanctuary

Sl. No	Common name	Scientific name	Family	Endemism	IUCN	WPA
1	African Mallow/ Marbled Skipper	<i>Gomalia elma</i>	Hesperiidae		LC	
2	African straight swift	<i>Parnara bada</i>	Hesperiidae		LC	
3	Angled Caster	<i>Ariadne ariadne</i>	Nymphalidae		LC	
4	Angled Flat	<i>Tapena twaitthesi</i>	Hesperiidae		LC	
5	Angled Pierrot	<i>Caleta caleta</i>	Lycaenidae		LC	
6	Apefly	<i>Spalgis epius</i>	Lycaenidae		LC	
7	Bamboo Treebrown	<i>Lethe europa</i>	Nymphalidae		LC	
8	Banded Blue Pierrot	<i>Discolampa ethion</i>	Lycaenidae		LC	
9	Baronet	<i>Euthalia nais</i>	Nymphalidae		LC	
10	Beavan's swift	<i>Borbo bevani</i>	Hesperiidae		LC	
11	Bicolour ace	<i>Sovia hyrtacus</i>	Hesperiidae	WG	LC	
12	Black prince	<i>Rohana parisatis</i>	Nymphalidae		LC	
13	Black rajah	<i>Charaxes solon</i>	Nymphalidae		LC	
14	Black swift	<i>Caltois kumara</i>	Hesperiidae		LC	
15	Blackvein sergeant	<i>Athyma ranga</i>	Nymphalidae		LC	Sch. II
16	Blue Admiral	<i>Kaniska canace</i>	Nymphalidae		LC	
17	Blue Mormon	<i>Papilio polymnestor</i>	Papilionidae		LC	
18	Blue nawab	<i>Polyura schreiber</i>	Nymphalidae		LC	
19	Blue Pansy	<i>Junonia orithiya</i>	Nymphalidae		LC	
20	Blue Tiger	<i>Tirumala limniace</i>	Nymphalidae		LC	
21	Brown Awl	<i>Badamia exclamatoris</i>	Hesperiidae		LC	
22	brush flitter	<i>Hyarotis microstictum</i>	Hesperiidae		LC	
23	Bush hopper	<i>Ampitta dioscorides</i>	Hesperiidae		LC	
24	chestnut angle	<i>Odontoptilum angulata</i>	Hesperiidae		LC	
25	Chestnut Bob	<i>Lambrix salsala</i>	Hesperiidae		LC	
26	chestnut-streaked sailer	<i>Neptis jumbah</i>	Nymphalidae		LC	
27	Chocolate Albatross	<i>Appias lyncida</i>	Pieridae		LC	
28	Chocolate Pansy	<i>Junonia iphita</i>	Nymphalidae		LC	
29	clipper	<i>Parthenos syloia</i>	Nymphalidae		LC	Sch. II
30	Club Beak	<i>Libythea myrrha</i>	Nymphalidae		LC	
31	Commander	<i>Limenitis procris</i>	Nymphalidae		LC	
32	Common Acacia Blue	<i>Surendra quercetorum</i>	Lycaenidae		LC	
33	Common Albatross	<i>Appias albina</i>	Pieridae		LC	
34	common awl	<i>Hasora badra</i>	Hesperiidae		LC	
35	Common Banded Awl	<i>Hasora chromus</i>	Hesperiidae		LC	
36	Common Banded Demon	<i>Notocrypta paralysos</i>	Hesperiidae		LC	
37	Common Banded Peacock	<i>Papilio crino</i>	Papilionidae		LC	
38	Common Baron	<i>Euthalia aconthea</i>	Nymphalidae		LC	

39	Common Beak	<i>Libythea lepita</i>	Nymphalidae		LC	
40	Common Bluebottle	<i>Graphium sarpedon</i>	Papilionidae		LC	
41	Common Bushbrown	<i>Mycalesis perseus</i>	Nymphalidae		LC	
42	Common Castor	<i>Aridne merione</i>	Nymphalidae		LC	
43	Common Cerulean	<i>Jamides celeno</i>	Lycaenidae		LC	
44	Common Emigrant	<i>Catopsilia pomona</i>	Pieridae		LC	
45	Common Evening Brown	<i>Melanitis leda</i>	Nymphalidae		LC	
46	Common Five-ring	<i>Ypthima baldus</i>	Nymphalidae		LC	
47	Common Four-ring	<i>Ypthima huebneri</i>	Nymphalidae		LC	
48	common grass dart	<i>Taractrocera maevius</i>	Hesperiidae		LC	
49	Common Grass Yellow	<i>Eurema hecabe</i>	Pieridae		LC	
50	Common Guava Blue	<i>Virachola isocrates</i>	Lycaenidae		LC	
51	Common Gull	<i>Cepora nerissa</i>	Pieridae		LC	
52	Common Hedge Blue	<i>Acytolepis puspa</i>	Lycaenidae		LC	
53	Common Indian Crow	<i>Euploea core</i>	Nymphalidae		LC	
54	Common Jay	<i>Graphium doson</i>	Papilionidae		LC	
55	Common jezebel	<i>Delias eucharis</i>	Pieridae		LC	
56	Common Lascar	<i>Pantoporia hordonia</i>	Nymphalidae		LC	
57	Common Leopard	<i>Phalanta phalantha</i>	Nymphalidae		LC	
58	Common Map	<i>Cyrestis thyodamas</i>	Nymphalidae		LC	
59	Common mime	<i>Papilio clytia</i>	Papilionidae		LC	
60	Common Mormon	<i>Papilio polytes</i>	Papilionidae		LC	
61	Common Nawab	<i>Polyura athamas</i>	Nymphalidae		LC	
62	Common Palmfly	<i>Elymnias hypermnestra</i>	Nymphalidae		LC	
63	Common Pierrot	<i>Castalius rosimon</i>	Lycaenidae		LC	
64	common redeye	<i>Matapa aria</i>	Hesperiidae		LC	
65	Common Rose	<i>Pachliopta aristolochiae</i>	Papilionidae		LC	
66	Common Sailor	<i>Neptis hylas</i>	Nymphalidae		LC	
67	Common Sergeant	<i>Athyma perius</i>	Nymphalidae		LC	
68	Common Silver line	<i>Spindasis vulcanus</i>	Lycaenidae		LC	
69	common small flat	<i>Sarangesa dasahara</i>	Hesperiidae		LC	
70	Common Snow Flat	<i>Tagiades japetus</i>	Hesperiidae		LC	
71	Common Spotted Flat	<i>Celaenorrhinus leucocera</i>	Hesperiidae		LC	
72	common three-ring	<i>Ypthima asterope</i>	Nymphalidae		LC	
73	Common Treebrown	<i>Lethe rohria</i>	Nymphalidae		LC	
74	Common Wanderer	<i>Pareronia valeria</i>	Nymphalidae		LC	
75	Common Yellow- breasted Flat	<i>Gerosis bhagava</i>	Hesperiidae		LC	
76	Crimson Rose	<i>Pachliopta hector</i>	Papilionidae		LC	
77	Crimson Tip	<i>Colotis danae</i>	Pieridae		LC	
78	cruisers	<i>Vindula erota</i>	Nymphalidae		LC	
79	Danaid Eggfly	<i>Hypolimnas misippus</i>	Nymphalidae		LC	
80	Dark Banded Bushbrown	<i>Mycalesis mineus</i>	Nymphalidae		LC	
81	Dark Blue Tiger	<i>Tirumala septentrionis</i>	Nymphalidae		LC	

82	Dark Cerulean	<i>Jamides bochus</i>	Lycaenidae		LC	
83	Dark evening brown	<i>Melanitis phedima</i>	Nymphalidae		LC	
84	Dark Grass Blue	<i>Zizeeria karsandra</i>	Lycaenidae		LC	
85	Dark Palm-Dart	<i>Telicota ancilla</i>	Hesperiidae		LC	
86	Dark Pierrot	<i>Tarucus ananda</i>	Lycaenidae		LC	
87	dingy scrub-hopper	<i>Aeromachus dubius</i>	Hesperiidae	WG	LC	
88	Dingy Swift	<i>Gegenes nostrodamus</i>	Hesperiidae		LC	
89	dusky partwing or coon	<i>Psolos fuligo</i>	Hesperiidae		LC	
90	Evershed's ace	<i>Thoressa evershedii</i>	Hesperiidae	WG	LC	
91	Five-bar swordtail	<i>Graphium antiphates</i>	Papilionidae		LC	
92	Forget-Me-Not	<i>Catochrysops strabo</i>	Lycaenidae		LC	
93	Fulvous Pied Flat	<i>Pseudocoladenia dan</i>	Hesperiidae		LC	
94	gaudy baron	<i>Euthalia lubentina</i>	Nymphalidae		LC	
95	giant redeye	<i>Gangara thyrasis</i>	Hesperiidae		LC	
96	Glad Eye Bushbrown	<i>Mycalesis patnia</i>	Nymphalidae		LC	
97	Glassy Tiger	<i>Parantica aglea</i>	Nymphalidae		LC	
98	Golden Angle	<i>Caprona ransonnetti</i>	Hesperiidae		LC	
99	Gram Blue	<i>Euchrysops cnejus</i>	Lycaenidae		LC	
100	Grass Demon	<i>Udaspes folus</i>	Hesperiidae		LC	
101	Grass Jewel	<i>Freyeria trochylus</i>	Lycaenidae		LC	
102	Great Eggfly	<i>Hypolimnas bolina</i>	Nymphalidae		LC	
103	Great Evening Brown	<i>Melanitis zitenius</i>	Nymphalidae		LC	
104	Great orange tip	<i>Hebomoia glaucippe</i>	Pieridae		LC	
105	Grey Count	<i>Tanaecia lepidea</i>	Nymphalidae		LC	
106	Grey Pansy	<i>Junonia atlites</i>	Nymphalidae		LC	
107	Hedge Hopper	<i>Baracus vittatus</i>	Hesperiidae		LC	
108	Immaculate/Large/S uffused Snow Flat	<i>Tagiades gana</i>	Hesperiidae		LC	
109	Indian ace	<i>Halpe homolea</i>	Hesperiidae		LC	Sch. II
110	Indian awlking	<i>Choaspes benjaminii</i>	Hesperiidae		LC	
111	Indian Cupid	<i>Chilades pandava</i>	Lycaenidae		LC	
112	Indian Fritillary	<i>Argynnis hyperbius</i>	Nymphalidae		LC	
113	Indian Grizzled / Indian Skipper	<i>Spialia galba</i>	Hesperiidae		LC	
114	Indian Palm Bob	<i>Suastus gremius</i>	Hesperiidae		LC	
115	Indian Red Admiral	<i>Vanessa indica</i>	Nymphalidae		LC	
116	Indian Red Flash	<i>Rapala iarbus</i>	Lycaenidae		LC	
117	Indian Sunbeam	<i>Curetis thetis</i>	Lycaenidae		LC	
118	Large oakblue	<i>Arhopala amantes</i>	Lycaenidae		LC	
119	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae		LC	
120	Lesser Albatross	<i>Appias wardi</i>	Pieridae	WG	LC	
121	Lesser Grass Blue	<i>Zizina otis</i>	Lycaenidae		LC	
122	lesser gull	<i>Cepora nadina</i>	Pieridae		LC	
123	Lime Butterfly	<i>Papilio demoleus</i>	Papilionidae		LC	
124	Limeblue	<i>Chilades lajus</i>	Lycaenidae		LC	
125	Long-brand bushbrown	<i>Mycalesis visala</i>	Nymphalidae		LC	

126	Maculate Lancer	<i>Salanoemia sala</i>	Hesperiidae		LC	
127	Madras Ace	<i>Thoressa honorei</i>	Hesperiidae	WG	LC	Sch. IV
128	Malabar banded peacock	<i>Papilio buddha</i>	Papilionidae	WG	LC	
129	Malabar banded swallowtail	<i>Papilio liomedon</i>	Papilionidae	WG	LC	Sch. I
130	Malabar raven	<i>Papilio dravidarum</i>	Papilionidae	WG		
131	Malabar rose	<i>Pachliopta pandiyana</i>	Papilionidae	WG	LC	
132	Malabar Spotted Flat	<i>Celaenorrhinus ambareesa</i>	Hesperiidae		LC	
133	Malabar tree nymph	<i>Idea malabarica</i>	Nymphalidae		LC	
134	Malayan	<i>Megisba malaya</i>	Lycaenidae		LC	
135	Monkey Puzzle	<i>Rathinda amor</i>	Lycaenidae		LC	
136	Moore's ace	<i>Halpe porus</i>	Hesperiidae		LC	
137	Mottled Emigrant	<i>Catopsilia pyranthe</i>	Pieridae		LC	
138	Nigger	<i>Orsotriaena medus</i>	Nymphalidae		LC	
139	one-spot grass yellow	<i>Eurema andersoni</i>	Pieridae		LC	
140	Painted Lady	<i>Vanessa cardui</i>	Nymphalidae		LC	
141	Painted Sawtooth	<i>Prioneris sita</i>	Pieridae		LC	
142	Palani dart	<i>Potanthus palnia</i>	Hesperiidae		LC	
143	Pale Grass Blue	<i>Pseudozizeeria maha</i>	Lycaenidae		LC	
144	Pale Palm-Dart	<i>Telicota colon</i>	Hesperiidae		LC	
145	palm-redeye	<i>Erionota torus</i>	Hesperiidae		LC	
146	Paris Peacock	<i>Papilio paris</i>	Papilionidae		LC	
147	Pea Blue	<i>Lampides boeticus</i>	Lycaenidae		LC	
148	Peacock pansy	<i>Junonia almana</i>	Nymphalidae		LC	
149	Pelopidas subochracea	<i>Large Branded Swift</i>	Hesperiidae		LC	
150	Pioneer or Caper White	<i>Belenois aurota</i>	Pieridae		LC	
151	plain hedge blue	<i>Celastrina lavendularis</i>	Lycaenidae		LC	
152	Plain Orange Tip	<i>Colotis eucharis</i>	Pieridae		LC	
153	Plain Puffin	<i>Appias indra</i>	Pieridae		LC	
154	Plain Tiger	<i>Danaus chrysippus</i>	Nymphalidae		LC	
155	Plains Cupid	<i>Chilades pandava</i>	Lycaenidae		LC	
156	Plum Judy	<i>Abisara echerius</i>	Lycaenidae		LC	
157	Psyche	<i>Leptosia nina</i>	Pieridae		LC	
158	pygmy scrub-hopper	<i>Aeromachus pygmaeus</i>	Hesperiidae		LC	
159	Quaker	<i>Neopithecops zalmora</i>	Lycaenidae		LC	
160	Red Helen	<i>Papilio helenus</i>	Papilionidae		LC	
161	Red spot	<i>Zesius chrysomallus</i>	Lycaenidae		LC	
162	red-spot duke	<i>Dophla evelina</i>	Nymphalidae		LC	
163	Restricted Demon	<i>Notocrypta curvifascia</i>	Hesperiidae		LC	
164	Rice Swift	<i>Borbo cinnara</i>	Hesperiidae		LC	
165	Rustic	<i>Cupha erymanthis</i>	Nymphalidae		LC	
166	Sitala ace	<i>Thoressa sitala</i>	Hesperiidae	WG	LC	
167	Slate Flash	<i>Rapala manea</i>	Lycaenidae		LC	
168	Small cupid	<i>Chilades parrhasius</i>	Lycaenidae		LC	

169	Small Grass Yellow	<i>Eurema brigitta</i>	Pieridae		LC	
170	Small Orange Tip	<i>Colotis etrida</i>	Pieridae		LC	
171	small palm bob	<i>Suastus minuta</i>	Hesperiidae		LC	
172	Southern Bird wing	<i>Troides minos</i>	Papilionidae	WG	LC	
173	southern blue oakleaf	<i>Kallima horsfieldii</i>	Nymphalidae	WG	LC	Sch. II
174	Southern Duffer	<i>Discophora lepida</i>	Nymphalidae		EN	
175	Spot Swordtail	<i>Graphium nomius</i>	Papilionidae		LC	
176	Spotless Grass Yellow	<i>Spotless Grass Yellow</i>	Pieridae		LC	
177	spotted angle	<i>Caprona agama</i>	Hesperiidae		LC	
178	spotted small flat	<i>Sarangesa purendra pandra</i>	Hesperiidae		LC	
179	Stripped or Common Tiger	<i>Danaus genutia</i>	Nymphalidae		LC	
180	Tailed Jay	<i>Graphium agamemnon</i>	Papilionidae		LC	
181	Tamil bushbrown	<i>Mycalesis subdita</i>	Nymphalidae		LC	
182	Tamil Cats eye	<i>Zipaetis saitis</i>	Nymphalidae	WG	LC	
183	Tamil Grass Dart	<i>Taractrocera ceramas</i>	Hesperiidae		LC	
184	Tamil Lacewing	<i>Cethosia nietneri</i>	Nymphalidae		LC	
185	Tamil Spotted Flat	<i>Celaenorrhinus ruficornis</i>	Hesperiidae		LC	
186	Tamil treebrown	<i>Lethe drypetis</i>	Nymphalidae		LC	
187	Tamil Yeoman	<i>Cirrochroa thais</i>	Nymphalidae		LC	
188	Tawny Coster	<i>Acraea terpsicore</i>	Nymphalidae		LC	
189	Tawny Rajah	<i>Charaxes bernardus</i>	Nymphalidae		LC	
190	Three Spot Grass Yellow	<i>Eurema blanda</i>	Pieridae		LC	
191	Tiny Grass Blue	<i>Zizula hylax</i>	Lycaenidae		LC	
192	Travancore Evening Brown	<i>Parantirrhoea marshalli</i>	Nymphalidae	WG	LC	
193	tree flitter	<i>Hyarotis adrastus</i>	Hesperiidae		LC	
194	Tricolored Pied Flat	<i>Coladenia indrani</i>	Hesperiidae		LC	
195	Unbranded Ace	<i>Thoressa astigmata</i>	Hesperiidae	WG	LC	
196	Vindhyan Bob	<i>Arnetta vindhiana</i>	Hesperiidae		LC	
197	Water Snow Flat	<i>Tagiades litigiosa</i>	Hesperiidae		LC	
198	Wax Dart	<i>Cupitha purreea</i>	Hesperiidae		LC	
199	Western Centaur Oak Blue	<i>Arhopala pseudocentaurus</i>	Lycaenidae		LC	
200	White Banded Awl	<i>Hasora taminatus</i>	Hesperiidae		LC	
201	White bar Bushbrown	<i>Mycalesis anaxias</i>	Nymphalidae		LC	
202	White or Ceylon Four Ring	<i>Ypthima ceylonica</i>	Nymphalidae		LC	
203	White Orange Tip	<i>Ixias marianne</i>	Pieridae		LC	
204	Yam butterfly	<i>Loxura atymnus</i>	Lycaenidae		LC	
205	Yellow Orange Tip	<i>Ixias pyrene</i>	Pieridae		LC	
206	Yellow Pansy	<i>Junonia hierta</i>	Nymphalidae		LC	
207	yellow-base flitter	<i>Quedara basiflava</i>	Hesperiidae	WG	LC	
208	Zebra Blue	<i>Tarucus plinius</i>	Lycaenidae		LC	

Lichen diversity in the HRML study area, Anjunadu valley, Kerala

Sl. No.	Species	Family	Habit	Habitat	Distribution
1	<i>Baeomyces soridiifer</i> Nyl.	Baeomycetaceae	Fruticose	Saxicolous	Chinnamala; Anaimudi, Munnar
2	<i>Brigantiaea fuscolutea</i> (Dicks.) R. Sant.	Lopadiaceae	Microlichen	Crustose	Peerumade
3	<i>Calopadia fusca</i> (Müll. Arg.) Vězda	Pilocarpaceae	Microlichen	Crustose (Epi- phyllous)	Thekkady forest
4	<i>Canoparmelia texana</i> (Tuck.) Elix & Hale	Parmeliaceae	Foliose	Corticolous	Eravikulam National Park, Munnar; Mannavanshola, Marayoor
5	<i>Cladonia carneola</i> (Fr.) Fr.	Cladoniaceae		Terricolous	Anaimudi, Munnar
6	<i>Cladonia ceratophylla</i> (Sw.) Spreng.	Cladoniaceae		Corticolous	Kattapara shola
7	<i>Cladonia coniocraea</i> (Flörke) Spreng.	Cladoniaceae		Corticolous	Pettimudi, Rajamala, Munnar
8	<i>Cladonia decorticate</i> (Flörke) Spreng.	Cladoniaceae		Corticolous	Mannavanshola, Marayoor
9	<i>Cladonia fimbriata</i> (L.) Fr.	Cladoniaceae		Saxicolous	Mannavanshola, Marayoor
10	<i>Cladonia foliacea</i> (Huds.) Willd.	Cladoniaceae		Saxicolous	Uppupara, Periyar Tiger Reserve
11	<i>Cladonia parasitica</i> (Hofm.) Hoffm.	Cladoniaceae		Saxicolous/ Corticolous	Kallar Estate; Silent Valley Estate, Munnar
12	<i>Cladonia ramulosa</i> (With.) J.R. Laundon	Cladoniaceae		Terricolous/ Corticolous/ Saxicolous	Mannavanshola, Marayoor; Rajamala; Anaimudi, Munnar
13	<i>Cladonia scabriuscula</i> (Delise) Nyl.	Cladoniaceae		Terricolous/ Corticolous/ Saxicolous	Eravikulam National Park; Silent Valley Estate, Munnar; Mannavanshola, Marayoor
14	<i>Coccocarpia erythroxyli</i> (Spreng.) Swinscow & Krog	Coccocarpiaceae		Corticolous/ Saxicolous	Mannavanshola, Marayoor; Uppupara, Periyar Tiger Reserve; Kattapara shola
15	<i>Coccocarpia palmicola</i> (Spreng.) Arv. & D.J. Galloway	Coccocarpiaceae		Corticolous/ Saxicolous	Chinnamala; Anaimudi, Munnar; Uppupara, Periyar Tiger Reserve; Kattapara shola

16	<i>Coccocarppia pellita</i> (Ach.) Müll. Arg.	Coccocarpiaceae		Corticolous / Sax-icolous	Eravikulam National Park, Munnar; Uppuppara, Periyar Tiger Reserve
17	<i>Collema flaccidum</i> (Ach.) Ach.	Collemataceae	Foliose	Corticolous	Kallar Estate, Munnar
18	<i>Collema subflaccidum</i> Degel.	Collemataceae	Foliose	Corticolous	Kallar Estate, Munnar
19	<i>Crespoa carneopruinata</i> (Zahlbr.) Lendem. & B.P. Hodk.	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
20	<i>Dermatocarpon velleereum</i> Zschacke	Verrucariaceae	Foliose	Saxicolous	Rajamala, Munnar
21	<i>Eumitria baileyi</i> Stirr.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
22	<i>Eumitria pectinata</i> (Taylor) Atticus	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
23	<i>Fibrillithecis halei</i> (Tuck. & Mont.) Mangold	Graphidaceae	Microlichen	-	Devikulam; Cardamom hills; Kumily
24	<i>Heterodermia comosa</i> (Eschr.) Folhmann & Radón	Physciaceae	Foliose	Corticolous	Mannavanshola, Marayoor
25	<i>Heterodermia dactyliza</i> (Nyl.) Swinnow & Krog	Physciaceae	Foliose	Corticolous	Eravikulam National Park; Silent Valley Es- tate; Anaimudi slope, Munnar
26	<i>Heterodermia diademata</i> (Taylor) D.D. Awasthi	Physciaceae	Foliose	Corticolous	Eravikulam National Park, Munnar
27	<i>Heterodermia dissecta</i> (Kurok.) D.D. Awasthi	Physciaceae	Foliose	Corticolous / Sax-icolous	Uppuppara, Periyar Tiger Reserve; Kattapara shola
28	<i>Heterodermia flabelata</i> (Fée) D.D. Awasthi	Physciaceae	Foliose	Corticolous	Uppuppara, Periyar Tiger Reserve; Kattapara shola
29	<i>Heterodermia incana</i> (Stirt.) D.D. Awasthi	Physciaceae	Foliose	Corticolous	Pettimudi; Silent Valley Estate, Munnar; Kat- tapara shola
30	<i>Heterodermia kojana</i> (Kurok.) Elix	Physciaceae	Foliose	Corticolous / Sax- icolous	Silent Valley Estate, Munnar
31	<i>Heterodermia obscurata</i> (Nyl.) Trevis	Physciaceae	Foliose	Corticolous / Sax- icolous	Eravikulam National Park; Silent Valley Es- tate, Munnar; Mannavanshola, Marayoor

32	<i>Heterodermia pellucidata</i> (D.D. Awasthi) D.D. Awasthi	Physciaceae	Foliose	Corticolous	Eravikulam National Park; Pettimudi, Munnar; Kattapara shola; Mannavanshola, Marayoor
33	<i>Heterodermia podocarpa</i> (Bél.) D.D. Awasthi	Physciaceae	Foliose	Corticolous	Kattapara shola
34	<i>Heterodermia pseudospeciosa</i> (Kurok.) W.L. Culb.	Physciaceae	Foliose	Corticolous/ Sax-icolous	Eravikulam National Park; Kattapara shola
35	<i>Heterodermia speciosa</i> (Wulfen) Trevis.	Physciaceae	Foliose	Corticolous	Eravikulam National Park; Silent Valley Estate, Munnar
36	<i>Hyperphyscia aglutinata</i> (Florke) Mayrn. & Poelt	Physciaceae	Foliose	Corticolous	Mannavanshola, Marayoor
37	<i>Hyperphyscia granulata</i> (Poelt) Moberg	Physciaceae	Foliose	Corticolous	Mannavanshola, Marayoor
38	<i>Hyperphyscia syncolla</i> (Tuck. ex Nyl.) Kalb	Physciaceae	Foliose	Corticolous	Silent Valley Estate, Munnar
39	<i>Hypogymnia pseudobitteriana</i> (D.D.) Awasthi	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
40	<i>Hypogymnia vittata</i> (Ach.) Parrique	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
41	<i>Hypotrachyna adducta</i> (Nyl.) Hale	Parmeliaceae	Foliose	Corticolous	Silent Valley Estate, Munnar
42	<i>Hypotrachyna brevirhiza</i> (Kurok.) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor; Kattapara shola
43	<i>Hypotrachyna cirrhata</i> (Fr.) Divakar, A. Crespo, Sipman, Elix & Lumbsch	Parmeliaceae	Foliose	Corticolous	Eravikulam National Park, Munnar; Man-navanshola, Marayoor; Rajamala; Pettimudi; Anaimudi slope, Munnar
44	<i>Hypotrachyna crenata</i> (Kurok.) Hale	Parmeliaceae	Foliose	Corticolous/ Sax-icolous	Kattapara shola
45	<i>Hypotrachyna dactylifera</i> (Vain.) Hale	Parmeliaceae	Foliose	Corticolous	Pettimudi, Munnaar
46	<i>Hypotrachyna degeii</i> (Hale) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor; Kattapara shola
47	<i>Hypotrachyna endochlora</i> (Leight.) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor

48	<i>Hypotrachyna expallida</i> (Kurok.) Ditakar, A. Crespo, Sipman, Elix & Lumbsch	Parmeliaceae	Foliose	Corticolous	Pettimudi, Munnar; Mannavanshola, Marayoor; Kattapara shola
49	<i>Hypotrachyna exsecta</i> (Taylor) Hale	Parmeliaceae	Foliose	Corticolous	Pettimudi; Silent Valley Estate, Munnar; Mannavanshola, Marayoor
50	<i>Hypotrachyna formosana</i> (Zahlbr.) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor; Eravikulam National Park, Munnar
51	<i>Hypotrachyna infirma</i> (Kurok.) Hale	Parmeliaceae	Foliose	Corticolous	Kallar Estate, Munnar; Kattapara shola; Uppuppara, Periyar Tiger Reserve
52	<i>Hypotrachyna masonhalei</i> Pat. & Prabhhu	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
53	<i>Hypotrachyna microlobulata</i> (D.D. Awasthi) Ditakar, A. Crespo, Sipman, Elix & Lumbsch	Parmeliaceae	Foliose	Corticolous	Kattapara shola
54	<i>Hypotrachyna nepalensis</i> (Taylor) Ditakar, A. Crespo, Sipman, Elix & Lumbsch	Parmeliaceae	Foliose	Corticolous / Terricolous	Eravikulam National Park, Pettimudi, Silent Valley Estate Munnar; Mannavanshola, Marayoor
55	<i>Hypotrachyna orientalis</i> (Hale) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
56	<i>Hypotrachyna revoluta</i> (Floerke) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
57	<i>Hypotrachyna vexans</i> (Zahlbr. ex W.L. Culb. & C.F.) Ditakar, A. Crespo, Sipman, Elix & Lumbsch	Parmeliaceae	Foliose	Corticolous / Saxicolous	Pettimudi, Silent Valley Estate, Munnar; Uppuppara, Periyar Tiger Reserve
58	<i>Lathagrium auriforme</i> (With.) Ohtlora, P.M. Jørg. & Wedin	Collemaataceae	Foliose	Open moist places	Mannavanshola, Marayoor
59	<i>Lecanora indica</i> Zahlbr.	Lecanoraceae	Placidoid	Saxicolous	Chockanad Estate, Munnar
60	<i>Lepraria pseudorbuscula</i> (Asahina) Lendemèr & B.P. Hodk.	Leprocaulaceae	-	Terricolous / Corticolous	Mannavanshola, Marayoor; Eravikulam, National Park, Munnar
61	<i>Leptogium austroamericanum</i> (Malme) C.W. Dodge	Collemaataceae	Foliose	Corticolous	Eravikulam National Park, Munnar

62	<i>Leptogium azureum</i> (Sw.) Mont.	Collemtaceae	Foliose	Corticolous	Uppupara, Periyar Tiger Reserve
63	<i>Leptogium brebissonii</i> Mont.	Collemtaceae	Foliose	Corticolous	Silent Valley Estate; Eravikulam National Park, Munnar
64	<i>Leptogium burgessii</i> (L.) Mont.	Collemtaceae	Foliose	Corticolous	Mannavanshola, Marayoor
65	<i>Leptogium chloromelum</i> (Ach.) Nyl.	Collemtaceae	Foliose	Corticolous	Eravikulam National Park, Munnar
66	<i>Leptogium corticola</i> (Taylor) Tuck.	Collemtaceae	Foliose	Corticolous	Uppupara, Periyar Tiger Reserve
67	<i>Leptogium cyanescens</i> (Ach.) Körb.	Collemtaceae	Foliose	Corticolous	Mannavanshola, Marayoor; Lockart, Munnar
68	<i>Leptogium marginellum</i> (Sw.) Gray	Collemtaceae	Foliose	Corticolous	Lockart, Munnar
69	<i>Leptogium moluccanum</i> (Pers.) Vain.	Collemtaceae	Foliose	Corticolous	Uppupara, Periyar Tiger Reserve
70	<i>Leptogium phyllocarpum</i> var. <i>phyllocarpum</i> (Pers.) Mont.	Collemtaceae	Foliose	Corticolous/ Sax-icolous	Uppupara, Periyar Tiger Reserve
71	<i>Leptogium pichneum</i> (Ach.) Nyl.	Collemtaceae	Foliose	Corticolous	Kattapara shola
72	<i>Leptogium tenuissimum</i> (Discson) Korber.	Collemtaceae	Foliose	Corticolous	Rajamala
73	<i>Leptogium uloaceum</i> (Pers.) Vain.	Collemtaceae	Foliose	Corticolous	Silent Valley Estate, Munnar
74	<i>Letrouitia vulpine</i> (Tuck.) Haf. & Bellem.	Letrouitiaceae	Microlichen	Crustose	Anamalai hills; Thekkady forest
75	<i>Leucodermia boryi</i> (Fée) Kalb	Physciaceae	Foliose	Corticolous/ Saxicolous/ Ter-ricolous	Eravikulam National Park, Munnar; Manna- vanshola, Marayoor
76	<i>Leucodermia leucomelos</i> (L.) Kalb	Physciaceae	Foliose	Corticolous	Eravikulam National Park, Munnar; Manna- vanshola, Marayoor
77	<i>Lobaria retigera</i> var. <i>retigera</i> (Bory) Trevis	Lobariaceae	Foliose	Corticolous	Chockanad Estate; Anaimudi, Munnar; Mannavanshola, Marayoor
78	<i>Lopadium granulosum</i> Patw. & Makhija	Lopadiaceae	Microlichen	Crustose	Devikulam; Thekkady forest
79	<i>Megalospora sulphurata</i> Meyen	Megalosporaceae	Microlichen	Corticolous	Myladumpara, Munnar
80	<i>Megalospora tuberculosa</i> (Fée) Sipman	Megalosporaceae	Microlichen	Corticolous	Myladumpara, Munnar
81	<i>Menegazzia terebrata</i> (Hoffm.) A. Massal.	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor

82	<i>Myriotrema microporum</i> (Mont.) Hale	Graphidaceae	Microlichen	Corticolous	Devikulam
83	<i>Ocellularia epitrypa</i> (Nyl.) Hale	Graphidaceae	Microlichen	Corticolous	Cardamom hills, Kummily
84	<i>Ocellularia papillata</i> (Leight.) Zahlbr.	Graphidaceae	Microlichen	Corticolous	Devikulam; Cardamom hills
85	<i>Pannaria leucosticta</i> (Tuck. in Darl.) Nyl.	Pannariaceae	Squamulose	Corticolous	Mannavanshola, Marayoor
86	<i>Pannaria rubiginosa</i> (Thunb. ex Ach.) Delise	Pannariaceae	Foliose	Corticolous	Uppupara, Periyar Tiger Reserve; Manna- vanshola, Marayoor
87	<i>Parmeliella pannosa</i> (Stu.) Müll. Arg.	Pannariaceae	Foliose	Corticolous	Kattapara shola
88	<i>Parmeliella tryptophylla</i> (Ach.) Müll. Arg.	Pannariaceae	Foliose	Corticolous / Sax- icolous	Mannavanshola, Marayoor; Uppupara, Periyar Tiger Reserve; Silent Val- ley Estate , Munnar
89	<i>Parmelina indica</i> Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
90	<i>Parmelina subauriculenta</i> (Nyl.) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
91	<i>Parmelinella simplicior</i> (Hale) Elix & Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor; Eravikulam Na- tional Park, Munnar
92	<i>Parmelinella wallichiana</i> (Taylor) Elix & Hale	Parmeliaceae	Foliose	Corticolous / Sax- icolous	Mannavanshola, Marayoor; Kattapara shola; Uppupara, Periyar Tiger Reserve
93	<i>Parmelinopsis horrescens</i> (Taylor) Elix & Hale	Parmeliaceae	Foliose	Corticolous / Sax- icolous	Pettimudi, Munnar; Mannavanshola, Maray- oor
94	<i>Parmotrema abessinicum</i> (Nyl. ex Kremp.) Hale	Parmeliaceae	Foliose	Corticolous	Pettimudi; Silent Valley Estate, Munnar
95	<i>Parmotrema arnoldii</i> (Du Rietz) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor; Rajamala, Mun- nar
96	<i>Parmotrema crinitum</i> (Ach.) M. Choisy	Parmeliaceae	Foliose	Corticolous	Pettimudi; Munnar; Uppupara, Periyar Tiger Reserve
97	<i>Parmotrema dilatatum</i> (Vain.) Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
98	<i>Parmotrema granatum</i> (Hue) Hale	Parmeliaceae	Foliose	Corticolous / Saxicolous	Pettimudi, Munnar; Uppupara, Periyar Tiger Reserve

99	<i>Parmotrema indicum</i> Hale	Parmeliaceae	Foliose	Corticolous	Uppupara, Periyar Tiger Reserve
100	<i>Parmotrema kamatii</i> Patw. & Prabhu	Parmeliaceae	Foliose	Corticolous	Eravikulam National Park, Munnar
101	<i>Parmotrema mesotropum</i> (Müll. Arg.) Hale	Parmeliaceae	Foliose	Corticolous	Pettimudi, Munnar
102	<i>Parmotrema nilgherrense</i> (Nyl.) Hale	Parmeliaceae	Foliose	Corticolous / Saxicolous	Chinnamala; Anaimudi, Munnar; Mannavanshola, Marayoor
103	<i>Parmotrema pseudonilgherrense</i> (Asahina) Hale	Parmeliaceae	Foliose	Corticolous	Silent Valley Estate, Munnar
104	<i>Parmotrema reticulatum</i> (Taylor) M. Choisy	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
105	<i>Parmotrema thomsonii</i> (Stirt.) A. Crespo, Dicoakar & Elix	Parmeliaceae	Foliose	Corticolous	Pettimudi; Silent Valley Estate, Munnar; Mannavanshola, Marayoor
106	<i>Parmotrema tinctorum</i> (Despr. ex Nyl.) Hale	Parmeliaceae	Foliose	Corticolous	Uppupara, Periyar Tiger Reserve; Silent Valley Estate, Munnar
107	<i>Parmotremopsis philyctina</i> (Hale) Elix & Hale	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
108	<i>Pectenaria plumbea</i> (Lightf.) P.M. Jørg., L. Lindblom, Wedin & S. Ekman	Pannariaceae	Foliose	Corticolous / Saxicolous	Uppupara, Periyar Tiger Reserve; Eravikulam National Park, Munnar
109	<i>Phaeographis subtigrina</i> (Vain.) Zahlbr.	Graphidaceae	Microlichen	Corticolous	Cardamom hills
110	<i>Phaeophyscia orbicularis</i> (Neck.) Moberg	Physciaceae	Foliose	Corticolous	Uppupara, Periyar Tiger Reserve
111	<i>Phaeotrema disciforme</i> (Leight.) Hale	Graphidaceae	Microlichen	Corticolous	Thekkady forest
112	<i>Phyllospora corallina</i> (Eschw.) Müll.	Lecidiaceae	Foliose	Corticolous	Pettimudi, Munnar
113	<i>Physcia albinea</i> (Ach.) Nyl.	Physciaceae	Foliose	Saxicolous	Mannavanshola, Marayoor
114	<i>Physcia dimidiata</i> (Arnold) Nyl.	Physciaceae	Foliose	Corticolous	Pettimudi, Munnar
115	<i>Physcia integrata</i> Nyl.	Physciaceae	Foliose	Corticolous	Mannavanshola, Marayoor
116	<i>Physciella nepalensis</i> (Poelt) Essl.	Physciaceae	Foliose	Corticolous	Silent Valley Estate, Munnar
117	<i>Pilophorus awasthianum</i> Ras.	Stereocaulaceae	Fruticose	Saxicolous	Anaimudi top, Munnar

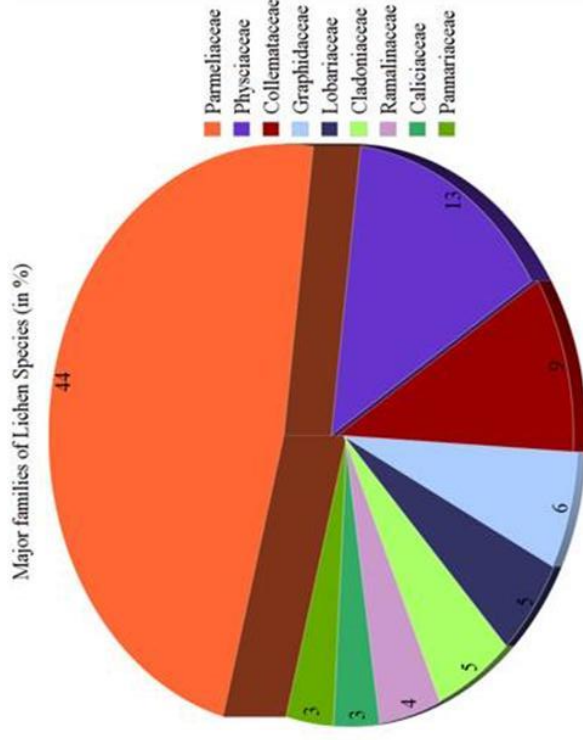
118	<i>Polypblastidium hypocaustium</i> (Yasuda ex Räsänen) Kalb	Physciaceae	Foliose	Corticolous / Saxicolous	Rajamala, Munnar; Mannavanshola, Marayoor; Uppupara, Periyar Tiger Reserve
119	<i>Polypblastidium microphyllum</i> (Kurok.) Kalb	Physciaceae	Foliose	Corticolous	Anaimudi, Munnar
120	<i>Polypblastidium togashii</i> (Kurok.) Kalb	Physciaceae	Foliose	Corticolous	Eravikulam National Park; Pettimudi; Chinnamala; Anaimudi; Silent Valley Estate, Munnar; Kattapara shola
121	<i>Pseudocyphellaria argyracea</i> (Delise) Vain.	Lobariaceae	Foliose	Corticolous	Eravikulam National Park; Kallar Estate; Anaimudi, Munnar; Mannavanshola, Marayoor
122	<i>Pseudoparmelia crozalzianna</i> (B. de Lesd.) Hale	Parmeliaceae	Foliose	Corticolous	Chinnamala; Anaimudi; Pettimudi, Munnar
123	<i>Psorella isidiophora</i> D.D. Awasthi & Kr.P. Singh	Parmeliaceae	Squamulose	Corticolous	Kattapara shola
124	<i>Pyxine asiatica</i> Vain.	Caliciaceae	Foliose	Saxicolous	Uppupara, Periyar Tiger Reserve
125	<i>Pyxine cylindrica</i> Kashitw.	Caliciaceae	Foliose	Corticolous	Eravikulam National Park; Silent Valley Estate, Munnar
126	<i>Pyxine meissnerina</i> Nyl.	Caliciaceae	Foliose	Corticolous	Mannavanshola, Marayoor
127	<i>Pyxine philippina</i> Vain.	Caliciaceae	Foliose	Corticolous	Kattapara shola
128	<i>Pyxine soredata</i> (Ach.) Mont.	Caliciaceae	Foliose	Corticolous / Saxicolous	Mannavanshola, Marayoor
129	<i>Ramalina australiensis</i> Nyl.	Ramalinaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
130	<i>Ramalina inflata</i> subsp. <i>inflata</i> (Hook. f. & Taylor) Hook. f. & Taylor	Ramalinaceae	Fruticose	Corticolous	Anaimudi slope, Munnar
131	<i>Ramalina lacera</i> (With.) J.R. Lamundon	Ramalinaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
132	<i>Ramalina pacifica</i> Asahina	Ramalinaceae	Fruticose	Corticolous	Mannavanshola, Marayoor

133	<i>Ramalina roesleri</i> (Hochst. ex Schaer.) Nyl.	Ramalinaceae	Fruticose	Corticolous	Lockart Gap, Munnar
134	<i>Ramalina subampliata</i> (Nyl.) Fink.	Ramalinaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
135	<i>Ramalina taitensis</i> Nyl.	Ramalinaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
136	<i>Heterodermia indica</i> (H. Magn.) D.D. Aowasthi	Physciaceae	Foliose	Corticolous	Silent Valley Estate, Munnar
137	<i>Reinmitzia santensis</i> (Tuck.) Kalb	Graphidaceae	Microlichen	Corticolous	Thekkady forest; Cardamom hills
138	<i>Relicina abstrusa</i> (Vain.) Hale	Parmeliaceae	Foliose	Corticolous	Cardamom hills
139	<i>Relicina sydneyensis</i> (Gyeln.) Hale	Parmeliaceae	Foliose	Corticolous	Cardamom hills
140	<i>Remototrachyna aowasthii</i> (Hale & Pateo.) Divakar & A. Crespo	Parmeliaceae	Foliose	Corticolous	Eravikulam National Park, Pettimudi, Anaimudi, Silent Valley Estate Munnar; Uppupara, Periyar Tiger Reserve
141	<i>Remototrachyna dodapetta</i> (Hale & Patw.) Divakar & A. Crespo	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor; Pettimudi, Munnar
142	<i>Remototrachyna flexilis</i> (Kurok.) Divakar & A. Crespo	Parmeliaceae	Foliose	Corticolous	Kattapara shola
143	<i>Remototrachyna rigidula</i> (Kurok.) Divakar & A. Crespo	Parmeliaceae	Foliose	Corticolous	Uppupara, Periyar Tiger Reserve
144	<i>Remototrachyna thryptica</i> (Hale) Divakar & A. Crespo	Parmeliaceae	Foliose	Corticolous	Mannavanshola, Marayoor
145	<i>Rhabdodiscus verrucosidiatus</i> (Nagarkar, Sethy & Patw.) S. Joshi, Upreti & Lücking	Graphidaceae	Microlichen	Corticolous	Devikulam; Cardamom hills
146	<i>Roccella montagnei</i> Bél.	Roccellaceae	Fruticose	Corticolous	Top station, Munnar
147	<i>Sarcographa dendroides</i> (Leight.) Luch & Lücking	Graphidaceae	Microlichen	Corticolous	Cardamom hills

148	<i>Scytinium gelatinosum</i> (With.) Otdólorá, <i>P.M. Jørg. & Wedin</i>	Collemataceae	Foliose	Corticolous	Silent Valley Estate, Munnar
149	<i>Stegobolus fissus</i> (Müll. Arg.) Frisch	Graphidaceae	Microlichen	Corticolous	Cardamom hills, Kumbily
150	<i>Stereocaulon austroindicum</i> I.M. Lamb	Stereocaulaceae	Persistent fruticose	Corticolous / Saxicolous	Rajamala, Munnar; Uppuppara, Periyar Tiger Reserve; Mannavanshola, Marayoor
151	<i>Sticta cyphelulata</i> (Müll. Arg.) Hue	Lobariaceae	Foliose	Corticolous	Eravikulam National Park; Anaimudi; Silent Valley Estate, Munnar; Uppuppara, Periyar Tiger Reserve
152	<i>Sticta filix</i> (Sw.) Nyl.	Lobariaceae	Foliose	Corticolous	Kallar Estate; Silent Valley Estate; Anaimudi, Munnar; Mannavanshola, Marayoor
153	<i>Sticta henryana</i> Müll. Arg.	Lobariaceae	Foliose	Corticolous	Pettimudi, Munnar
154	<i>Sticta limbata</i> (Sm.) Ach.	Lobariaceae	Foliose	Corticolous	Silent Valley Estate, Munnar; Uppuppara, Periyar Tiger Reserve
155	<i>Sticta neocaledonica</i> (Müll. Arg.) Hue	Lobariaceae	Foliose	Corticolous	Silent Valley Estate, Munnar
156	<i>Sticta orbicularis</i> (A. Braun ex Meyen & <i>Flot.</i>) Hue	Lobariaceae	Foliose	Corticolous	Eravikulam National Park, Munnar; Mannavanshola, Marayoor; Uppuppara, Periyar Tiger Reserve
157	<i>Sticta sylvatica</i> (Huds.) Ach.	Lobariaceae	Foliose	Corticolous	Anaimudi, Munnar
158	<i>Sticta weigelii</i> Isert	Lobariaceae	Foliose	Corticolous	Kattappara shola; Kallar Estate, Munnar; Uppuppara, Periyar Tiger Reserve; Mannavanshola, Marayoor
159	<i>Teloschistes flavicans</i> (Sw.) Norman	Teloschistaceae	Fruticose	Corticolous	Mannavanshola, Marayoor; Mattupetti; Top station, Munnar
160	<i>Thelotrema keralense</i> Patw. & Kulk.	Graphidaceae	Microlichen	-	Munnar
161	<i>Usnea austroindica</i> G. Awasthi	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
162	<i>Usnea bimolliuscula</i> Zahlbr.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor

163	<i>Usnea bornmuelleri</i> J. Steiner	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor; Rajamala; Anaimudi, Munnar
164	<i>Usnea cineraria</i> Motyka	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
165	<i>Usnea complanata</i> (Miill. Arg.) Motyka	Parmeliaceae	Fruticose	Corticolous	Pettimudi, Munnar
166	<i>Usnea corallina</i> Motyka	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor; Anamalai hills, Munnar
167	<i>Usnea dentritica</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Eravikulam National Park; Chinnamala; Anaimudi slope, Munnar
168	<i>Usnea eumitrioides</i> Motyka	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
169	<i>Usnea fischeri</i> G. Awasthi	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor; Pettimudi; Mattupetti; Silent Valley Estate, Munnar
170	<i>Usnea fragilis</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor; Anaimudi slope; Mattupetti, Munnar
171	<i>Usnea gigas</i> Motyka	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
172	<i>Usnea himalayana</i> C. Bab.	Parmeliaceae	Fruticose	Corticolous	Eravikulam National Park; Chinnamala; Anaimudi slope; Silent Valley Estate, Munnar; Mannavanshola, Marayoor
173	<i>Usnea indica</i> Motyka	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
174	<i>Usnea maculata</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
175	<i>Usnea nepalensis</i> G. Awasthi	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
176	<i>Usnea nilgirica</i> G. Awasthi	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor; Silent Valley Estate, Munnar
177	<i>Usnea orientalis</i> Motyka	Parmeliaceae	Fruticose	Corticolous	Eravikulam National Park; Anaimudi slope; Silent Valley Estate, Munnar; Mannavanshola, Marayoor

178	<i>Usnea pangiana</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
179	<i>Usnea pectinate</i> Tayl.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
180	<i>Usnea picta</i> (J. Steiner) Motyka	Parmeliaceae	Fruticose	Corticolous	Anaimudi slope; Pettimudi; Silent Valley Estate, Munnar; Mannavanshola, Marayoor
181	<i>Usnea pictoides</i> G. Awasthi	Parmeliaceae	Fruticose	Corticolous	Anaimudi slope, Munnar
182	<i>Usnea pseudosinensis</i> Asahina	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
183	<i>Usnea rigida</i> (Stirt.) G. Awasthi	Parmeliaceae	Fruticose	Corticolous	Rajamala; Silent Valley Estate, Munnar; Mannavanshola, Marayoor
184	<i>Usnea rubicunda</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor; Eravikulam National Park, Munnar; Silent Valley Estate, Munnar
185	<i>Usnea spinosula</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Eravikulam National Park, Munnar; Mannavanshola, Marayoor
186	<i>Usnea splendens</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
187	<i>Usnea stigmatoidea</i> G. Awasthi	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor; Kattappara, Rajamala
188	<i>Usnea subchalybea</i> Zahlbr.	Parmeliaceae	Fruticose	Corticolous	Anaimudi, Munnar; Mannavanshola, Marayoor
189	<i>Usnea subflorida</i> (Zahlbr.) Motyka	Parmeliaceae	Fruticose	Corticolous	Eravikulam National Park, Munnar; Mannavanshola, Marayoor
190	<i>Usnea thomsonii</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Silent Valley Estate, Munnar
191	<i>Usnea undulata</i> Stirt.	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
192	<i>Usnea vegae</i> Motyka	Parmeliaceae	Fruticose	Corticolous	Silent Valley Estate, Munnar
193	<i>Usnea waasmuthii</i> Rasnien	Parmeliaceae	Fruticose	Corticolous	Mannavanshola, Marayoor
194	<i>Vahlia leucophaea</i> (Vahl) P.M. Jørg.	Pannariaceae	Squamulose-ceustose	Corticolous	Mannavanshola, Marayoor



Bryophytes from the HRML study area, Anjunadu valley, Kerala

Sl. No.	Species	Family	Habitat	Locality
1	<i>Anacolia menziesii</i> (Turner) Paris	Bartramiaceae	Rocks	Attukadu
2	<i>Aneura tenuicosata</i> (Schiffner) Stephani	Aneuraceae		
3	<i>Anisothecium molliculum</i> (Mitt.) Broth.	Dicranaceae	Rocks	Attukadu
4	<i>Anoectangium stracheyanum</i> Mitt.	Pottiaceae		

5	<i>Anomobryum auratum</i> (Mitt.) A. Jaeger	Bryaceae			
6	<i>Anomobryum brachymenioides</i> Dixon & P. de la Varde	Bryaceae	Wet rocks	Munnar	
7	<i>Anomobryum cymbifolium</i> (Lindb.) Broth.	Bryaceae	Wet rocks	Athirapalli	
8	<i>Anomobryum pelucidum</i> Dixon & Badhw.	Bryaceae	Wet rocks	Attukadu	
9	<i>Anthoceros crispulus</i> (Mont.) Douin	Anthocerotaceae			
10	<i>Anthoceros erectus</i> Stephani	Anthocerotaceae			
11	<i>Anthoceros gemmulosus</i> Schiffner & Pande	Anthocerotaceae			
12	<i>Asterella leptophylla</i> (Mont.) Grolle	Aytoniaceae			
13	<i>Asterella wallichiana</i> (Lehm.) Grolle	Aytoniaceae			
14	<i>Atrichum longifolium</i> Cardot & Dixon ex Gangulee	Polytrichaceae	Loose soil	Attukadu	
15	<i>Atrichum obtusulum</i> (Müll. Hal.) A. Jaeger	Polytrichaceae	Loose soil	Kannimalai	
16	<i>Bartramiodula bartramioides</i> (Griff.) Wijk & Margad.	Bartramiaceae			
17	<i>Bartramiodula roylei</i> (Hook. f.) Bruch & Schimp.	Bartramiaceae	Wet rocks	Kannimalai	
18	<i>Brachymenium acuminatum</i> Harv.	Bryaceae	Wet rocks	Munnar	
19	<i>Brachymenium bryioides</i> Hook. ex Schwägr.	Bryaceae			
20	<i>Brachymenium exile</i> (Dozy & Molk.) Bosch & Sande Lac.	Bryaceae			
21	<i>Brachymenium ptychothecium</i> (Besch.) Ochi	Bryaceae	Soil	Poyankutti	
22	<i>Brachymenium sikkimense</i> Renaud & Cardot	Bryaceae	Tree bark	Munnar	
23	<i>Brachymenium walckeri</i> Broth.	Bryaceae			
24	<i>Brachythecium kannounense</i> (Harv.) A. Jaeger	Brachytheciaceae	Rocks	Devikulam	
25	<i>Brachythecium populcum</i> (Hedw.) Schimp.	Brachytheciaceae	Soil	Attukadu	
26	<i>Brotherella dixonii</i> Herzog	Sematophyllaceae	Wet rocks	Eravikulam	
27	<i>Bryum argenteum</i> Hedw.	Bryaceae			
28	<i>Bryum atrocirens</i> Brid.	Bryaceae	Soil	Thekadi	

29	<i>Bryum auratum</i> Mitt.	Bryaceae	Wet rocks	Munnar
30	<i>Bryum badhwarii</i> Ochi	Bryaceae		
31	<i>Bryum coronatum</i> Schwägr.	Bryaceae		
32	<i>Bryum dichotomum</i> Hedw.	Bryaceae	Soil	Munnar
33	<i>Bryum pseudotriquetrum</i> (Hedw.) P. Gaertn., B. Mey. & Scherb.	Bryaceae		
34	<i>Bryum uliginosum</i> (Brid.) Bruch & Schimp.	Bryaceae		
35	<i>Callicostella papillata</i> (Mont.) Mitt.	Pilotrichaceae		
36	<i>Calliargon cordifolium</i> (Hedw.) Kindb.	Amblystegiaceae	Wet rocks	Munnar
37	<i>Calycularia crispula</i> Mitt.	Allisoniaceae		
38	<i>Calymperes graeffeanum</i> Müll. Hal.	Calymperaceae		
39	<i>Campylopodia tenella</i> Cardot	Dicranaceae	Rocks	Athirapalli
40	<i>Campylopus atrovirens</i> De Not.	Dicranaceae		
41	<i>Campylopus flexuosus</i> (Hedw.) Brid.	Dicranaceae	Rocks	Munnar
42	<i>Campylopus fragilis</i> subsp. <i>goughii</i> (Mitt.) J.-P. Frahm	Dicranaceae	Rocks	Athirapalli
43	<i>Campylopus gracilis</i> (Mitt.) A. Jaeger	Dicranaceae	Rocks	Munnar
44	<i>Campylopus richardii</i> Brid.	Dicranaceae	Rocks	Munnar
45	<i>Campylopus schmidii</i> (Müll. Hal.) A. Jaeger	Dicranaceae	Rocks	Munnar
46	<i>Campylopus subfragilis</i> Renauld & Cardot	Dicranaceae	Rocks	Matupatti
47	<i>Catharinaea aculeata</i> (Cardot & P. de la Varde) Broth.	Polytrichaceae	Loose soil	Devikulam
48	<i>Cephalozia kiaeeri</i> (Austin) S.W. Arnell	Cephalozellaceae		
49	<i>Ceratodon purpureus</i> (Hedw.) Brid.	Ditrichaceae	Soil, rocks and roofs	Kothamangalam
50	<i>Claopodium pellucinerve</i> (Mitt.) Best	Thuidiaceae	Rocks	Munnar
51	<i>Claopodium prionophyllum</i> (Müll. Hal.) Broth.	Thuidiaceae		

52	<i>Cyathodium tuberculatum</i> Udar & D.K. Singh	Taragoniaceae		
53	<i>Diaphanodon blandus</i> (Harv.) Renauld & Cardot	Trachypodaceae		
54	<i>Didadiella cubensis</i> (Mitt.) W.R. Buck	Meteoriaceae		
55	<i>Dicranella macrospora</i> Gangulee	Dicranaceae	Soil	Munnar
56	<i>Dicranella spiralis</i> (Mitt.) A. Jaeger	Dicranaceae	Moist soil	Munnar
57	<i>Dicranodontium denudatum</i> (Brid.) E. Britton	Dicranaceae	Rocks	Athirapalli
58	<i>Dicranolejeunea yoshinagana</i> (S. Hatt.) Mizut.	Lejeuneaceae		
59	<i>Ditrichum darjeelingense</i> Renauld & Cardot	Dicranaceae		Poyankutti
60	<i>Ditrichum difficile</i> (Duby) M. Fleisch.	Ditrichaceae		
61	<i>Ditrichum heteromallum</i> (Hedw.) E. Britton	Ditrichaceae	Wet rocks	Thattakad
62	<i>Ditrichum pusillum</i> (Hedw.) Hampe	Ditrichaceae	Rocks	Munnar
63	<i>Ditrichum tortipes</i> (Mitt.) Kuntze	Ditrichaceae	Dry exposed rocks	Munnar
64	<i>Ditrichum tortuloides</i> Grout	Ditrichaceae	Exposed rocks	Thattakad
65	<i>Dumortiera hirsuta</i> (Sw.) Nees	Marchantiaceae		
66	<i>Ectropothecium buitenzorgii</i> (Bél.) Mitt.	Hypnaceae		
67	<i>Ectropothecium dealbatum</i> (Reinw. & Hornsch.) A. Jaeger	Hypnaceae		
68	<i>Entodon laetus</i> (Griff.) A. Jaeger	Entodontaceae	Tree bark	Athirapalli
69	<i>Entodon macropodus</i> (Hedw.) Mill. Hal.	Entodontaceae		
70	<i>Entodon plicatus</i> Mill. Hal.	Entodontaceae		
71	<i>Entodontopsis nitens</i> (Mitt.) W.R. Buck & R.R. Ireland	Stereophyllaceae		
72	<i>Entosthodon nutans</i> Mitt.	Funariaceae	Rocks	Munnar
73	<i>Entosthodon wallichii</i> Mitt.	Funariaceae	Rocks	Eravikulam
74	<i>Entosthodon zwichurae</i> M. Fleisch.	Funariaceae		
75	<i>Erythrodonium julaceum</i> (Hook. ex Schwägr.) Paris	Entodontaceae		

76	<i>Fabronia pusilla</i> Raddi	Fabroniaceae	Rocks	Idukki
77	<i>Fissidens ceylonensis</i> var. <i>acutifolius</i> Dixon & P. Varde	Fissidentaceae		
78	<i>Fissidens anomalus</i> Mont.	Fissidentaceae		
79	<i>Fissidens ceylonensis</i> Dozy & Molk.	Fissidentaceae		
80	<i>Fissidens dubius</i> P. Beauv.	Fissidentaceae		
81	<i>Fissidens hollianus</i> Dozy & Molk.	Fissidentaceae		
82	<i>Fissidens involutus</i> Wilson ex Mitt.	Fissidentaceae		
83	<i>Fissidens polypodioides</i> Hedw.	Fissidentaceae	Soil	Devikulam
84	<i>Fissidens schmidii</i> Müll. Hal.	Fissidentaceae		
85	<i>Fissidens taxifolius</i> Hedw.	Fissidentaceae	Soil	Munnar
86	<i>Fissidens zippelianus</i> Dozy & Molk.	Fissidentaceae		
87	<i>Folioceros pandei</i> Udar & Shaheen	Antherotaceae		
88	<i>Fossombronia cristula</i> Austin	Fossombroniaceae		
89	<i>Fossombronia himalayensis</i> Kashyap	Fossombroniaceae		
90	<i>Fossombronia indica</i> Stephani	Fossombroniaceae		
91	<i>Fruillania tamarisci</i> (L.) Dumort.	Jubulaceae		
92	<i>Funaria hygrometrica</i> Hedw.	Funariaceae		
93	<i>Funaria vijkii</i> R.S. Chopra	Funariaceae	Rocks	Attukadu
94	<i>Garckea flexuosa</i> (Griff.) Margad. & Nork.	Ditrichaceae	Shaded rocks	Adimali
95	<i>Garckea phascoides</i> (Hook.) Müll. Hal.	Ditrichaceae		
96	<i>Hageniella assamica</i> Dixon	Sematophyllaceae	Wet rocks	Eravikulam
97	<i>Haplocladium schimperii</i> Thér.	Thuidiaceae	Litter	Matupatti
98	<i>Heliconema peguense</i> (Besch.) L.T. Ellis & A. Eddy	Calymperaceae	Wet rocks	Charpa
99	<i>Herpetineuron toccoeae</i> (Sull. & Lesq.) Cardot	Thuidiaceae	Rocks	Attukadu

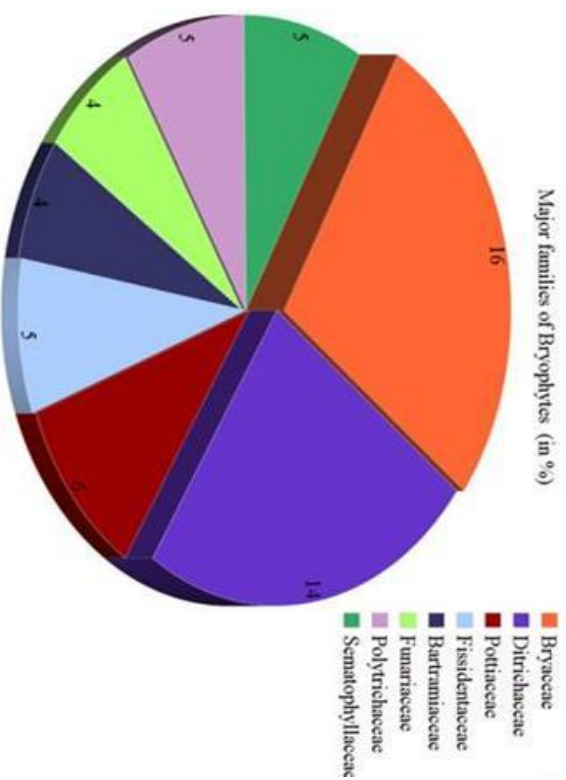
100	<i>Homaliodendron exiguum</i> (Bosch & Sande Lac.) M. Fleisch.	Neckeraceae		
101	<i>Homaliodendron flabellatum</i> (Sm.) M. Fleisch.	Neckeraceae		
102	<i>Hydrogonium consanguineum</i> (Thwaites & Mitt.) Hilp.	Pottiaceae		
103	<i>Hydrogonium pseudoehrenbergii</i> (M. Fleisch.) P.C. Chen	Pottiaceae	Wet rocks	Kallar
104	<i>Hymenostylium recurvirostrum</i> (Hedw.) Dixon	Pottiaceae		
105	<i>Hyophila involuta</i> (Hook.) A. Jaeger	Pottiaceae		
106	<i>Hyophila rosea</i> R.S. Williams	Pottiaceae	Rocks	Munnar
107	<i>Hypnum aduncoides</i> (Brid.) Müll. Hal.	Hypnaceae	Soil	Munnar
108	<i>Hypnum setstroanicum</i> (Broth.) Ardo	Hypnaceae	Soil	Munnar
109	<i>Isopterygium lignicola</i> (Mitt.) A. Jaeger	Hypnaceae		
110	<i>Isopterygium polhiacarpum</i> (Sull. & Lesq.) A. Jaeger	Hypnaceae		
111	<i>Leptobryum pyriforme</i> (Hedw.) Wilson	Bryaceae	Rocks	Wariyum
112	<i>Leptopterigynandrum decolor</i> (Mitt.) M. Fleisch.	Thuidiaceae	Tree base	Attukadu
113	<i>Lescuraea incurvata</i> (Hedw.) E. Lavaton	Leskeaceae	Munnar	Tree bark
114	<i>Leucobryum humilimum</i> Cardot	Dicranaceae		
115	<i>Leucobryum neilgherrense</i> Müll. Hal.	Dicranaceae		
116	<i>Leucoloma amoene-virens</i> Mitt.	Dicranaceae		
117	<i>Lopholejeunea subfusca</i> (Nees) Schiffner	Lejeuneaceae		
118	<i>Macromitrium vohraii</i> Rajeevan	Orthotrichaceae		
119	<i>Macromitrium moorcroftii</i> (Hook. & Grev.) Schwagr.	Orthotrichaceae		
120	<i>Macromitrium nepalense</i> (Hook. & Grev.) Schwagr.	Orthotrichaceae		
121	<i>Marchantia kashyapii</i> Udar & Shaheen	Marchantiaceae		
122	<i>Marchantia palmata</i> Reinw., Nees & Blume	Marchantiaceae		
123	<i>Meiothecium jagorii</i> (Müll. Hal.) Broth.	Sematophyllaceae	Rocks	Athirapalli

124	<i>Meteoricella soluta</i> (Mitt.) S. Okamura		Pterobryaceae	Tree branches		Athirapalli			
125	<i>Meteoropsis reclinata</i> (Müll. Hal.) M. Fleisch.		Meteoriaceae						
126	<i>Meteoropsis squarrosa</i> (Hook. ex Harv.) M. Fleisch.		Meteoriaceae						
127	<i>Metzgeria nilgiriensis</i> S.C. Srinast. & Udar		Metzgeriaceae						
128	<i>Microcampylopus khasianus</i> (Griffiths) Giese & J.-P. Frahm		Dicranaceae	Rocks		Rajamalai			
129	<i>Microdus brasiliensis</i> (Duby) Thér.		Dicranaceae	Wet rocks		Matupatti			
130	<i>Mielichhoferia himalayana</i> Mitt.		Bryaceae	Soil		Munnar			
131	<i>Mnium thomsonii</i> Schimp.		Mniaceae	Wet rocks		Matupatti			
132	<i>Molendoa sendtneriana</i> (Bruch & Schimp.) Limpr.		Pottiaceae						
133	<i>Myurium borii</i> (Dixon) Magill		Myuriaceae	Tree bark		Eravikulam			
134	<i>Nantheicum foreaui</i> Dixon & P. de la Varde		Entodontaceae						
135	<i>Notothylas dissecta</i> Steph		Notothyladaceae						
136	<i>Octoblepharum albidum</i> Hedw.		Octoblepharaceae						
137	<i>Orthodontium infractum</i> Dozy & Molk.		Bryaceae	Tree base		Munnar			
138	<i>Orthomnion bryoides</i> (Griff.) Nork.		Mniaceae						
139	<i>Orthotrichum speciosum</i> Nees		Orthotrichaceae	Tree branches		Matupatti			
140	<i>Oxystegus stenophyllus</i> (Mitt.) Gangulee		Pottiaceae	Soil		Rajamalai			
141	<i>Phaeoceros laevis</i> (L.) Prosk.		Anthocerotaceae						
142	<i>Philonotis fontana</i> (Hedw.) Brid.		Bartramiaceae						
143	<i>Philonotis hastata</i> (Duby) Wijk & Margad.		Bartramiaceae						
144	<i>Philonotis leptocarpa</i> Mitt.		Bartramiaceae						
145	<i>Philonotis thwaitesii</i> Mitt.		Bartramiaceae						
146	<i>Physcomitrium eurystomum</i> Sendtn.		Funariaceae						
147	<i>Physcomitrium japonicum</i> (Hedw.) Mitt.		Funariaceae	Soil		Kannimalai			

148	<i>Plagiobryum zierii</i> (Dicks. ex Hedw.) Lindb.	Bryaceae	Wet rocks	Attukadu
149	<i>Plagiochasma intermedium</i> Lindenb. & Gottsche	Aytoniaceae		
150	<i>Plagiomnium rostratum</i> (Schnrad.) T.J. Kop.	Miniaceae		
151	<i>Plagiothecium carifolium</i> (Brid.) Z. Iwats.	Plagiotheciaceae	Tree base	Matupatti
152	<i>Pleuriidium tenue</i> Mitt.	Ditrichaceae	Wet rocks	Adimali
153	<i>Pogonatum aloides</i> (Hedw.) P. Beauv.	Polytrichaceae	Munnar	Munnar
154	<i>Pogonatum cirratum</i> (Sw.) Brid.	Polytrichaceae	Soil	Matupatti
155	<i>Pogonatum microstomum</i> (R. Br. ex Schwägr.) Brid.	Polytrichaceae	Rocks	Eravikulam
156	<i>Pogonatum neesii</i> (Müll. Hal.) Dozy	Polytrichaceae	Soil	Attukadu
157	<i>Pogonatum perichaetiale</i> (Mont.) A. Jaeger	Polytrichaceae	Wet rocks	Eravikulam
158	<i>Pohlia forenui</i> Rajeevan	Bryaceae		
159	<i>Pohlia flexuosa</i> Harv.	Bryaceae		
160	<i>Pohlia geddeana</i> (Bosch & Sande Lac.) Gangulæ	Bryaceae		
161	<i>Pohlia himalayana</i> (Mitt.) Broth.	Bryaceae	Tree base	Devikulam
162	<i>Pohlia ludwigii</i> (Spreng. ex Schwägr.) Broth.	Bryaceae	Soil	Attukadu
163	<i>Polytrichastrum formosum</i> var. <i>densifolium</i> (Wilson ex Mitt.) Z. Iwats. & Nog.	Polytrichaceae	Soil	Munnar
164	<i>Pseudoneura multifida</i> (L.) Gottsche	Aneuraceae		
165	<i>Pseudosymblypharis bombayensis</i> (Müll. Hal.) P. Soliman	Pottiaceae		
166	<i>Pseudotaxiphyllum elegans</i> (Brid.) Z. Iwats.	Plagiotheciaceae		
167	<i>Pterobryopsis keralensis</i> (Rajeevan) Dix.	Pterobryaceae		
168	<i>Pterobryopsis flexipes</i> (Mitt.) M. Eletsch.	Pterobryaceae		
169	<i>Ptychostomum capillare</i> (Hedw.) D. T. Holyoak & N. Pedersen	Bryaceae	Wet rocks	Attukadu

170	<i>Pylaisiadelphina drepanioides</i> Carlot & Dixon	Sematophyllaceae	Wet rocks	Eravikulam
171	<i>Reboulia hemisphaerica</i> (L.) Raddi	Aytoniaceae		
172	<i>Regmatodon declinatus</i> (Hook.) Brid.	Regmatodontaceae	Rocks	Eravikulam
173	<i>Rhabdoweisia crenulata</i> (Mitt.) H. Jameson	Rhabdoweisiaceae	Wet rocks	Kannimalai
174	<i>Rhaphidostichum glauco-virens</i> (Mitt.) Broth.	Sematophyllaceae	Rocks	Matupatti
175	<i>Rhaphidostichum subleptocarpum</i> (Thér. & P. de la Varde) Broth.	Sematophyllaceae		
176	<i>Rhodobryum giganteum</i> (Schwägr.) Paris	Bryaceae		
177	<i>Rhodobryum laxelimbatum</i> (Hampe ex Ochi) Z. Iwats. & T.J. Kop.	Bryaceae	Rocks	Attukadu
178	<i>Riccardia levieri</i> Schiffner	Aneuraceae		
179	<i>Riccia billardieri</i> Mont. & Nees ex Gottsche, Lindenb. & Nees	Ricciaceae		
180	<i>Riccia crustata</i> Trab. ex Grolle	Ricciaceae		
181	<i>Riccia crystallina</i> L.	Ricciaceae		
182	<i>Riccia stricta</i> (Gottsche, Lindenb. & Nees) Perold	Ricciaceae		
183	<i>Rosulabryum billardieri</i> (Schwägr.) J.R. Spence	Bryaceae		
184	<i>Schiffneriolejeunea indica</i> (Steph.) Udar & Awashti	Lejeuneaceae		
185	<i>Sematophyllum humile</i> (Mitt.) Broth.	Sematophyllaceae	Tree bark	Munnar
186	<i>Sematophyllum subpinnatum</i> (Brid.) E. Britton	Sematophyllaceae	Tree bark	Athirapalli
187	<i>Symphysodontella involuta</i> (Thwaites & Mitt.) M. Fleisch.	Pterobryaceae		
188	<i>Syrrophodon albidus</i> Thwaites & Mitt.	Calymperaceae		
189	<i>Targionia hypophylla</i> L.	Targioniaceae		
190	<i>Targionia indica</i> Udar & A. Gupta	Targioniaceae		
191	<i>Thuidium cymbifolium</i> (Dozy & Molk.) Dozy & Molk.	Thuidiaceae		

192	<i>Tortula schmidii</i> (Müll. Hal.) Broth.	Pottiaceae		
193	<i>Trachypus bicolor</i> Reinv. & Hornsch.	Trachypodaceae		
194	<i>Trematodon kurzii</i> Hampe ex Gangulee	Bruchiaceae	Sandy soil	Athirapalli
195	<i>Trematodon longicollis</i> Michx.	Bruchiaceae		
196	<i>Trematodon schmidii</i> Mill. Hal.	Bruchiaceae	Sandy soil	Adimali
197	<i>Trematodon subulosus</i> Griff.	Bruchiaceae	Soil	Kallar
198	<i>Trichostomum criotum</i> R.H. Zander	Pottiaceae	Rocks	Munnar
199	<i>Trichostomum tenuirostre</i> (Hook. & Taylor) Lindb.	Pottiaceae		



**Check list of Medicinal plants in the HRML study area, Anjunadu valley,
Kerala**

Sl. No.	Plant name	Family
1	<i>Abelmoschus esculentus</i> (L.) Moench	Malvaceae
2	<i>Abelmoschus manihot</i> (L.) Medik.	Malvaceae
3	<i>Abelmoschus moschatus</i> Medik.	Malvaceae
4	<i>Abrus precatorius</i> L.	Leguminosae
5	<i>Abrus pulchellus</i> Thwaites	Leguminosae
6	<i>Abutilon hirtum</i> (Lam.) Sweet	Malvaceae
7	<i>Abutilon indicum</i> (L.) Sweet	Malvaceae
8	<i>Abutilon persicum</i> (Burm.f.) Merr.	Malvaceae
9	<i>Acacia caesia</i> (L.) Willd.	Leguminosae
10	<i>Acacia catechu</i> (L.f.) Willd.	Leguminosae
11	<i>Acacia chundra</i> (Rottler) Willd.	Leguminosae
12	<i>Acacia dealbata</i> Link	Leguminosae
13	<i>Acacia ferruginea</i> DC.	Leguminosae
14	<i>Acacia leucophloea</i> (Roxb.) Willd.	Leguminosae
15	<i>Acacia melanoxylon</i> R.Br.	Leguminosae
16	<i>Acacia nilotica</i> (L.) Delile	Leguminosae
17	<i>Acacia pennata</i> (L.) Willd.	Leguminosae
18	<i>Acacia planifrons</i> Wight & Arn.	Leguminosae
19	<i>Acacia sinuata</i> (Lour.) Merr.	Leguminosae
20	<i>Acacia torta</i> (Roxb.) Craib	Leguminosae
21	<i>Acalypha ciliata</i> Forssk.	Euphorbiaceae
22	<i>Acalypha fruticosa</i> Forssk.	Euphorbiaceae
23	<i>Acalypha hispida</i> Burm.f.	Euphorbiaceae
24	<i>Acalypha indica</i> L.	Euphorbiaceae
25	<i>Acalypha paniculata</i> Miq.	Euphorbiaceae
26	<i>Acampe praemorsa</i> (Roxb.) Blatt. & McCann	Orchidaceae
27	<i>Acanthospermum hispidum</i> DC.	Asteraceae
28	<i>Achyranthes aspera</i> L.	Amaranthaceae
29	<i>Achyranthes bidentata</i> Blume	Amaranthaceae
30	<i>Acmella paniculata</i> (Wall. ex DC.)	Asteraceae
31	<i>Acorus calamus</i> L.	Acoraceae
32	<i>Acronychia pedunculata</i> (L.) Miq.	Rutaceae
33	<i>Acrotrema arnottianum</i> Wight	Dilleniaceae
34	<i>Adenia hondala</i> (Gaertn.) W.J.de Wilde	Passifloraceae
35	<i>Adenia wightiana</i> (Wall. ex Wight & Arn.)	Passifloraceae

36	<i>Adenostemma lavenia</i> (L.) Kuntze	Asteraceae
37	<i>Aeginetia indica</i> L.	Orobanchaceae
38	<i>Aegle marmelos</i> (L.) Corrêa	Rutaceae
39	<i>Aerva lanata</i> (L.) Juss.	Amaranthaceae
40	<i>Aeschynomene aspera</i> L.	Leguminosae
41	<i>Aeschynomene indica</i> L.	Leguminosae
42	<i>Aganosma cymosa</i> (Roxb.) G.Don	Apocynaceae
43	<i>Agave americana</i> L.	Asparagaceae
44	<i>Ageratina adenophora</i> (Spreng.) R.M.King &	Asteraceae
45	<i>Ageratum conyzoides</i> (L.) L.	Asteraceae
46	<i>Ageratum houstonianum</i> Mill.	Asteraceae
47	<i>Aglaia elaeagnoidea</i> (A.Juss.) Benth.	Meliaceae
48	<i>Aglaia lawii</i> (Wight) C.J.Saldanha	Meliaceae
49	<i>Ailanthus excelsa</i> Roxb.	Simaroubaceae
50	<i>Ailanthus triphysa</i> (Dennst.) Alston	Simaroubaceae
51	<i>Alangium salviifolium</i> (L.f.) Wangerin	Cornaceae
52	<i>Albizia amara</i> (Roxb.) B.Boivin	Leguminosae
53	<i>Albizia chinensis</i> (Osbeck) Merr.	Leguminosae
54	<i>Albizia lebbeck</i> (L.) Benth.	Leguminosae
55	<i>Albizia odoratissima</i> (L.f.) Benth.	Leguminosae
56	<i>Albizia procera</i> (Roxb.) Benth.	Leguminosae
57	<i>Albizia saman</i> (Jacq.) Merr.	Leguminosae
58	<i>Allamanda cathartica</i> L.	Apocynaceae
59	<i>Allmania nodiflora</i> (L.) R.Br. ex Wight	Amaranthaceae
60	<i>Allophylus cobbe</i> (L.) Raeusch.	Sapindaceae
61	<i>Allophylus serratus</i> (Hiern) Kurz	Sapindaceae
62	<i>Alloteropsis cimicina</i> (L.) Stapf	Poaceae
63	<i>Alocasia fornicata</i> (Roxb.) Schott	Araceae
64	<i>Aloe vera</i> (L.) Burm.f.	Xanthorrhoeaceae
65	<i>Alpinia calcarata</i> (Haw.) Roscoe	Zingiberaceae
66	<i>Alpinia galanga</i> (L.) Willd.	Zingiberaceae
67	<i>Alpinia malaccensis</i> (Burm.f.) Roscoe	Zingiberaceae
68	<i>Alseodaphne semecarpifolia</i> Nees	Lauraceae
69	<i>Alstonia scholaris</i> (L.) R. Br.	Apocynaceae
70	<i>Alstonia venenata</i> R.Br.	Apocynaceae
71	<i>Alternanthera pungens</i> Kunth	Amaranthaceae
72	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Amaranthaceae
73	<i>Alysicarpus bupleurifolius</i> (L.) DC.	Leguminosae
74	<i>Alysicarpus monilifer</i> (L.) DC.	Leguminosae
75	<i>Alysicarpus vaginalis</i> (L.) DC.	Leguminosae
76	<i>Amaranthus caudatus</i> L.	Amaranthaceae
77	<i>Amaranthus spinosus</i> L.	Amaranthaceae

78	<i>Amaranthus tricolor</i> L.	Amaranthaceae
79	<i>Amaranthus viridis</i> L.	Amaranthaceae
80	<i>Ammannia baccifera</i> L.	Lythraceae
81	<i>Amorphophallus bulbifer</i> (Roxb.) Blume	Araceae
82	<i>Amorphophallus commutatus</i> (Schott) Engl.	Araceae
83	<i>Amorphophallus paeoniifolius</i> (Dennst.)	Araceae
84	<i>Ampelocissus indica</i> (L.) Planch.	Vitaceae
85	<i>Ampelocissus tomentosa</i> (B.Heyne & Roth)	Vitaceae
86	<i>Anacardium occidentale</i> L.	Anacardiaceae
87	<i>Anacolosia densiflora</i> Bedd.	Olacaceae
88	<i>Anamirta cocculus</i> (L.) Wight & Arn.	Menispermaceae
89	<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae
90	<i>Ancistrocladus heyneanus</i> Wall. ex J.Graham	Ancistrocladaceae
91	<i>Andrographis atropurpurea</i> (Dennst.) Alston	Acanthaceae
92	<i>Andrographis paniculata</i> (Burm.f.) Nees	Acanthaceae
93	<i>Anemone rivularis</i> Buch.-Ham. ex DC.	Ranunculaceae
94	<i>Anisochilus carnosus</i> (L.f.) Wall.	Lamiaceae
95	<i>Anisomeles indica</i> (L.) Kuntze	Lamiaceae
96	<i>Annona muricata</i> L.	Annonaceae
97	<i>Annona reticulata</i> L.	Annonaceae
98	<i>Annona squamosa</i> L.	Annonaceae
99	<i>Anodendron paniculatum</i> A.DC.	Apocynaceae
100	<i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex	Combretaceae
101	<i>Antiaris toxicaria</i> Lesch.	Moraceae
102	<i>Antidesma acidum</i> Retz.	Phyllanthaceae
103	<i>Apluda mutica</i> L.	Poaceae
104	<i>Aporosa cardiosperma</i> (Gaertn.) Merr.	Phyllanthaceae
105	<i>Archidendron bigeminum</i> (L.) I.C.Nielsen	Leguminosae
106	<i>Archidendron chypearia</i> (Jack) I.C.Nielsen	Leguminosae
107	<i>Areca catechu</i> L.	Arecaceae
108	<i>Arenga wightii</i> Griff.	Arecaceae
109	<i>Argyreia cuneata</i> Ker Gawl.	Convolvulaceae
110	<i>Argyreia daltonii</i> C.B.Clarke	Convolvulaceae
111	<i>Argyreia imbricata</i> Santapau & V.Patel	Convolvulaceae
112	<i>Arisaema barnesii</i> C.E.C.Fisch.	Araceae
113	<i>Arisaema leschenaultii</i> Blume	Araceae
114	<i>Arisaema murrayi</i> (J.Graham) Hook.	Araceae
115	<i>Arisaema tortuosum</i> (Wall.) Schott	Araceae
116	<i>Aristida adscensionis</i> L.	Poaceae
117	<i>Aristida setacea</i> Retz.	Poaceae
118	<i>Aristolochia indica</i> L.	Aristolochiaceae
119	<i>Aristolochia tagala</i> Cham.	Aristolochiaceae

120	<i>Artanema longifolium</i> (L.) Vatke	Linderniaceae
121	<i>Artemisia nilagirica</i> (C.B.Clarke) Pamp.	Asteraceae
122	<i>Artocarpus gomezianus</i> Wall. ex Trécul	Moraceae
123	<i>Artocarpus heterophyllus</i> Lam.	Moraceae
124	<i>Artocarpus hirsutus</i> Lam.	Moraceae
125	<i>Asclepias curassavica</i> L.	Apocynaceae
126	<i>Asystasia dalzelliana</i> Santapau	Acanthaceae
127	<i>Asystasia gangetica</i> (L.) T.Anderson	Acanthaceae
128	<i>Atalantia monophylla</i> DC.	Rutaceae
129	<i>Atalantia racemosa</i> Wight ex Hook.	Rutaceae
130	<i>Averrhoa bilimbi</i> L.	Oxalidaceae
131	<i>Averrhoa carambola</i> L.	Oxalidaceae
132	<i>Azadirachta indica</i> A.Juss.	Meliaceae
133	<i>Baccharoides anthelmintica</i> (L.) Moench	Asteraceae
134	<i>Bacopa monnieri</i> (L.) Wettst.	Plantaginaceae
135	<i>Balanophora fungosa</i> subsp. <i>indica</i> (Arn.)	Balanophoraceae
136	<i>Baliospermum solanifolium</i> (Burm.) Suresh	Euphorbiaceae
137	<i>Bambusa bambos</i> (L.) Voss	Poaceae
138	<i>Barleria acuminata</i> Wight ex Nees	Acanthaceae
139	<i>Barleria courtallica</i> Nees	Acanthaceae
140	<i>Barleria cristata</i> L.	Acanthaceae
141	<i>Barleria involucreta</i> Nees	Acanthaceae
142	<i>Barleria mysorensis</i> B.Heyne ex Roth	Acanthaceae
143	<i>Barleria prattensis</i> Santapau	Acanthaceae
144	<i>Barleria prionitis</i> L.	Acanthaceae
145	<i>Bauhinia malabarica</i> Roxb.	Leguminosae
146	<i>Bauhinia phoenicea</i> Wight & Arn.	Leguminosae
147	<i>Bauhinia racemosa</i> Lam.	Leguminosae
148	<i>Bauhinia scandens</i> L.	Leguminosae
149	<i>Bauhinia tomentosa</i> L.	Leguminosae
150	<i>Bauhinia variegata</i> L.	Leguminosae
151	<i>Begonia malabarica</i> Lam.	Begoniaceae
152	<i>Benincasa hispida</i> (Thunb.) Cogn.	Cucurbitaceae
153	<i>Benkara malabarica</i> (Lam.) Tirveng.	Rubiaceae
154	<i>Bentinckia condapanna</i> Berry ex Roxb.	Arecaceae
155	<i>Berberis leschenaultii</i> Wall. ex Wight & Arn.	Berberidaceae
156	<i>Bidens biternata</i> (Lour.) Merr. & Sherff	Asteraceae
157	<i>Bidens pilosa</i> L.	Asteraceae
158	<i>Biophytum reinwardtii</i> (Zucc.) Klotzsch	Oxalidaceae
159	<i>Biophytum sensitivum</i> (L.) DC.	Oxalidaceae
160	<i>Bischofia javanica</i> Blume	Phyllanthaceae
161	<i>Blepharis maderaspatensis</i> (L.) B.Heyne ex	Acanthaceae

162	<i>Blumea axillaris</i> (Lam.) DC.	Asteraceae
163	<i>Blumea eriantha</i> DC.	Asteraceae
164	<i>Blumea lacera</i> (Burm.f.) DC.	Asteraceae
165	<i>Blumea lanceolaria</i> (Roxb.) Druce	Asteraceae
166	<i>Blumea membranacea</i> DC.	Asteraceae
167	<i>Blumea oxydonta</i> DC.	Asteraceae
168	<i>Blyxa octandra</i> (Roxb.) Planch. ex Thwaites	Hydrocharitaceae
169	<i>Boehmeria macrophylla</i> Hornem.	Urticaceae
170	<i>Boerhavia chinensis</i> (L.) Rottb.	Nyctaginaceae
171	<i>Boerhavia erecta</i> L.	Nyctaginaceae
172	<i>Bombax ceiba</i> L.	Malvaceae
173	<i>Borassus flabellifer</i> L.	Arecaceae
174	<i>Boswellia serrata</i> Roxb. ex Colebr.	Burseraceae
175	<i>Bougainvillea spectabilis</i> Willd.	Nyctaginaceae
176	<i>Brachiaria ramosa</i> (L.) Stapf	Poaceae
177	<i>Brachiaria reptans</i> (L.) C.A.Gardner &	Poaceae
178	<i>Brassica juncea</i> (L.) Czern.	Brassicaceae
179	<i>Breynia retusa</i> (Dennst.) Alston	Phyllanthaceae
180	<i>Breynia vitis-idaea</i> (Burm.f.) C.E.C.Fisch.	Phyllanthaceae
181	<i>Bridelia retusa</i> (L.) A.Juss.	Phyllanthaceae
182	<i>Bridelia stipularis</i> (L.) Blume	Phyllanthaceae
183	<i>Brugmansia suaveolens</i> (Humb. & Bonpl. ex	Solanaceae
184	<i>Buchanania cochinchinensis</i> (Lour.)	Anacardiaceae
185	<i>Bulbophyllum sterile</i> (Lam.) Suresh	Orchidaceae
186	<i>Bulbostylis barbata</i> (Rottb.) C.B.Clarke	Cyperaceae
187	<i>Butea monosperma</i> (Lam.) Taub.	Leguminosae
188	<i>Cadaba fruticosa</i> (L.) Druce	Capparaceae
189	<i>Caesalpinia bonduc</i> (L.) Roxb.	Leguminosae
190	<i>Caesalpinia coriaria</i> (Jacq.) Willd.	Leguminosae
191	<i>Caesalpinia cucullata</i> Roxb.	Leguminosae
192	<i>Caesalpinia decapetala</i> (Roth) Alston	Leguminosae
193	<i>Caesalpinia mimosoides</i> Lam.	Leguminosae
194	<i>Caesalpinia pulcherrima</i> (L.) Sw.	Leguminosae
195	<i>Cajanus cajan</i> (L.) Millsp.	Leguminosae
196	<i>Calamus thwaitesii</i> Becc.	Arecaceae
197	<i>Callicarpa tomentosa</i> (L.) L.	Lamiaceae
198	<i>Calophyllum calaba</i> L.	Clusiaceae
199	<i>Calophyllum inophyllum</i> L.	Clusiaceae
200	<i>Calotropis gigantea</i> (L.) Dryand.	Apocynaceae
201	<i>Camellia sinensis</i> (L.) Kuntze	Theaceae
202	<i>Canarium strictum</i> Roxb.	Burseraceae
203	<i>Canna indica</i> L.	Cannaceae

204	<i>Canscora diffusa</i> (Vahl) R.Br. ex Roem. &	Gentianaceae
205	<i>Canscora perfoliata</i> Lam.	Gentianaceae
206	<i>Canthium angustifolium</i> Roxb.	Rubiaceae
207	<i>Canthium coromandelicum</i> (Burm.f.) Alston	Rubiaceae
208	<i>Canthium rheedei</i> DC.	Rubiaceae
209	<i>Capparis divaricata</i> Lam.	Capparaceae
210	<i>Capparis roxburghii</i> DC.	Capparaceae
211	<i>Capparis zeylanica</i> L.	Capparaceae
212	<i>Capsicum annuum</i> L.	Solanaceae
213	<i>Carallia brachiata</i> (Lour.) Merr.	Rhizophoraceae
214	<i>Caralluma adscendens</i> (Roxb.) R.Br.	Apocynaceae
215	<i>Caralluma indica</i> (Wight & Arn.) N.E.Br.	Apocynaceae
216	<i>Caralluma umbellata</i> Haw.	Apocynaceae
217	<i>Cardiospermum corindum</i> L.	Sapindaceae
218	<i>Cardiospermum halicacabum</i> L.	Sapindaceae
219	<i>Careya arborea</i> Roxb.	Lecythidaceae
220	<i>Carissa carandas</i> L.	Apocynaceae
221	<i>Caryota urens</i> L.	Arecaceae
222	<i>Cascabela thevetia</i> (L.) Lippold	Apocynaceae
223	<i>Casearia ovata</i> (Lam.) Willd.	Salicaceae
224	<i>Casearia tomentosa</i> Roxb.	Salicaceae
225	<i>Cassia fistula</i> L.	Leguminosae
226	<i>Cassytha filiformis</i> L.	Lauraceae
227	<i>Catharanthus pusillus</i> (Murray) G.Don	Apocynaceae
228	<i>Catharanthus roseus</i> (L.) G.Don	Apocynaceae
229	<i>Cayratia mollissima</i> (Planch.) Gagnep.	Vitaceae
230	<i>Cayratia pedata</i> (Lam.) Gagnep.	Vitaceae
231	<i>Cayratia trifolia</i> (L.) Domin	Vitaceae
232	<i>Ceiba pentandra</i> (L.) Gaertn.	Malvaceae
233	<i>Celosia argentea</i> L.	Amaranthaceae
234	<i>Celtis philippensis</i> Blanco	Cannabaceae
235	<i>Celtis tetrandra</i> Roxb.	Cannabaceae
236	<i>Celtis timorensis</i> Span.	Cannabaceae
237	<i>Centella asiatica</i> (L.) Urb.	Apiaceae
238	<i>Centranthera indica</i> (L.) Gamble	Orobanchaceae
239	<i>Centrosema pubescens</i> Benth.	Leguminosae
240	<i>Cerastium lanceolatum</i> (Poir.) Volponi	Caryophyllaceae
241	<i>Ceropegia beddomei</i> Hook.f.	Apocynaceae
242	<i>Ceropegia candelabrum</i> L.	Apocynaceae
243	<i>Ceropegia juncea</i> Roxb.	Apocynaceae
244	<i>Cestrum nocturnum</i> L.	Solanaceae
245	<i>Chamaecrista absus</i> (L.) H.S.Irwin & Barneby	Leguminosae

246	<i>Chamaecrista mimosoides</i> (L.) Greene	Leguminosae
247	<i>Chassalia curviflora</i> var. <i>ophioxylodes</i> (Wall.)	Rubiaceae
248	<i>Cheilocostus speciosus</i> (J.Koenig) C.D.Specht	Costaceae
249	<i>Chionachne gigantea</i> (J.Koenig) Veldkamp	Poaceae
250	<i>Chionanthus mala-elengi</i> (Dennst.) P.S.Green	Oleaceae
215	<i>Chloris barbata</i> Sw.	Poaceae
252	<i>Chlorophytum indicum</i> (Willd. ex Schult. &	Asparagaceae
253	<i>Chonemorpha fragrans</i> (Moon) Alston	Apocynaceae
254	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	Asteraceae
255	<i>Chrysophyllum cainito</i> L.	Sapotaceae
256	<i>Chrysophyllum roxburghii</i> G.Don	Sapotaceae
257	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Poaceae
258	<i>Chrysopogon fulvous</i> (Spreng.) Chiov.	Poaceae
259	<i>Chukrasia tabularis</i> A.Juss.	Meliaceae
260	<i>Cinnamomum camphora</i> (L.) J.Presl	Lauraceae
261	<i>Cinnamomum cassia</i> (L.) J.Presl	Lauraceae
262	<i>Cinnamomum malabattrum</i> (Burm.f.) J.Presl	Lauraceae
263	<i>Cinnamomum sulphuratum</i> Nees	Lauraceae
264	<i>Cinnamomum verum</i> J.Presl	Lauraceae
265	<i>Cinnamomum wightii</i> Meisn.	Lauraceae
266	<i>Circaea alpina</i> L.	Onagraceae
267	<i>Cirsium wallichii</i> DC.	Asteraceae
268	<i>Cissampelos pareira</i> L.	Menispermaceae
269	<i>Cissus javana</i> DC.	Vitaceae
270	<i>Cissus latifolia</i> Lam.	Vitaceae
271	<i>Cissus quadrangularis</i> L.	Vitaceae
272	<i>Cissus repens</i> Lam.	Vitaceae
273	<i>Cissus vitiginea</i> L.	Vitaceae
274	<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae
275	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	Cucurbitaceae
276	<i>Citrus limon</i> (L.) Osbeck	Rutaceae
277	<i>Citrus medica</i> L.	Rutaceae
278	<i>Cleisostoma tenuifolium</i> (L.) Garay	Orchidaceae
279	<i>Clematis gouriana</i> Roxb. ex DC.	Ranunculaceae
280	<i>Clematis smilacifolia</i> Wall.	Ranunculaceae
281	<i>Clematis wightiana</i> Wall.	Ranunculaceae
282	<i>Cleome monophylla</i> L.	Cleomaceae
283	<i>Cleome rutidosperma</i> var. <i>burmannii</i> (Wight & Arn.) Siddiqui & S.N.Dixit	Cleomaceae
284	<i>Cleome viscosa</i> L.	Cleomaceae
285	<i>Clerodendrum indicum</i> (L.) Kuntze	Lamiaceae
286	<i>Clerodendrum infortunatum</i> L.	Lamiaceae

287	<i>Clerodendrum phlomoides hort. ex DC.</i>	Lamiaceae
288	<i>Clitoria ternatea L.</i>	Leguminosae
289	<i>Coccinia grandis (L.) Voigt</i>	Cucurbitaceae
290	<i>Cocculus laurifolius DC.</i>	Menispermaceae
291	<i>Cochlospermum religiosum (L.) Alston</i>	Bixaceae
292	<i>Cocos nucifera L.</i>	Arecaceae
293	<i>Codariocalyx motorius (Houtt.) H.Ohashi</i>	Leguminosae
294	<i>Coffea arabica L.</i>	Rubiaceae
295	<i>Coix lacryma-jobi L.</i>	Poaceae
296	<i>Coldenia procumbens L.</i>	Boraginaceae
297	<i>Colebrookea oppositifolia Sm.</i>	Lamiaceae
298	<i>Colocasia esculenta (L.) Schott</i>	Araceae
299	<i>Combretum indicum (L.) DeFilipps</i>	Combretaceae
300	<i>Commelina benghalensis L.</i>	Commelinaceae
301	<i>Commelina diffusa Burm.f.</i>	Commelinaceae
302	<i>Commiphora berryi (Arn.) Engl.</i>	Burseraceae
303	<i>Commiphora caudata (Wight & Arn.) Engl.</i>	Burseraceae
304	<i>Connarus monocarpus L.</i>	Connaraceae
305	<i>Corallocarpus epigaeus (Rottler) Hook.f.</i>	Cucurbitaceae
306	<i>Corchorus aestuans L.</i>	Malvaceae
307	<i>Coriandrum sativum L.</i>	Apiaceae
308	<i>Corypha umbraculifera L.</i>	Arecaceae
309	<i>Coscinium fenestratum (Goetgh.) Colebr.</i>	Menispermaceae
310	<i>Cosmostigma cordatum (Poir.) M.R.Almeida</i>	Apocynaceae
311	<i>Crassocephalum crepidioides (Benth.) S.Moore</i>	Asteraceae
312	<i>Crateva adansonii DC.</i>	Capparaceae
313	<i>Crateva religiosa G.Forst.</i>	Capparaceae
314	<i>Crinum asiaticum L.</i>	Amaryllidaceae
315	<i>Crinum latifolium L.</i>	Amaryllidaceae
316	<i>Crossandra infundibuliformis (L.) Nees</i>	Acanthaceae
317	<i>Crotalaria albida Roth</i>	Leguminosae
318	<i>Crotalaria calycina Schrank</i>	Leguminosae
319	<i>Crotalaria juncea L.</i>	Leguminosae
320	<i>Crotalaria medicaginea Lam.</i>	Leguminosae
321	<i>Crotalaria mysorensis Roth</i>	Leguminosae
322	<i>Crotalaria pallida Aiton</i>	Leguminosae
323	<i>Crotalaria spectabilis Roth</i>	Leguminosae
324	<i>Crotalaria verrucosa L.</i>	Leguminosae
325	<i>Croton bonplandianus Baill.</i>	Euphorbiaceae
326	<i>Croton caudatus Geiseler</i>	Euphorbiaceae
327	<i>Croton malabaricus Bedd.</i>	Euphorbiaceae
328	<i>Croton tiglium L.</i>	Euphorbiaceae

329	<i>Croton zeylanicus</i> Müll.Arg.	Euphorbiaceae
330	<i>Cryptostegia grandiflora</i> Roxb. ex R.Br.	Apocynaceae
331	<i>Ctenolepis garcini</i> (L.) C.B.Clarke	Cucurbitaceae
332	<i>Cucumis leiospermus</i> (Wight & Arn.) Ghebret.	Cucurbitaceae
333	<i>Cucumis melo</i> L.	Cucurbitaceae
334	<i>Cucumis prophetarum</i> L.	Cucurbitaceae
335	<i>Cucumis sativus</i> L.	Cucurbitaceae
336	<i>Cucurbita maxima</i> Duchesne	Cucurbitaceae
337	<i>Cucurbita pepo</i> L.	Cucurbitaceae
338	<i>Cullenia exarillata</i> A.Robyns	Malvaceae
339	<i>Curculigo orchoides</i> Gaertn.	Hypoxidaceae
340	<i>Curcuma aromatica</i> Salisb.	Zingiberaceae
341	<i>Curcuma longa</i> L.	Zingiberaceae
342	<i>Curcuma montana</i> Roxb.	Zingiberaceae
343	<i>Curcuma zedoaria</i> (Christm.) Roscoe	Zingiberaceae
344	<i>Cuscuta chinensis</i> Lam.	Convolvulaceae
345	<i>Cuscuta reflexa</i> Roxb.	Convolvulaceae
346	<i>Cyanotis axillaris</i> (L.) D.Don ex Sweet	Commelinaceae
347	<i>Cyanotis cristata</i> (L.) D.Don	Commelinaceae
348	<i>Cyanotis papilionacea</i> (Burm.f.) Schult. &	Commelinaceae
349	<i>Cyanthillium albicans</i> (DC.) H.Rob.	Asteraceae
350	<i>Cyanthillium cinereum</i> (L.) H.Rob.	Asteraceae
351	<i>Cyathula prostrata</i> (L.) Blume	Amaranthaceae
352	<i>Cyclea fissicalyx</i> Dunn	Menispermaceae
353	<i>Cyclea peltata</i> (Lam.) Hook.f. & Thomson	Menispermaceae
354	<i>Cymbidium aloifolium</i> (L.) Sw.	Orchidaceae
355	<i>Cymbopogon caesius</i> (Hook. & Arn.) Stapf	Poaceae
356	<i>Cymbopogon citratus</i> (DC.) Stapf	Poaceae
357	<i>Cymbopogon flexuosus</i> (Nees ex Steud.)	Poaceae
358	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae
359	<i>Cyperus compressus</i> L.	Cyperaceae
360	<i>Cyperus diffusus</i> Vahl	Cyperaceae
361	<i>Cyperus distans</i> L.f.	Cyperaceae
362	<i>Cyperus exaltatus</i> Retz.	Cyperaceae
363	<i>Cyperus haspan</i> L.	Cyperaceae
364	<i>Cyperus iria</i> L.	Cyperaceae
365	<i>Cyperus malaccensis</i> Lam.	Cyperaceae
366	<i>Cyperus nutans</i> var. <i>eleusinoides</i> (Kunth)	Cyperaceae
367	<i>Cyperus pangorei</i> Rotth.	Cyperaceae
368	<i>Cyperus pilosus</i> Vahl	Cyperaceae
369	<i>Cyperus rotundus</i> L.	Cyperaceae
370	<i>Dalbergia lanceolaria</i> L.f.	Leguminosae

371	<i>Dalbergia latifolia</i> Roxb.	Leguminosae
372	<i>Dalbergia sissooides</i> Wight & Arn.	Leguminosae
373	<i>Dalbergia volubilis</i> Roxb.	Leguminosae
374	<i>Daphniphyllum neilgherrense</i> (Wight)	Daphniphyllaceae
375	<i>Datura metel</i> L.	Solanaceae
376	<i>Debregeasia longifolia</i> (Burm.f.) Wedd.	Urticaceae
377	<i>Decalepis hamiltonii</i> Wight & Arn.	Apocynaceae
378	<i>Delonix regia</i> (Hook.) Raf.	Leguminosae
379	<i>Dendrobium nodosum</i> Dalzell	Orchidaceae
380	<i>Dendrobium ovatum</i> (L.) Kraenzl.	Orchidaceae
381	<i>Dendrocalamus strictus</i> (Roxb.) Nees	Poaceae
382	<i>Dendrocnide sinuata</i> (Blume) Chew	Urticaceae
383	<i>Dendrolobium triangulare</i> (Retz.) Schindl.	Leguminosae
384	<i>Dendrophthoe falcata</i> (L.f.) Ettingsh.	Loranthaceae
385	<i>Dentella repens</i> (L.) J.R.Forst. & G.Forst.	Rubiaceae
386	<i>Derris scandens</i> (Roxb.) Benth.	Leguminosae
387	<i>Desmodium gangeticum</i> (L.) DC.	Leguminosae
388	<i>Desmodium heterocarpon</i> var. <i>strigosum</i>	Leguminosae
389	<i>Desmodium heterophyllum</i> (Willd.) DC.	Leguminosae
390	<i>Desmodium laxiflorum</i> DC.	Leguminosae
391	<i>Desmodium microphyllum</i> (Thunb.) DC.	Leguminosae
392	<i>Desmodium styracifolium</i> (Osbeck) Merr.	Leguminosae
393	<i>Desmodium triflorum</i> (L.) DC.	Leguminosae
394	<i>Desmodium velutinum</i> (Willd.) DC.	Leguminosae
395	<i>Dichrocephala integrifolia</i> (L.f.) Kuntze	Asteraceae
396	<i>Dichrostachys cinerea</i> (L.) Wight & Arn.	Leguminosae
397	<i>Dicliptera cuneata</i> Nees	Acanthaceae
398	<i>Dicliptera paniculata</i> (Forssk.) I.Darbysh.	Acanthaceae
399	<i>Digera muricata</i> (L.) Mart.	Amaranthaceae
400	<i>Dillenia pentagyna</i> Roxb.	Dilleniaceae
401	<i>Dimocarpus longan</i> Lour.	Sapindaceae
402	<i>Diospyros bourdillonii</i> Brandis	Ebenaceae
403	<i>Diospyros buxifolia</i> (Blume) Hiern	Ebenaceae
404	<i>Diospyros candolleana</i> Wight	Ebenaceae
405	<i>Diospyros ebenum</i> J.Koenig ex Retz.	Ebenaceae
406	<i>Diospyros malabarica</i> (Desr.) Kostel.	Ebenaceae
407	<i>Diospyros melanoxylon</i> Roxb.	Ebenaceae
408	<i>Diospyros montana</i> Roxb.	Ebenaceae
409	<i>Diospyros paniculata</i> Dalzell	Ebenaceae
410	<i>Diospyros sylvatica</i> Roxb.	Ebenaceae
411	<i>Diospyros vera</i> (Lour.) A.Chev.	Ebenaceae
412	<i>Diploclisia glaucescens</i> (Blume) Diels	Menispermaceae

413	<i>Diplocyclos palmatus</i> (L.) C.Jeffrey	Cucurbitaceae
414	<i>Dipteracanthus prostratus</i> (Poir.) Nees	Acanthaceae
415	<i>Dodonaea viscosa</i> (L.) Jacq.	Sapindaceae
416	<i>Dolichandrone arcuata</i> (Wight) C.B.Clarke	Bignoniaceae
417	<i>Dolichos trilobus</i> L.	Leguminosae
418	<i>Dopatrium junceum</i> (Roxb.) Buch.-Ham. ex	Plantaginaceae
419	<i>Dregea volubilis</i> (L.f.) Benth. ex Hook.f.	Apocynaceae
420	<i>Drymaria cordata</i> (L.) Willd. ex Schult.	Caryophyllaceae
421	<i>Dysoxylum malabaricum</i> Bedd. ex C.DC.	Meliaceae
422	<i>Ecbolium viride</i> (Forssk.) Alston	Acanthaceae
423	<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Poaceae
424	<i>Echinochloa stagnina</i> (Retz.) P.Beauv.	Poaceae
425	<i>Eclipta prostrata</i> (L.) L.	Asteraceae
426	<i>Eichhornia crassipes</i> (Mart.) Solms	Pontederiaceae
427	<i>Elaeagnus conferta</i> Roxb.	Elaeagnaceae
428	<i>Elaeocarpus munroii</i> Mast.	Elaeocarpaceae
429	<i>Elaeocarpus serratus</i> L.	Elaeocarpaceae
430	<i>Elaeocarpus tuberculatus</i> Roxb.	Elaeocarpaceae
431	<i>Elatostema lineolatum</i> Wight	Urticaceae
432	<i>Elephantopus scaber</i> L.	Asteraceae
433	<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae
434	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae
435	<i>Elytranthe parasitica</i> (L.) Danser	Loranthaceae
436	<i>Embelia ribes</i> Burm.f.	Primulaceae
437	<i>Emilia sonchifolia</i> (L.) DC. ex DC.	Asteraceae
438	<i>Entada rheedii</i> Spreng.	Leguminosae
439	<i>Eragrostis gangetica</i> (Roxb.) Steud.	Poaceae
440	<i>Eragrostis nutans</i> (Retz.) Nees ex Steud.	Poaceae
441	<i>Eragrostis viscosa</i> (Retz.) Trin.	Poaceae
442	<i>Erigeron bonariensis</i> L.	Asteraceae
443	<i>Erigeron trilobus</i> (Decne.) Boiss.	Asteraceae
444	<i>Eriocaulon sexangulare</i> L.	Eriocaulaceae
445	<i>Eriolaena hookeriana</i> Wight & Arn.	Malvaceae
446	<i>Eriolaena lushingtonii</i> Dunn	Malvaceae
447	<i>Eriolaena quinquelocularis</i> (Wight & Arn.)	Malvaceae
448	<i>Erycibe paniculata</i> Roxb.	Convolvulaceae
449	<i>Erythrina stricta</i> Roxb.	Leguminosae
450	<i>Erythrina suberosa</i> Roxb.	Leguminosae
451	<i>Erythralium scandens</i> Blume	Olacaceae
452	<i>Eucalyptus camaldulensis</i> Dehnh.	Myrtaceae
453	<i>Eucalyptus globulus</i> Labill.	Myrtaceae
454	<i>Eucalyptus tereticornis</i> Sm.	Myrtaceae

455	<i>Eugenia roxburghii</i> DC.	Myrtaceae
456	<i>Eulophia epidendreaea</i> (J.Koenig ex Retz.)	Orchidaceae
457	<i>Eulophia pratensis</i> Lindl.	Orchidaceae
458	<i>Eulophia spectabilis</i> (Dennst.) Suresh	Orchidaceae
459	<i>Euonymus crenulatus</i> Wall. ex Wight & Arn.	Celastraceae
460	<i>Euonymus indicus</i> B.Heyne ex Wall.	Celastraceae
461	<i>Euonymus serratifolius</i> Bedd.	Celastraceae
462	<i>Euphorbia antiquorum</i> L.	Euphorbiaceae
463	<i>Euphorbia hirta</i> L.	Euphorbiaceae
464	<i>Euphorbia milii</i> Des Moul.	Euphorbiaceae
465	<i>Euphorbia nivulia</i> Buch.-Ham.	Euphorbiaceae
466	<i>Euphorbia pulcherrima</i> Willd. ex Klotzsch	Euphorbiaceae
467	<i>Euphorbia rosea</i> Retz.	Euphorbiaceae
468	<i>Euphorbia rothiana</i> Spreng.	Euphorbiaceae
469	<i>Euphorbia thymifolia</i> L.	Euphorbiaceae
470	<i>Euphorbia tirucalli</i> L.	Euphorbiaceae
471	<i>Euphorbia tortilis</i> Rottler ex Ainslie	Euphorbiaceae
472	<i>Eurya nitida</i> Korth.	Pentaphylacaceae
473	<i>Evolvulus alsinoides</i> (L.) L.	Convolvulaceae
474	<i>Evolvulus nummularius</i> (L.) L.	Convolvulaceae
475	<i>Exacum tetragonum</i> Roxb.	Gentianaceae
476	<i>Excoecaria agallocha</i> L.	Euphorbiaceae
477	<i>Fagraea ceilanica</i> Thunb.	Gentianaceae
478	<i>Ficus amplissima</i> Sm.	Moraceae
479	<i>Ficus arnottiana</i> (Miq.) Miq.	Moraceae
480	<i>Ficus benghalensis</i> L.	Moraceae
481	<i>Ficus callosa</i> Willd.	Moraceae
482	<i>Ficus dalhousiae</i> Miq.	Moraceae
483	<i>Ficus drupacea</i> Thunb.	Moraceae
484	<i>Ficus elastica</i> Roxb. ex Hornem.	Moraceae
485	<i>Ficus exasperata</i> Vahl	Moraceae
486	<i>Ficus hispida</i> L.f.	Moraceae
487	<i>Ficus microcarpa</i> L.f.	Moraceae
488	<i>Ficus mollis</i> Vahl	Moraceae
489	<i>Ficus racemosa</i> L.	Moraceae
490	<i>Ficus religiosa</i> L.	Moraceae
491	<i>Ficus talbotii</i> King	Moraceae
492	<i>Ficus tinctoria</i> subsp. <i>gibbosa</i> (Blume) Corner	Moraceae
493	<i>Ficus tsjakela</i> Burm.f.	Moraceae
494	<i>Filicium decipiens</i> (Wight & Arn.) Thwaites	Sapindaceae
495	<i>Fimbristylis bisumbellata</i> (Forssk.) Bubani	Cyperaceae
496	<i>Fimbristylis falcata</i> (Vahl) Kunth	Cyperaceae

497	<i>Fimbristylis ovata</i> (Burm.f.) J.Kern	Cyperaceae
498	<i>Firmiana colorata</i> (Roxb.) R.Br.	Malvaceae
499	<i>Firmiana simplex</i> (L.) W.Wight	Malvaceae
500	<i>Flacourtia indica</i> (Burm.f.) Merr.	Salicaceae
501	<i>Flemingia grahamiana</i> Wight & Arn.	Leguminosae
502	<i>Flemingia macrophylla</i> (Willd.) Merr.	Leguminosae
503	<i>Flemingia semialata</i> Roxb.	Leguminosae
504	<i>Flemingia strobilifera</i> (L.) W.T.Aiton	Leguminosae
505	<i>Flemingia wightiana</i> Wight & Arn.	Leguminosae
506	<i>Floscopa scandens</i> Lour.	Commelinaceae
507	<i>Galinsoga parviflora</i> Cav.	Asteraceae
508	<i>Galium asperifolium</i> Wall.	Rubiaceae
509	<i>Garcinia cowa</i> Roxb. ex Choisy	Clusiaceae
510	<i>Garcinia gummi-gutta</i> (L.) Roxb.	Clusiaceae
511	<i>Garcinia mangostana</i> L.	Clusiaceae
512	<i>Garcinia morella</i> (Gaertn.) Desr.	Clusiaceae
513	<i>Garcinia spicata</i> Hook.f.	Clusiaceae
514	<i>Garcinia wightii</i> T.Anderson	Clusiaceae
515	<i>Gardenia gummiifera</i> L.f.	Rubiaceae
516	<i>Gardenia jasminoides</i> J.Ellis	Rubiaceae
517	<i>Gardenia resinifera</i> Roth	Rubiaceae
518	<i>Geodorum densiflorum</i> (Lam.) Schltr.	Orchidaceae
519	<i>Geophila repens</i> (L.) I.M.Johnst.	Rubiaceae
520	<i>Getonia floribunda</i> Roxb.	Combretaceae
521	<i>Girardinia diversifolia</i> (Link) Friis	Urticaceae
522	<i>Gisekia pharnaceoides</i> L.	Gisekiaceae
523	<i>Glinus lotoides</i> L.	Molluginaceae
524	<i>Glinus oppositifolius</i> (L.) Aug.DC.	Molluginaceae
525	<i>Globba marantina</i> L.	Zingiberaceae
526	<i>Gloriosa superba</i> L.	Colchicaceae
527	<i>Glycosmis macrocarpa</i> Wight	Rutaceae
528	<i>Glycosmis mauritiana</i> (Lam.) Tanaka	Rutaceae
529	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Rutaceae
530	<i>Gmelina arborea</i> Roxb.	Lamiaceae
531	<i>Gmelina asiatica</i> L.	Lamiaceae
532	<i>Gomphrena celosioides</i> Mart.	Amaranthaceae
533	<i>Gomphrena globosa</i> L.	Amaranthaceae
534	<i>Goniothalamus wightii</i> Hook.f. & Thomson	Annonaceae
535	<i>Gordonia obtusa</i> Wall. ex Wight	Theaceae
536	<i>Gouania microcarpa</i> DC.	Rhamnaceae
537	<i>Grangea maderaspatana</i> (L.) Poir.	Asteraceae
538	<i>Grevillea robusta</i> A.Cunn. ex R.Br.	Proteaceae

539	<i>Grewia laevigata</i> Vahl	Malvaceae
540	<i>Grewia villosa</i> Willd.	Malvaceae
541	<i>Grewia abutilifolia</i> Vent. ex Juss.	Malvaceae
542	<i>Grewia bracteata</i> Roth	Malvaceae
543	<i>Grewia heterotricha</i> Mast.	Malvaceae
544	<i>Grewia hirsuta</i> Vahl	Malvaceae
545	<i>Grewia oppositifolia</i> Roxb. ex DC.	Malvaceae
546	<i>Grewia orbiculata</i> Rottler	Malvaceae
547	<i>Grewia tiliifolia</i> Vahl	Malvaceae
548	<i>Gymnema khandalense</i> Santapau	Apocynaceae
549	<i>Gymnema sylvestre</i> (Retz.) R.Br. ex Sm.	Apocynaceae
550	<i>Gymnostachyum febrifugum</i> Benth.	Acanthaceae
551	<i>Gynura pseudo-china</i> Benth.	Asteraceae
552	<i>Habenaria crinifera</i> Lindl.	Orchidaceae
553	<i>Habenaria furcifera</i> Lindl.	Orchidaceae
554	<i>Habenaria longicorniculata</i> J.Graham	Orchidaceae
555	<i>Habenaria plantaginea</i> Lindl.	Orchidaceae
556	<i>Habenaria rariflora</i> A.Rich.	Orchidaceae
557	<i>Habenaria roxburghii</i> Nicolson	Orchidaceae
558	<i>Hackelochloa granularis</i> (L.) Kuntze	Poaceae
559	<i>Haldina cordifolia</i> (Roxb.) Ridsdale	Rubiaceae
560	<i>Hamelia patens</i> Jacq.	Rubiaceae
561	<i>Hardwickia binata</i> Roxb.	Leguminosae
562	<i>Harpullia arborea</i> (Blanco) Radlk.	Sapindaceae
563	<i>Hedychium coronarium</i> J.Koenig	Zingiberaceae
564	<i>Hedyotis articularis</i> R.Br. ex G.Don	Rubiaceae
565	<i>Helicteres isora</i> L.	Malvaceae
566	<i>Heliotropium indicum</i> L.	Boraginaceae
567	<i>Helixanthera wallichiana</i> Danser	Loranthaceae
568	<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	Apocynaceae
569	<i>Heracleum candolleanum</i> Gamble	Apiaceae
570	<i>Heracleum rigens</i> Wall. ex DC.	Apiaceae
571	<i>Heritiera papilio</i> Bedd.	Malvaceae
572	<i>Heteropogon contortus</i> (L.) P.Beauv. ex Roem.	Poaceae
573	<i>Hewittia malabarica</i> (L.) Suresh	Convolvulaceae
574	<i>Heynea trijuga</i> Roxb. ex Sims	Meliaceae
575	<i>Hibiscus hispidissimus</i> Griff.	Malvaceae
576	<i>Hibiscus lunariifolius</i> Willd.	Malvaceae
577	<i>Hibiscus micranthus</i> L.f.	Malvaceae
578	<i>Hibiscus mutabilis</i> L.	Malvaceae
579	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae
580	<i>Hibiscus sabdariffa</i> L.	Malvaceae

581	<i>Hibiscus surattensis</i> L.	Malvaceae
582	<i>Hiptage benghalensis</i> (L.) Kurz	Malpighiaceae
583	<i>Holarrhena pubescens</i> Wall. ex G.Don	Apocynaceae
584	<i>Holigarna arnottiana</i> Hook.f.	Anacardiaceae
585	<i>Holigarna ferruginea</i> Marchand	Anacardiaceae
586	<i>Holigarna grahamii</i> (Wight) Kurz	Anacardiaceae
587	<i>Holigarna nigra</i> Bourd.	Anacardiaceae
588	<i>Holoptelea integrifolia</i> Planch.	Ulmaceae
589	<i>Holostemma ada-kodien</i> Schult.	Apocynaceae
590	<i>Hoya wightii</i> Hook.f.	Apocynaceae
591	<i>Hoya ovalifolia</i> Wight & Arn.	Apocynaceae
592	<i>Humboldtia vahliana</i> Wight	Leguminosae
593	<i>Hunteria zeylanica</i> (Retz.) Gardner ex	Apocynaceae
594	<i>Hybanthus enneaspermus</i> (L.) F.Muell.	Violaceae
595	<i>Hydnocarpus alpina</i> Wight	Achariaceae
596	<i>Hydnocarpus macrocarpa</i> Warb.	Achariaceae
597	<i>Hydnocarpus pentandrus</i> (Buch.-Ham.) Oken	Achariaceae
598	<i>Hydrilla verticillata</i> (L.f.) Royle	Hydrocharitaceae
599	<i>Hydrocotyle javanica</i> Thunb.	Araliaceae
600	<i>Hydrocotyle sibthorpioides</i> Lam.	Araliaceae
601	<i>Hydrolea zeylanica</i> (L.) Vahl	Hydroleaceae
602	<i>Hygrophila auriculata</i> (Schumach.) Heine	Acanthaceae
603	<i>Hygrophila ringens</i> (L.) R. Br. ex Spreng.	Acanthaceae
604	<i>Hygrophila ringens</i> var. <i>ringens</i>	Acanthaceae
605	<i>Hymenodictyon obovatum</i> Wall.	Rubiaceae
606	<i>Hymenodictyon orixense</i> (Roxb.) Mabb.	Rubiaceae
607	<i>Hypericum humifusum</i> L.	Hypericaceae
608	<i>Hypericum japonicum</i> Thunb.	Hypericaceae
609	<i>Hypericum mysurense</i> Wall. ex Wight & Arn.	Hypericaceae
610	<i>Hypolytrum nemorum</i> (Vahl) Spreng.	Cyperaceae
611	<i>Hypoxis aurea</i> Lour.	Hypoxidaceae
612	<i>Hyptis capitata</i> Jacq.	Lamiaceae
613	<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae
614	<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton	Apocynaceae
615	<i>Ilex wightiana</i> Wall. ex Wight	Aquifoliaceae
616	<i>Ilex denticulata</i> Wall. ex Wight	Aquifoliaceae
617	<i>Impatiens balsamina</i> L.	Balsaminaceae
618	<i>Indigofera astragalina</i> DC.	Leguminosae
619	<i>Indigofera cassioides</i> DC.	Leguminosae
620	<i>Indigofera galeoides</i> DC.	Leguminosae
621	<i>Indigofera hirsuta</i> L.	Leguminosae
622	<i>Indigofera linnaei</i> Ali	Leguminosae

623	<i>Indigofera tinctoria</i> L.	Leguminosae
624	<i>Ipomoea alba</i> L.	Convolvulaceae
625	<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae
626	<i>Ipomoea cairica</i> (L.) Sweet	Convolvulaceae
627	<i>Ipomoea eriocarpa</i> R. Br.	Convolvulaceae
628	<i>Ipomoea hederifolia</i> L.	Convolvulaceae
629	<i>Ipomoea mauritiana</i> Jacq.	Convolvulaceae
630	<i>Ipomoea nil</i> (L.) Roth	Convolvulaceae
631	<i>Ipomoea obscura</i> (L.) Ker Gawl.	Convolvulaceae
632	<i>Ipomoea pes-tigridis</i> L.	Convolvulaceae
633	<i>Ipomoea quamoclit</i> L.	Convolvulaceae
634	<i>Ipomoea staphylina</i> Roem. & Schult.	Convolvulaceae
635	<i>Ipomoea turbinata</i> Lag.	Convolvulaceae
636	<i>Isachne globosa</i> (Thunb.) Kuntze	Poaceae
637	<i>Isodon nilgherricus</i> (Benth.) H.Hara	Lamiaceae
638	<i>Ixora coccinea</i> L.	Rubiaceae
639	<i>Ixora cuneifolia</i> Roxb.	Rubiaceae
640	<i>Ixora nigricans</i> R.Br. ex Wight & Arn.	Rubiaceae
641	<i>Ixora notoniana</i> Wall. ex G.Don	Rubiaceae
642	<i>Ixora pavetta</i> Andr.	Rubiaceae
643	<i>Jasminum angustifolium</i> (L.) Willd.	Oleaceae
644	<i>Jasminum auriculatum</i> Vahl	Oleaceae
645	<i>Jasminum azoricum</i> L.	Oleaceae
646	<i>Jasminum bignoniaceum</i> Wall. & G.Don	Oleaceae
647	<i>Jasminum calophyllum</i> Wall. & G.Don	Oleaceae
648	<i>Jasminum cuspidatum</i> Rottl. & Willd.	Oleaceae
649	<i>Jasminum grandiflorum</i> L.	Oleaceae
650	<i>Jasminum multiflorum</i> (Burm.f.) Andrews	Oleaceae
651	<i>Jasminum sambac</i> (L.) Aiton	Oleaceae
652	<i>Jasminum trichotomum</i> B.Heyne ex Roth	Oleaceae
653	<i>Justicia adhatoda</i> L.	Acanthaceae
654	<i>Justicia betonica</i> L.	Acanthaceae
655	<i>Justicia gendarussa</i> Burm.f.	Acanthaceae
656	<i>Justicia procumbens</i> L.	Acanthaceae
657	<i>Justicia prostrata</i> Gamble	Acanthaceae
658	<i>Justicia tranquebariensis</i> L.f.	Acanthaceae
659	<i>Kaempferia galanga</i> L.	Zingiberaceae
660	<i>Kamettia caryophyllata</i> (Roxb.) Nicolson &	Apocynaceae
661	<i>Kleinia grandiflora</i> (Wallich ex DC.) N.Rani	Asteraceae
662	<i>Knoxia sumatrensis</i> (Retz.) DC.	Rubiaceae
663	<i>Kopsia fruticosa</i> (Roxb.) A.DC.	Apocynaceae
664	<i>Kyllinga squamulata</i> Vahl	Cyperaceae

665	<i>Kyllinga brevifolia</i> Rottb.	Cyperaceae
666	<i>Kyllinga nemoralis</i> (J.R.Forst. & G.Forst.)	Cyperaceae
667	<i>Lablab purpureus</i> (L.) Sweet	Leguminosae
668	<i>Lagenandra ovata</i> (L.) Thwaites	Araceae
669	<i>Lagenandra toxicaria</i> Dalzell	Araceae
670	<i>Lagenaria siceraria</i> (Molina) Standl.	Cucurbitaceae
671	<i>Lagerstroemia indica</i> L.	Lythraceae
672	<i>Lagerstroemia microcarpa</i> Wight	Lythraceae
673	<i>Lagerstroemia speciosa</i> (L.) Pers.	Lythraceae
674	<i>Laggera crispata</i> (Vahl) Hepper & J.R.I.Wood	Asteraceae
675	<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae
676	<i>Lantana camara</i> L.	Verbenaceae
677	<i>Laportea interrupta</i> (L.) Chew	Urticaceae
678	<i>Launaea acaulis</i> (Roxb.) Bab. ex Kerr	Asteraceae
679	<i>Lawsonia inermis</i> L.	Lythraceae
680	<i>Leea guineensis</i> G. Don	Vitaceae
681	<i>Leea indica</i> (Burm. f.) Merr.	Vitaceae
682	<i>Leea macrophylla</i> Roxb. ex Hornem.	Vitaceae
683	<i>Leonotis nepetifolia</i> (L.) R.Br.	Lamiaceae
684	<i>Lepidagathis incurva</i> Buch.-Ham. ex D. Don	Acanthaceae
685	<i>Lepidagathis scariosa</i> Nees	Acanthaceae
686	<i>Lepidium didymum</i> L.	Brassicaceae
687	<i>Leptadenia reticulata</i> (Retz.) Wight & Arn.	Apocynaceae
688	<i>Leucas decemdentata</i> (Willd.) Sm.	Lamiaceae
689	<i>Leucas lavandulaefolia</i> Rees	Lamiaceae
690	<i>Leucas martinicensis</i> (Jacq.) R.Br.	Lamiaceae
691	<i>Leucas urticifolia</i> (Vahl) Sm.	Lamiaceae
692	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Lamiaceae
693	<i>Ligustrum perrottetii</i> A.DC.	Oleaceae
694	<i>Ligustrum robustum</i> (Roxb.) Blume	Oleaceae
695	<i>Limnophila aromatica</i> (Lam.) Merr.	Plantaginaceae
696	<i>Limnophila indica</i> (L.) Druce	Plantaginaceae
697	<i>Limonia acidissima</i> Groff	Rutaceae
698	<i>Lindernia anagallis</i> (Burm.f.) Pennell	Linderniaceae
699	<i>Lindernia antipoda</i> (L.) Alston	Linderniaceae
700	<i>Lindernia caespitosa</i> (Blume) Panigrahi	Linderniaceae
701	<i>Lindernia ciliata</i> (Colsm.) Pennell	Linderniaceae
702	<i>Lindernia crustacea</i> (L.) F.Muell.	Linderniaceae
703	<i>Lindernia hyssopoides</i> (L.) Haines	Linderniaceae
704	<i>Lindernia oppositifolia</i> (L.) Mukerjee	Linderniaceae
705	<i>Lindernia rotundifolia</i> (L.) Alston	Linderniaceae
706	<i>Lindernia ruellioides</i> (Colsm.) Pennell	Linderniaceae

707	<i>Lipocarpha squarrosa</i> (L.) Goetgh.	Cyperaceae
708	<i>Lippia javanica</i> (Burm.f.) Spreng.	Verbenaceae
709	<i>Litchi chinensis</i> Sonn.	Sapindaceae
710	<i>Litsea coriacea</i> Hook.f.	Lauraceae
711	<i>Litsea quinqueflora</i> (Dennst.) Suresh	Lauraceae
712	<i>Litsea stocksii</i> Hook.f.	Lauraceae
713	<i>Lobelia nicotianifolia</i> Roth ex Schult.	Campanulaceae
714	<i>Lobelia alsinoides</i> Lam.	Campanulaceae
715	<i>Lobelia leschenaultiana</i> (C.Presl) Skottsb.	Campanulaceae
716	<i>Loeseneriella obtusifolia</i> (Roxb.) A.C.Sm.	Celastraceae
717	<i>Lolium temulentum</i> L.	Poaceae
718	<i>Luffa acutangula</i> (L.) Roxb.	Cucurbitaceae
719	<i>Luffa cylindrica</i> (L.) M.Roem.	Cucurbitaceae
720	<i>Lycianthes laevis</i> (Dunal) Bitter	Solanaceae
721	<i>Lycianthes denticulata</i> (Blume) Bitter	Solanaceae
722	<i>Lycopersicon esculentum</i> Mill.	Solanaceae
723	<i>Madhuca longifolia</i> (J.Koenig ex L.) J.F.Macbr.	Sapotaceae
724	<i>Madhuca neriifolia</i> (Moon) H.J.Lam	Sapotaceae
725	<i>Maesa indica</i> (Roxb.) A. DC.	Primulaceae
726	<i>Magnolia champaca</i> (L.) Baill. ex Pierre	Magnoliaceae
727	<i>Magnolia nilagirica</i> (Zenker) Figlar	Magnoliaceae
728	<i>Malvastrum coromandelianum</i> (L.) Garcke	Malvaceae
729	<i>Mangifera indica</i> L.	Anacardiaceae
730	<i>Manilkara hexandra</i> (Roxb.) Dubard	Sapotaceae
731	<i>Manilkara zapota</i> (L.) P.Royen	Sapotaceae
732	<i>Marsdenia tirunelvelica</i> A.N.Henry & Subr.	Apocynaceae
733	<i>Mastixia arborea</i> (Wight) C.B.Clarke	Cornaceae
734	<i>Mazus pumilus</i> (Burm.f.) Steenis	Phrymaceae
735	<i>Melastoma malabathricum</i> L.	Melastomataceae
736	<i>Melia azedarach</i> L.	Meliaceae
737	<i>Meliosma simplicifolia</i> (Roxb.) Walp.	Sabiaceae
738	<i>Melochia corchorifolia</i> L.	Malvaceae
739	<i>Memecylon angustifolium</i> Wight	Melastomataceae
740	<i>Memecylon talbotianum</i> Brandis	Melastomataceae
741	<i>Memecylon umbellatum</i> Burm. f.	Melastomataceae
742	<i>Merremia hederacea</i> (Burm. f.) Hallier f.	Convolvulaceae
743	<i>Merremia tridentata</i> (L.) Hallier f.	Convolvulaceae
744	<i>Merremia umbellata</i> (L.) Hallier f.	Convolvulaceae
745	<i>Merremia vitifolia</i> (Burm. f.) Hallier f.	Convolvulaceae
746	<i>Mesua ferrea</i> L.	Calophyllaceae
747	<i>Micromeria biflora</i> (Buch.-Ham. ex D.Don)	Lamiaceae
748	<i>Microstegium ciliatum</i> (Trin.) A.Camus	Poaceae

749	<i>Mikania micrantha</i> Kunth	Asteraceae
750	<i>Miliusa tomentosa</i> (Roxb.) J.Sinclair	Annonaceae
751	<i>Millingtonia hortensis</i> L.f.	Bignoniaceae
752	<i>Mimosa pudica</i> var. <i>unijuga</i> (Duchass. &	Leguminosae
753	<i>Mimusops elengi</i> L.	Sapotaceae
754	<i>Mirabilis jalapa</i> L.	Nyctaginaceae
755	<i>Mitracarpus hirtus</i> (L.) DC.	Rubiaceae
756	<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Rubiaceae
757	<i>Mollugo nudicaulis</i> Lam.	Molluginaceae
758	<i>Mollugo pentaphylla</i> L.	Molluginaceae
759	<i>Momordica charantia</i> L.	Cucurbitaceae
760	<i>Momordica dioica</i> Roxb. ex Willd.	Cucurbitaceae
761	<i>Monochoria vaginalis</i> (Burm.f.) C.Presl	Pontederiaceae
762	<i>Morinda pubescens</i> Sm.	Rubiaceae
763	<i>Morinda umbellata</i> L.	Rubiaceae
764	<i>Moringa pterygosperma</i> Gaertn.	Moringaceae
765	<i>Morus alba</i> L.	Moraceae
766	<i>Mucuna monosperma</i> Wight	Leguminosae
767	<i>Mucuna pruriens</i> (L.) DC.	Leguminosae
768	<i>Mukia maderaspatana</i> (L.) M.Roem.	Cucurbitaceae
769	<i>Mundulea sericea</i> (Willd.) A.Chev.	Leguminosae
770	<i>Munronia pinnata</i> (Wall.) W.Theob.	Meliaceae
771	<i>Murdannia japonica</i> (Thunb.) Faden	Commelinaceae
772	<i>Murdannia nudiflora</i> (L.) Brenan	Commelinaceae
773	<i>Murraya koenigii</i> (L.) Spreng.	Rutaceae
774	<i>Murraya paniculata</i> (L.) Jack	Rutaceae
775	<i>Musa paradisiaca</i> L.	Musaceae
776	<i>Mussaenda frondosa</i> L.	Rubiaceae
777	<i>Myristica fragrans</i> Hoult.	Myristicaceae
778	<i>Myristica malabarica</i> Lam.	Myristicaceae
779	<i>Myxopyrum smilacifolium</i> (Wall.) Blume	Oleaceae
780	<i>Naravelia zeylanica</i> (L.) DC.	Ranunculaceae
781	<i>Naregamia alata</i> Wight & Arn.	Meliaceae
782	<i>Naringi crenulata</i> (Roxb.) Nicolson	Rutaceae
783	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Rubiaceae
784	<i>Neolitsea scrobiculata</i> Gamble	Lauraceae
785	<i>Nerium oleander</i> L.	Apocynaceae
786	<i>Nervilia plicata</i> (Andrews) Schltr.	Orchidaceae
787	<i>Nicandra physalodes</i> (L.) Gaertn.	Solanaceae
788	<i>Nicotiana tabacum</i> L.	Solanaceae
789	<i>Nilgirianthus wightianus</i> (Nees) Bremek.	Acanthaceae
790	<i>Nothopegia colebrookiana</i> (Wight) Blume	Anacardiaceae

791	<i>Nothosaerva brachiata</i> (L.) Wight	Amaranthaceae
792	<i>Nymphoides hydrophylla</i> (Lour.) Kuntze	Menyanthaceae
793	<i>Nymphoides indica</i> (L.) Kuntze	Menyanthaceae
794	<i>Ocimum americanum</i> L.	Lamiaceae
795	<i>Ocimum basilicum</i> L.	Lamiaceae
796	<i>Ocimum gratissimum</i> L.	Lamiaceae
797	<i>Ocimum tenuiflorum</i> L.	Lamiaceae
798	<i>Oldenlandia auricularia</i> (L.) K.Schum.	Rubiaceae
799	<i>Oldenlandia brachypoda</i> DC.	Rubiaceae
800	<i>Oldenlandia corymbosa</i> L.	Rubiaceae
801	<i>Oldenlandia diffusa</i> (Willd.) Roxb.	Rubiaceae
802	<i>Oldenlandia herbacea</i> (L.) Roxb.	Rubiaceae
803	<i>Oldenlandia umbellata</i> L.	Rubiaceae
804	<i>Olea dioica</i> Roxb.	Oleaceae
805	<i>Ophiopogon intermedius</i> D.Don	Asparagaceae
806	<i>Ophiorrhiza mungos</i> L.	Rubiaceae
807	<i>Opuntia elatior</i> Mill.	Cactaceae
808	<i>Opuntia ficus-indica</i> (L.) Mill.	Cactaceae
809	<i>Opuntia stricta</i> (Haw.) Haw.	Cactaceae
810	<i>Oreocnide integrifolia</i> (Gaudich.) Miq.	Urticaceae
811	<i>Ormocarpum cochinchinense</i> (Lour.) Merr.	Leguminosae
812	<i>Ormosia travancorica</i> Bedd.	Leguminosae
813	<i>Oroxylum indicum</i> (L.) Kurz	Bignoniaceae
814	<i>Orthosiphon aristatus</i> (Blume) Miq.	Lamiaceae
815	<i>Orthosiphon thymiflorus</i> (Roth) Sleesen	Lamiaceae
816	<i>Oryza rufipogon</i> Griff.	Poaceae
817	<i>Oryza sativa</i> L.	Poaceae
818	<i>Osbeckia aspera</i> Blume	Melastomataceae
819	<i>Osbeckia zeylanica</i> Steud. ex Naudin	Melastomataceae
820	<i>Osyris lanceolata</i> Hochst. & Steud.	Santalaceae
821	<i>Oxalis corniculata</i> L.	Oxalidaceae
822	<i>Pajanelia longifolia</i> (Willd.) K.Schum.	Bignoniaceae
823	<i>Palaquium ellipticum</i> (Dalzell) Baill.	Sapotaceae
824	<i>Pancratium triflorum</i> Roxb.	Amaryllidaceae
825	<i>Pandanus thwaitesii</i> Martelli	Pandanaceae
826	<i>Panicum antidotale</i> Retz.	Poaceae
827	<i>Panicum maximum</i> Jacq.	Poaceae
828	<i>Panicum repens</i> L.	Poaceae
829	<i>Panicum sumatrense</i> Roth	Poaceae
830	<i>Paracalyx scariosus</i> (Roxb.) Ali	Leguminosae
831	<i>Paramignya monophylla</i> Wight	Rutaceae
832	<i>Parkinsonia aculeata</i> L.	Leguminosae

833	<i>Parochetus communis</i> D.Don	Leguminosae
834	<i>Parthenium hysterophorus</i> L.	Asteraceae
835	<i>Paspalum distichum</i> L.	Poaceae
836	<i>Paspalum scrobiculatum</i> L.	Poaceae
837	<i>Passiflora edulis</i> Sims	Passifloraceae
838	<i>Passiflora foetida</i> L.	Passifloraceae
839	<i>Pavetta tomentosa</i> Roxb. ex Sm.	Rubiaceae
840	<i>Pedaliium murex</i> L.	Pedaliaceae
841	<i>Peltophorum pterocarpum</i> (DC.) K.Heyne	Leguminosae
842	<i>Pentanema indicum</i> (L.) Ling	Asteraceae
843	<i>Peperomia pellucida</i> (L.) Kunth	Piperaceae
844	<i>Peperomia tetraphylla</i> (G.Forst.) Hook. & Arn.	Piperaceae
845	<i>Pergularia daemia</i> (Forssk.) Chiov.	Apocynaceae
846	<i>Perotis indica</i> (L.) Kuntze	Poaceae
847	<i>Persea macrantha</i> (Nees) Kosterm.	Lauraceae
848	<i>Petrea volubilis</i> L.	Verbenaceae
849	<i>Phaulopsis imbricata</i> (Forssk.) Sweet	Acanthaceae
850	<i>Phoebe wightii</i> Meisn.	Lauraceae
851	<i>Phoenix loureiroi</i> Kunth	Arecaceae
852	<i>Pholidota imbricata</i> Lindl.	Orchidaceae
853	<i>Phragmites karka</i> (Retz.) Trin. ex Steud.	Poaceae
854	<i>Physalis angulata</i> L.	Solanaceae
855	<i>Physalis peruviana</i> L.	Solanaceae
856	<i>Pilea microphylla</i> (L.) Liebm.	Urticaceae
857	<i>Pimpinella heyneana</i> (DC.) Benth.	Apiaceae
858	<i>Pimpinella pulneyensis</i> Gamble	Apiaceae
859	<i>Piper argyrophyllum</i> Miq.	Piperaceae
860	<i>Piper barberi</i> Gamble	Piperaceae
861	<i>Piper betle</i> L.	Piperaceae
862	<i>Piper longum</i> L.	Piperaceae
863	<i>Piper mullesua</i> Buch.-Ham. ex D. Don	Piperaceae
864	<i>Piper nigrum</i> L.	Piperaceae
865	<i>Piper trichostachyon</i> (Miq.) C. DC.	Piperaceae
866	<i>Piper umbellatum</i> L.	Piperaceae
867	<i>Pisonia aculeata</i> L.	Nyctaginaceae
868	<i>Pistia stratiotes</i> L.	Araceae
869	<i>Pittosporum napaulense</i> (DC.) Rehder & E.H.	Pittosporaceae
870	<i>Pittosporum neelgherrense</i> Wight & Arn.	Pittosporaceae
871	<i>Pittosporum tetraspermum</i> Wight & Arn.	Pittosporaceae
872	<i>Platostoma hispidum</i> (L.) A.J.Paton	Lamiaceae
873	<i>Pleiospermium alatum</i> (Wight & Arn.)	Rutaceae
874	<i>Pleurostyliia opposita</i> (Wall.) Alston	Celastraceae

875	<i>Plumbago indica</i> L.	Plumbaginaceae
876	<i>Plumbago zeylanica</i> L.	Plumbaginaceae
877	<i>Plumeria alba</i> L.	Apocynaceae
878	<i>Plumeria rubra</i> L.	Apocynaceae
879	<i>Poeciloneuron indicum</i> Bedd.	Calophyllaceae
880	<i>Pogonatherum crinitum</i> (Thunb.) Kunth	Poaceae
881	<i>Pogostemon auricularius</i> (L.) Hassk.	Lamiaceae
882	<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze	Lamiaceae
883	<i>Pogostemon heyneanus</i> Benth.	Lamiaceae
884	<i>Pogostemon paniculatus</i> (Willd.) Benth.	Lamiaceae
885	<i>Pogostemon pubescens</i> Benth.	Lamiaceae
886	<i>Pogostemon purpurascens</i> Dalzell	Lamiaceae
887	<i>Polyalthia cerasoides</i> (Roxb.) Bedd.	Annonaceae
888	<i>Polyalthia coffeoides</i> (Thwaites) Hook.f. &	Annonaceae
889	<i>Polyalthia fragrans</i> (Dalzell) Benth. & Hook. f.	Annonaceae
890	<i>Polyalthia longifolia</i> (Sonn.) Thwaites	Annonaceae
891	<i>Polycarpaea corymbosa</i> (L.) Lam.	Caryophyllaceae
892	<i>Polycarpon prostratum</i> (Forssk.) Asch. &	Caryophyllaceae
893	<i>Polygala arvensis</i> Willd.	Polygalaceae
894	<i>Polygala chinensis</i> L.	Polygalaceae
895	<i>Polygala elongata</i> Klein ex Willd.	Polygalaceae
896	<i>Polygala sphenoptera</i> Fresen.	Polygalaceae
897	<i>Polygonum plebeium</i> R.Br.	Polygalaceae
898	<i>Pongamia pinnata</i> (L.) Pierre	Leguminosae
899	<i>Portulaca grandiflora</i> Hook.	Portulacaceae
900	<i>Portulaca oleracea</i> L.	Portulacaceae
901	<i>Portulaca pilosa</i> L.	Portulacaceae
902	<i>Portulaca quadrifida</i> L.	Portulacaceae
903	<i>Pothos scandens</i> L.	Araceae
904	<i>Pouzolzia bennettiana</i> Wight	Urticaceae
905	<i>Pouzolzia zeylanica</i> (L.) Benn.	Urticaceae
906	<i>Premna coriacea</i> C.B. Clarke	Lamiaceae
907	<i>Premna herbacea</i> Roxb.	Lamiaceae
908	<i>Premna mollissima</i> Roth	Lamiaceae
909	<i>Premna serratifolia</i> L.	Lamiaceae
910	<i>Premna tomentosa</i> Willd.	Lamiaceae
911	<i>Priva cordifolia</i> (L.f.) Druce	Verbenaceae
912	<i>Prunus ceylanica</i> (Wight) Miq.	Rosaceae
913	<i>Prunus persica</i> (L.) Batsch	Rosaceae
914	<i>Pseudarthria viscida</i> (L.) Wight & Arn.	Leguminosae
915	<i>Psidium guajava</i> L.	Myrtaceae
916	<i>Psychotria glandulosa</i> (Dennst.) Suresh	Rubiaceae

917	<i>Pterocarpus marsupium</i> Roxb.	Leguminosae
918	<i>Pterolobium hexapetalum</i> (Roth) Santapau &	Leguminosae
919	<i>Pterospermum diversifolium</i> Blume	Malvaceae
920	<i>Pterospermum rubiginosum</i> B.Heyne ex Wall.	Malvaceae
921	<i>Pueraria phaseoloides</i> (Roxb.) Benth.	Leguminosae
922	<i>Pueraria tuberosa</i> (Willd.) DC.	Leguminosae
923	<i>Punica granatum</i> L.	Lythraceae
924	<i>Pupalia lappacea</i> (L.) Juss.	Amaranthaceae
925	<i>Putranjiva roxburghii</i> Wall.	Putranjivaceae
926	<i>Pycnospora lutescens</i> (Poir.) Schindl.	Leguminosae
927	<i>Radermachera xylocarpa</i> (Roxb.) Roxb. ex	Bignoniaceae
928	<i>Rauvolfia micrantha</i> Hook.f.	Apocynaceae
929	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz	Apocynaceae
930	<i>Rauvolfia tetraphylla</i> L.	Apocynaceae
931	<i>Reissantia indica</i> (Willd.) N.Hallé	Celastraceae
932	<i>Remusatia vivipara</i> (Roxb.) Schott	Araceae
933	<i>Rhaphidophora pertusa</i> (Roxb.) Schott	Araceae
934	<i>Rhinacanthus nasutus</i> (L.) Kurz	Acanthaceae
935	<i>Rhododendron arboreum</i> Sm.	Ericaceae
936	<i>Rhodomyrtus tomentosa</i> (Aiton) Hassk.	Myrtaceae
937	<i>Rhynchostylis retusa</i> (L.) Blume	Orchidaceae
938	<i>Richardia scabra</i> L.	Rubiaceae
939	<i>Rivea ornata</i> Choisy	Convolvulaceae
940	<i>Rotala indica</i> (Willd.) Koehne	Lythraceae
941	<i>Rothea serrata</i> (L.) Steane & Mabb.	Lamiaceae
942	<i>Rothia indica</i> (L.) Druce	Leguminosae
943	<i>Rotula aquatica</i> Lour.	Boraginaceae
944	<i>Rourea minor</i> (Gaertn.) Alston	Connaraceae
945	<i>Rubia cordifolia</i> L.	Rubiaceae
946	<i>Rubus ellipticus</i> Sm.	Rubiaceae
947	<i>Rubus niveus</i> Thunb.	Rosaceae
948	<i>Rubus rugosus</i> Sm.	Rosaceae
949	<i>Ruellia patula</i> Jacq.	Acanthaceae
950	<i>Rumex nepalensis</i> Spreng.	Polygonaceae
951	<i>Rungia pectinata</i> (L.) Nees	Acanthaceae
952	<i>Saccharum officinarum</i> L.	Poaceae
953	<i>Saccharum spontaneum</i> L.	Poaceae
954	<i>Sacciolepis indica</i> (L.) Chase	Poaceae
955	<i>Sacciolepis interrupta</i> (Willd.) Stapf	Poaceae
956	<i>Sagina saginoides</i> (L.) H.Karst.	Caryophyllaceae
957	<i>Salacia fruticosa</i> Wall.	Celastraceae
958	<i>Salacia macrosperma</i> Wight	Celastraceae

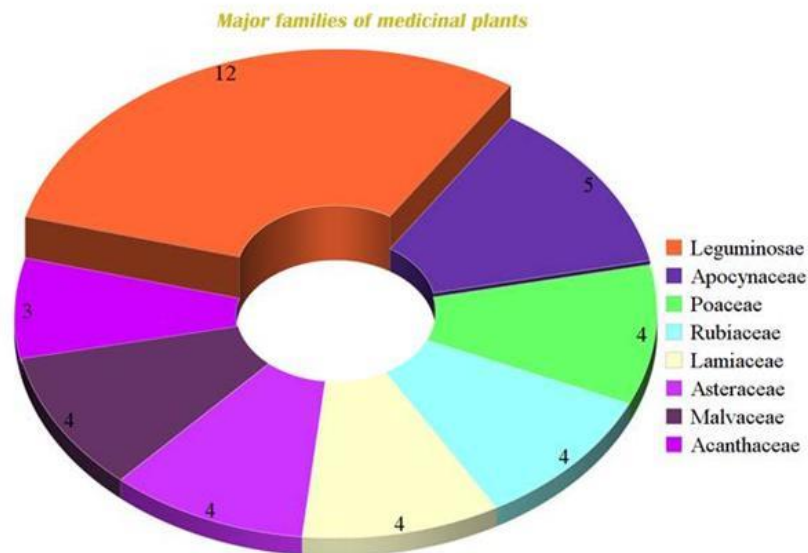
959	<i>Salacia oblonga</i> Wall.	Celastraceae
960	<i>Salvia officinalis</i> L.	Lamiaceae
961	<i>Santalum album</i> L.	Santalaceae
962	<i>Sapindus emarginatus</i> Vahl	Sapindaceae
963	<i>Sapindus trifoliatus</i> L.	Sapindaceae
964	<i>Saraca asoca</i> (Roxb.) Willd.	Leguminosae
965	<i>Sarcostemma acidum</i> (Roxb.) Voigt	Apocynaceae
966	<i>Sarcostemma viminalis</i> subsp. <i>brunonianum</i>	Apocynaceae
967	<i>Satyrium nepalense</i> D. Don	Orchidaceae
968	<i>Schefflera stellata</i> (Gaertn.) Baill.	Araliaceae
969	<i>Schefflera venulosa</i> (Wight & Arn.) Harms	Araliaceae
970	<i>Schleichera oleosa</i> (Lour.) Merr.	Sapindaceae
971	<i>Scleria levis</i> Retz.	Cyperaceae
972	<i>Scleria lithosperma</i> (L.) Sw.	Cyperaceae
973	<i>Scleria terrestris</i> (L.) Fassett	Cyperaceae
974	<i>Scleropyrum pentandrum</i> (Dennst.) Mabb.	Santalaceae
975	<i>Scolopia crenata</i> Clos	Salicaceae
976	<i>Scoparia dulcis</i> L.	Plantaginaceae
977	<i>Scurrula parasitica</i> L.	Loranthaceae
978	<i>Secamone emetica</i> (Retz.) R. Br. ex Schult.	Apocynaceae
979	<i>Semecarpus travancorica</i> Bedd.	Anacardiaceae
980	<i>Senna hirsuta</i> (L.) H.S. Irwin & Barneby	Leguminosae
981	<i>Senna occidentalis</i> (L.) Link	Leguminosae
982	<i>Senna siamea</i> (Lam.) H.S. Irwin & Barneby	Leguminosae
983	<i>Senna tora</i> (L.) Roxb.	Leguminosae
984	<i>Sesamum indicum</i> L.	Pedaliaceae
985	<i>Sesbania grandiflora</i> (L.) Pers.	Leguminosae
986	<i>Setaria verticillata</i> (L.) P. Beauv.	Poaceae
987	<i>Sigesbeckia orientalis</i> L.	Asteraceae
988	<i>Smilax aspera</i> L.	Smilacaceae
989	<i>Smilax perfoliata</i> Lour.	Smilacaceae
990	<i>Smilax wightii</i> A. DC.	Smilacaceae
991	<i>Smilax zeylanica</i> L.	Smilacaceae
992	<i>Solanum americanum</i> Mill.	Solanaceae
993	<i>Solanum capsicoides</i> All.	Solanaceae
994	<i>Solanum erianthum</i> D. Don	Solanaceae
995	<i>Solanum giganteum</i> Jacq.	Solanaceae
996	<i>Solanum lasiocarpum</i> Dunal	Solanaceae
997	<i>Solanum melongena</i> L.	Solanaceae
998	<i>Solanum pubescens</i> Willd.	Solanaceae
999	<i>Solanum seaforthianum</i> Andrews	Solanaceae
1000	<i>Solanum sisymbriifolium</i> Lam.	Solanaceae

1001	<i>Solanum torvum</i> Sw.	Solanaceae
1002	<i>Solanum trilobatum</i> L.	Solanaceae
1003	<i>Solanum violaceum</i> Ortega	Solanaceae
1004	<i>Solena amplexicaulis</i> (Lam.) Gandhi	Cucurbitaceae
1005	<i>Sonchus oleraceus</i> (L.) L.	Asteraceae
1006	<i>Sonchus wightianus</i> DC.	Asteraceae
1007	<i>Sonerila rheedei</i> Wall.	Melastomataceae
1008	<i>Sopubia delphinifolia</i> G.Don	Orobanchaceae
1009	<i>Sorghum bicolor</i> (L.) Moench	Poaceae
1010	<i>Sorghum halepense</i> (L.) Pers.	Poaceae
1011	<i>Spatholobus parviflorus</i> (DC.) Kuntze	Leguminosae
1012	<i>Spergula arvensis</i> L.	Caryophyllaceae
1013	<i>Spermacoce articularis</i> L.f.	Rubiaceae
1014	<i>Sphaeranthus indicus</i> L.	Asteraceae
1015	<i>Sphagneticola calendulacea</i> (L.) Prusk	Asteraceae
1016	<i>Sphenoclea zeylanica</i> Gaertn.	Sphenocleaceae
1017	<i>Spondias pinnata</i> (L. f.) Kurz	Anacardiaceae
1018	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Verbenaceae
1019	<i>Stachytarpheta urticifolia</i> (Salisb.) Sims	Verbenaceae
1020	<i>Stellaria media</i> (L.) Vill.	Caryophyllaceae
1021	<i>Stephania japonica</i> (Thunb.) Miers	Menispermaceae
1022	<i>Stephania wightii</i> Dunn	Menispermaceae
1023	<i>Sterculia foetida</i> L.	Malvaceae
1024	<i>Sterculia guttata</i> Roxb. ex G.Don	Malvaceae
1025	<i>Sterculia villosa</i> Roxb.	Malvaceae
1026	<i>Stictocardia tiliifolia</i> (Desr.) Hallier f.	Convolvulaceae
1027	<i>Striga asiatica</i> (L.) Kuntze	Orobanchaceae
1028	<i>Striga gesnerioides</i> (Willd.) Vatke	Orobanchaceae
1029	<i>Strobilanthes ciliata</i> Nees	Acanthaceae
1030	<i>Strobilanthes consanguineus</i> Clarke	Acanthaceae
1031	<i>Strobilanthes heyneanus</i> Nees	Acanthaceae
1032	<i>Strychnos potatorum</i> L.f.	Loganiaceae
1033	<i>Stylosanthes fruticosa</i> (Retz.) Alston	Leguminosae
1034	<i>Swertia corymbosa</i> Wight ex Griseb.	Gentianaceae
1035	<i>Swertia minor</i> Knobl.	Gentianaceae
1036	<i>Swietenia macrophylla</i> King	Meliaceae
1037	<i>Swietenia mahogani</i> L.	Meliaceae
1038	<i>Symplocos cochinchinensis</i> var. <i>laurina</i> (Retz.)	Symplocaceae
1039	<i>Symplocos monantha</i> Wight	Symplocaceae
1040	<i>Symplocos racemosa</i> Roxb.	Symplocaceae
1041	<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae
1042	<i>Syzygium aromaticum</i> (L.) Merr. &	Myrtaceae

1043	<i>Syzygium caryophyllatum</i> (L.) Alston	Myrtaceae
1044	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae
1045	<i>Syzygium hemisphericum</i> (Wight) Alston	Myrtaceae
1046	<i>Syzygium jambos</i> (L.) Alston	Myrtaceae
1047	<i>Syzygium salicifolium</i> (Wight) J.Graham	Myrtaceae
1048	<i>Tabernaemontana alternifolia</i> L.	Apocynaceae
1049	<i>Tabernaemontana divaricata</i> (L.) R.Br. ex	Apocynaceae
1050	<i>Tadehagi triquetrum</i> (L.) H.Ohashi	Leguminosae
1051	<i>Tamarindus indica</i> L.	Leguminosae
1052	<i>Tarenna asiatica</i> (L.) Kuntze ex K.Schum.	Rubiaceae
1053	<i>Taxillus tomentosus</i> Tiegh.	Loranthaceae
1054	<i>Tecoma stans</i> (L.) Juss. ex Kunth	Bignoniaceae
1055	<i>Tectona grandis</i> L.f.	Lamiaceae
1056	<i>Tephrosia candida</i> (Roxb.) DC.	Leguminosae
1057	<i>Tephrosia purpurea</i> (L.) Pers.	Leguminosae
1058	<i>Tephrosia tinctoria</i> Pers.	Leguminosae
1059	<i>Tephrosia villosa</i> (L.) Pers.	Leguminosae
1060	<i>Teramnus labialis</i> (L.f.) Spreng.	Leguminosae
1061	<i>Terminalia paniculata</i> Roth	Combretaceae
1062	<i>Terminalia travancorensis</i> Wight & Arn.	Combretaceae
1063	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae
1064	<i>Terminalia catappa</i> L.	Combretaceae
1065	<i>Terminalia chebula</i> Retz.	Combretaceae
1066	<i>Tetracera akara</i> Merr.	Dilleniaceae
1067	<i>Tetrameles nudiflora</i> R. Br.	Tetramelaceae
1068	<i>Tetrastigma leucostaphylum</i> (Dennst.) Alston	Vitaceae
1069	<i>Themeda triandra</i> Forssk.	Poaceae
1070	<i>Theridophonum infaustum</i> N.E.Br.	Araceae
1071	<i>Thottea siliquosa</i> (Lam.) Ding Hou	Aristolochiaceae
1072	<i>Thunbergia alata</i> Bojer ex Sims	Acanthaceae
1073	<i>Thunbergia fragrans</i> Roxb.	Acanthaceae
1074	<i>Thunbergia grandiflora</i> (Roxb. ex Rottl.) Roxb.	Acanthaceae
1075	<i>Tiliacora racemosa</i> Colebr.	Menispermaceae
1076	<i>Tinospora sinensis</i> (Lour.) Merr.	Menispermaceae
1077	<i>Tithonia diversifolia</i> (Hemsl.) A.Gray	Asteraceae
1078	<i>Toddalia asiatica</i> (L.) Lam.	Rutaceae
1079	<i>Toona ciliata</i> M.Roem.	Meliaceae
1080	<i>Torenia bicolor</i> Dalzell	Linderniaceae
1081	<i>Torenia travancorica</i> Gamble	Linderniaceae
1082	<i>Trema orientalis</i> (L.) Blume	Cannabaceae
1083	<i>Trichodesma indicum</i> (L.) Lehm.	Boraginaceae
1084	<i>Trichodesma zeylanicum</i> (Burm.f.) R.Br.	Boraginaceae

1085	<i>Trichopodium zeylanicum</i> (Gaertn.) Thwaites	Leguminosae
1086	<i>Trichosanthes anaimalaiensis</i> Bedd.	Cucurbitaceae
1087	<i>Trichosanthes cucumerina</i> L.	Cucurbitaceae
1088	<i>Trichosanthes lobata</i> Roxb.	Cucurbitaceae
1089	<i>Trichosanthes nervifolia</i> L.	Cucurbitaceae
1090	<i>Trichosanthes tricuspida</i> Lour.	Cucurbitaceae
1091	<i>Tridax procumbens</i> (L.) L.	Asteraceae
1092	<i>Triumfetta annua</i> L.	Malvaceae
1093	<i>Triumfetta rhomboidea</i> Jacq.	Malvaceae
1094	<i>Turpinia cochinchinensis</i> (Lour.) Merr.	Staphyleaceae
1095	<i>Turraea pubescens</i> Hell.	Meliaceae
1096	<i>Tylophora fasciculata</i> Buch.-Ham. ex Wight	Apocynaceae
1097	<i>Tylophora flexuosa</i> R. Br.	Apocynaceae
1098	<i>Tylophora indica</i> (Burm. f.) Merr.	Apocynaceae
1099	<i>Typha domingensis</i> Pers.	Typhaceae
1100	<i>Uraria rufescens</i> (DC.) Schindl.	Leguminosae
1101	<i>Utricularia reticulata</i> Sm.	Lentibulariaceae
1102	<i>Uvaria hookeri</i> King	Annonaceae
1103	<i>Uvaria narum</i> (Dunal) Blume	Annonaceae
1104	<i>Vanda tessellata</i> (Roxb.) Hook. ex G.Don	Orchidaceae
1105	<i>Vanda testacea</i> (Lindl.) Rchb.f.	Orchidaceae
1106	<i>Ventilago maderaspatana</i> Gaertn.	Rhamnaceae
1107	<i>Vepris bilocularis</i> Engl.	Rutaceae
1108	<i>Vernonia arborea</i> Buch.-Ham.	Asteraceae
1109	<i>Vigna grahamiana</i> (Wight & Arn.) Verdc.	Leguminosae
1110	<i>Vigna mungo</i> (L.) Hepper	Leguminosae
1111	<i>Vigna radiata</i> (L.) R.Wilczek	Leguminosae
1112	<i>Vigna trilobata</i> (L.) Verdc.	Leguminosae
1113	<i>Vigna umbellata</i> (Thunb.) Ohwi & H. Ohashi	Leguminosae
1114	<i>Vigna unguiculata</i> (L.) Walp.	Leguminosae
1115	<i>Vigna vexillata</i> (L.) A.Rich.	Leguminosae
1116	<i>Viscum articulatum</i> Burm. f.	Santalaceae
1117	<i>Viscum cruciatum</i> Sieber ex Boiss.	Santalaceae
1118	<i>Viscum monoicum</i> Roxb. ex DC.	Santalaceae
1119	<i>Vitex altissima</i> L.f.	Lamiaceae
1120	<i>Vitex leucoxydon</i> L.f.	Lamiaceae
1121	<i>Vitex negundo</i> L.	Lamiaceae
1122	<i>Vitis vinifera</i> L.	Vitaceae
1123	<i>Volkameria inermis</i> L.	Lamiaceae
1124	<i>Wahlenbergia marginata</i> (Thunb.) A.DC.	Campanulaceae
1125	<i>Walsura trifoliolata</i> (A.Juss.) Harms	Meliaceae
1126	<i>Waltheria indica</i> L.	Malvaceae

1127	<i>Wrightia arborea</i> (Dennst.) Mabb.	Apocynaceae
1128	<i>Wrightia tinctoria</i> R.Br.	Apocynaceae
1129	<i>Xanthium strumarium</i> L.	Asteraceae
1130	<i>Xantolis tomentosa</i> (Roxb.) Raf.	Sapotaceae
1131	<i>Xylia xylocarpa</i> (Roxb.) Taub.	Leguminosae
1132	<i>Xyris pauciflora</i> Willd.	Xyridaceae
1133	<i>Youngia japonica</i> (L.) DC.	Asteraceae
1134	<i>Zanonia indica</i> L.	Cucurbitaceae
1135	<i>Zanthoxylum ovalifolium</i> Tutcher	Rutaceae
1136	<i>Zanthoxylum rhetsa</i> DC.	Rutaceae
1137	<i>Zanthoxylum tetraspermum</i> Wight & Arn.	Rutaceae
1138	<i>Zehneria maysorensis</i> Arn.	Cucurbitaceae
1139	<i>Zehneria scabra</i> Sond.	Cucurbitaceae
1140	<i>Zehneria thwaitesii</i> (Schweinf.) C.Jeffrey	Cucurbitaceae
1141	<i>Zeuxine longilabris</i> (Lindl.) Trimen	Orchidaceae
1142	<i>Zingiber cernuum</i> Dalzell	Zingiberaceae
1143	<i>Zingiber officinale</i> Roscoe	Zingiberaceae
1144	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	Zingiberaceae
1145	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae
1146	<i>Ziziphus oenopolia</i> (L.) Mill.	Rhamnaceae
1147	<i>Ziziphus xylopyrus</i> (Retz.) Willd.	Rhamnaceae
1148	<i>Zornia gibbosa</i> Span.	Leguminosae



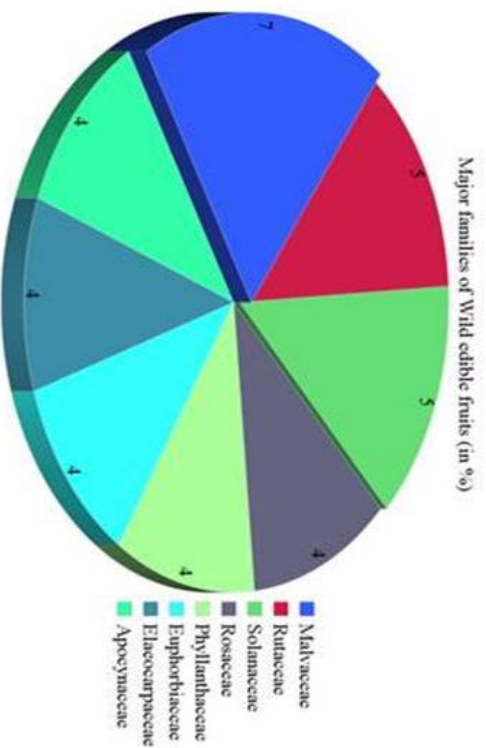
List of wild edible fruits found in the HRML study area

Sl. No.	Species name	Family	Local name	Location
1	<i>Acronychia pedunculata</i> (L.) Miq.	Rutaceae	Kattuorange, Kambili	Munnar
2	<i>Aerva lanata</i> (L.) Juss.	Amaranthaceae	Cherula	Chullipetty
3	<i>Alangium alvifolium</i> (L.f.) Wangerin	Cornaceae	Kilikuthippazham, Ottangudi	Kolanikavu (Thodupuzha)
4	<i>Antidesma montanum</i> Blume	Phyllanthaceae	Nilamvetti, Kattupulinchi	Adimali
5	<i>Artocarpus lacucha</i> Buch.-Ham.	Moraceae	Kurangu pilavu	Bhoothathankettu
6	<i>Asparagus racemosus</i> Willd.	Asparagaceae	Shathavari	Kanthalloor, Marayur
7	<i>Atalantia monophylla</i> DC.	Rutaceae	Kuruthan	Marayur, Chinnar
8	<i>Azadirachta indica</i> A.Juss.	Meliaceae	Veppu	Chinnar
9	<i>Baccaurea courtallensis</i> (Wight) Müll.Arg.	Phyllanthaceae	Mootti, Mootippuli	Adimali, Neriymangalam
10	<i>Bridelia stipularis</i> (L.) Blume	Phyllanthaceae	Thondanvalli	Adimali, Irumbupalam
11	<i>Capparis sepiaria</i> L.	Capparaceae	-	Marayur, Chinnar
12	<i>Capparis zeylanica</i> L.	Capparaceae	Athanda	Churulipetty, Chinnar
13	<i>Carallumaum bellata</i> Haw.	Apocynaceae	Kathal, Ekidi	Chullipetty, Chinnar
14	<i>Carissa carandas</i> L.	Apocynaceae	Kela, Kelavu, Mulli, Karimulli,	Chullipetty, Chinnar
15	<i>Celastrus paniculatus</i> Willd.	Celastraceae	Valuluva	Chinnar
16	<i>Cereus pterogonus</i> Lem.	Cactaceae	Chathurakolli	Chinnar
17	<i>Cipadessa baccifera</i> (Roth) Miq.	Meliaceae	Mainappazham, Thalethirukka	Munnar, Adimali
18	<i>Cissus quadrangularis</i> L.	Vitaceae	Changalamparanda	Chambakkad
19	<i>Cleome gynandra</i> L.	Cleomaceae	Kattukaduku	Peermede
20	<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	Koval,	Chinnar
21	<i>Crotalaria grahamiana</i> Wight & Arn.	Leguminosae	Chalanga	Chinnar
22	<i>Croton malabaricus</i> Bedd.	Euphorbiaceae	Thavittupulavu	Adimali
23	<i>Debregeasia longifolia</i> (Burm.f.) Wedd.	Urticaceae	Neerinch	Munnar, Marayur
24	<i>Diospyros montana</i> Roxb.	Ebenaceae	Vakkana	Chinnar, Marayur
25	<i>Diplocyclos palmatus</i> (L.) C.Jeffrey	Cucurbitaceae	-	Marayur, Kuthukal

26	<i>Elaeagnus conferta</i> Roxb.	Elaeagnaceae	Kurangupazham, Katummunthiri, Bhasmadhooi	Munnar, Devikulam, Vagamaurai, Kanthalloor
27	<i>Elaeagnus indica</i> Serrett.	Elaeagnaceae	Kurangu rudrakasham	Kanthalloor, Marayur
28	<i>Elaeocarpus hygrophilus</i> Kurz	Elaeocarpaceae	Kaippan kara, kelakotta	Adimali, Munnar, Marayur, Brindaran estate
29	<i>Elaeocarpus munroii</i> Mast.	Elaeocarpaceae	Kattukara	Devikulam, Munnar
30	<i>Elaeocarpus serratus</i> L.	Elaeocarpaceae	Kara	Adimali, Neryamangalam, 6th stone, Munnar
31	<i>Elaeocarpus tuberculatus</i> Roxb.	Elaeocarpaceae	Rudrakasham	Marayur, Kanthalloor
32	<i>Eleusine coracana</i> (L.) Gaertn.	Poaceae	Keppa, Kuravu	Kuthukal
33	<i>Embelia ribes</i> Burm.f.	Primulaceae	Vizhal	Marayur
34	<i>Entada rheedii</i> Spreng.	Leguminosae	Paranda, Kakkumkali, Thelikkodi	Adimali
35	<i>Euonymus angulatus</i> Wight	Celastraceae	-	Anamudi Motta
36	<i>Ficus racemosa</i> L.	Moraceae	Athi	Kanthalloor, Marayur
37	<i>Firriana simplex</i> (L.) W.Wight	Malvaceae	Thondi	Chinnar, Marayur
38	<i>Garcinia gummi-gutta</i> (L.) Roxb.	Clusiaceae	-	Rajamala
39	<i>Gardenia resinifera</i> Roth	Rubiaceae	Katupera, Kambimaram	Marayur, Chinnar
40	<i>Gaultheria fragrantissima</i> Wall.	Ericaceae	Colgate chedi	Munnar, Devikulam
41	<i>Givotia moluccana</i> (L.) Sreem.	Euphorbiaceae	-	Marayur, Chinnar
42	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Rutaceae	Panal, panchi	Thodupuzha
43	<i>Gmelina arborea</i> Roxb.	Lamiaceae	Kumbil, Kumizhu	Marayur, Kanthloor
44	<i>Gmelina asiatica</i> L.	Lamiaceae	Cherukumbil	Chinnar
45	<i>Grewia damine</i> Gaertn.	Malvaceae	Chathura kalla	Marayur, Chinnar
46	<i>Grewia gamblei</i> J.R.Drumm.	Malvaceae	Malankalla, Vivakukettum valli	Marayur, Chinnar
47	<i>Grewia rothii</i> DC.	Malvaceae	Kalla	Chinnar
48	<i>Grewia serrulata</i> DC.	Malvaceae	-	Adimali
49	<i>Grewia villosa</i> Willd.	Malvaceae	Tholkalla	Munnar, Chinnar
50	<i>Gymnema sylvestre</i> (Retz.) R.Br. ex Sm.	Apocynaceae	Chakkarakolli	Chinnar, Chambakkad
51	<i>Heraclium candolleum</i> Gamble	Apiaceae	Chittelam, Vathamkolli	Devikulam
52	<i>Herrisantia crispa</i> (L.) Brizicky	Malvaceae	Urikka	Chambakkad
53	<i>Lantana camara</i> L.	Verbenaceae	Chulli	Munnar

54	<i>Maesa indica</i> (Roxb.) A. DC.	Primulaceae	Kirithi	Rajamala, Munnar, Marayur
55	<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Euphorbiaceae	Thavittu	Marayur
56	<i>Manilkara roxburghiana</i> (Wight) Dubard	Sapotaceae	-	Chinnar
57	<i>Mimusops elengi</i> L.	Sapotaceae	Eriñil, Elanji	Marayur
58	<i>Murraya paniculata</i> (L.) Jack	Rutaceae	Kattukariveppu	Marayur, Chinnar, Mannavanshola
59	<i>Nicandra physalodes</i> (L.) Gaertn.	Solanaceae	-	Vattayar
60	<i>Nothopogon beddomei</i> Gamble	Anacardiaceae	-	Kolanikavu (Thodupuzha)
61	<i>Olea dioica</i> Roxb.	Oleaceae	Edana	Marayur
62	<i>Opuntia elatior</i> Mill.	Cactaceae	Pattanathumkalli	Chinnar
63	<i>Opuntia stricta</i> (Haw.) Haw.	Cactaceae	Kalli, Chuvannakalli, Pathikalli	Chambakkad, Chinnar
64	<i>Oxalis corniculata</i> L.	Oxalidaceae	Puliyarila	Mattupetty
65	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Nelli	Munnar, Adimali, Kanthalloor
66	<i>Physalis angulata</i> L.	Solanaceae	Njotta-njodi, potti	Chinnar, Munnar
67	<i>Piper schmidtii</i> Hook.f.	Piperaceae	Kattukurumulaku	Anamudi, Munnar
68	<i>Piper wightii</i> Miq.	Piperaceae	Kattukurumulaku	Munnar
69	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Leguminosae	Korukkapuli, Kodukkapuli	Chambakkaad
70	<i>Rhodomyrtus tomentosa</i> (Aiton) Hassk.	Myrtaceae	Kattukoyyapazham	Anamudi
71	<i>Ricinus communis</i> L.	Euphorbiaceae	Avanakku	Munnar, Adimali
72	<i>Rivea hypocrateriformis</i> Choisy	Convolvulaceae	-	Alampetty, chinnar
73	<i>Rotheca serrata</i> (L.) Steene & Mabb.	Lamiaceae	Cheruthekkku	Mattupetty
74	<i>Rubia cordifolia</i> L.	Rubiaceae	Manjishta	Vandiperiyar
75	<i>Rubus ellipticus</i> Sm.	Rosaceae	Mulli, Manjamulli	Munnar, Devikulam, Anamudi, Rajamala
76	<i>Rubus micropetalus</i> Gardner	Rosaceae	Chuvannamulli	Anamudi, Rajamala
77	<i>Rubus niveus</i> Thunb.	Rosaceae	Mulli	Munnar
78	<i>Rubus racemosus</i> Roxb.	Rosaceae	Chambamulli	Munnar, Anamudi, Rajamala
79	<i>Santalum album</i> L.	Santalaceae	Chandanam	Marayur, Chinnar
80	<i>Sapindus emarginatus</i> Vahl	Sapindaceae	Soppumkaya	Chinnar
81	<i>Schleichera oleosa</i> (Lour.) Merr.	Sapindaceae	Puvanam, Puvan, Puvanna	Chinnar, Marayur
82	<i>Smilax perfoliata</i> Lour.	Smilacaceae	Chural	Chinnar
83	<i>Solanum americanum</i> Mill.	Solanaceae	Manithakkali, Cherra, Chunda	Kanthalloor

84	<i>Solanum pubescens</i> Willd.	Solanaceae	Chunda, Cheriya chunda	Chambakkad
85	<i>Solanum surattense</i> Burm. f.	Solanaceae	Kazhuthachunda	Vattayar
86	<i>Spondias pinnata</i> (L. f.) Kurz i	Anacardiaceae	Ambazham	Adimali, Munnar
87	<i>Strychnos potatorum</i> L.f.	Loganiaceae	Chillachillam, Thettamparal	Chinnar
88	<i>Symplocos cochinchinensis</i> (Lour.) S. Moore	Symplocaceae	Pachotti, Choolamani, Thulasimararam	Munnar, Devikulam
89	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	Njaval	Devikulam, chinnar
90	<i>Syzygium densiflorum</i> Wall. ex Wight & Arn.	Myrtaceae	Navrapappazham	Anamudi
91	<i>Toddalia asiatica</i> (L.) Lam.	Rutaceae	Melakarana, Mullicheedi, Kadichikarantakam	Marayur, Chinnar, Kanthalloor, Mannavanshola
92	<i>Vaccinium leschenaultii</i> Wight	Ericaceae	Glass pazham	Munnar, Adimali
93	<i>Wrightia tinctoria</i> R.Br.	Apocynaceae	Attukombu, Kathippala, Koppela	Chambakkad, Munnar, Chinnar, Marayur, Peermade
94	<i>Ziziphus glabrata</i> B. Heyne ex Roth	Rhamnaceae	Karukotta	Chinnar, Chullipetty
95	<i>Ziziphus oenoplia</i> (L.) Mill.	Rhamnaceae	Thodali, Churi	Chinnar
96	<i>Ziziphus xylopyrrus</i> (Retz.) Willd.	Rhamnaceae	Kattukotta, Kadamankotta	Chinnar



List of selected tradable bio-resources in the HRML study area

S. No.	NTPP	2013-14		2014-15		2015-16		2016-17		2017-18		2018-19		ThreatStatus*
		Kg	Rs.	Kg	Rs.	Kg	Rs.	Kg	Rs.	Kg	Rs.	Kg	Rs.	
1	<i>Nilgiriianthus ciliatus</i> (Nees) Bremek. Acanthaceae	2778	31518	1325	19825	4197	51539	5449	76986	9856	147840	9990	160830	VU
			Rs. 11/kg		Rs. 15/kg		Rs. 12/kg		Rs. 14/kg		Rs. 15/kg		Rs. 16/kg	
2	<i>Nothapodytes nimmoriana</i> (J.Graham) Mabb. Iacinaceae	2040	55280	80	2800	4664	145998	1450	50750	1350	47250	2367	101750	NE
			Rs. 27/kg		Rs. 35/kg		Rs. 31/kg		Rs. 35/kg		Rs. 35/kg		Rs. 43/kg	
3	<i>Hydnocarpus pentandrus</i> (Buch.-Ham.) Oken Achariaceae	9500	552	8	480	30	1980	100	6000	100	7000	902	144320	VU
			-		Rs. 60/kg		Rs. 66/kg		Rs. 60/kg		Rs. 70/kg		Rs. 160/kg	
4	<i>Symplocos cochinchinensis</i> (Lour.) S. Moore Symplocaceae	547	16454	180	645	319	11165	-	-	17	765	2732	157952	NE
			Rs. 30/kg		Rs. 4/kg		Rs. 35/kg		-		Rs. 45/kg		Rs. 58/kg	
5	<i>Acacia intsia</i> (L.) Willd. Leguminosa	-	-	370	18338	-	-	886	44325	904	50852	775	45711	NE
			-		Rs. 50/kg		-		Rs. 50/kg		Rs. 56/kg		Rs. 59/kg	
6	<i>Sidarhombifolia</i> L. Malvaceae	-	-	-	-	-	-	-	-	30	1350	405	21350	NE
			-		-		-		-		Rs. 45/kg		Rs. 53/kg	
7	<i>Kurumulaku</i> <i>Piper nigrum</i> L. Piperaceae	928	19761	-	-	413	12380	324	11357	2429	88261	2563	130112	NE
			Rs. 21/kg		-		Rs. 30/kg		Rs. 35/kg		Rs. 36/kg		Rs. 51/kg	
8	<i>Terminalia bellirica</i> (Gaertn.) Roxb. Combretaceae	-	-	800	8000	-	-	-	-	-	-	-	-	NE
			-		Rs. 10/kg		-		-		-		-	
9	<i>Curcuma aromatic</i> Salisb. Zingiberaceae	1184	83915	1747	129394	829	52962	1330	79386	953	71925	-	-	NE
			Rs. 71/kg		Rs. 74/kg		Rs. 64/kg		Rs. 60/kg		Rs. 75/kg		-	
10	<i>Alpinia calcarata</i> (Haw.) Roscoe Zingiberaceae	-	-	-	-	-	-	60	4200	41	3280	-	-	NE
			-		-		Rs. 70/kg		Rs. 80/kg		-		-	

	NTFP	2013-14		2014-15		2015-16		2016-17		2017-18		2018-19		ThreatStatus*
		Kg	Rs.	Kg	Rs.	Kg	Rs.	Kg	Rs.	Kg	Rs.	Kg	Rs.	
11	Kattupadavalam <i>Trichosanthes cucumerina</i> L. Cucurbitaceae	140	14000	182	31624	-	-	235	23500	212	30750	-	-	NE
		Rs. 100/kg		Rs. 174/kg		-		Rs. 100/kg		Rs. 145/kg		-		
12	Cheevaka <i>Acacia sinuate</i> (Lour.) Merr. Leguminosa	614	18280	2420	84990	390	9750	176	6490	70	3500	-	-	NE
		Rs. 30/kg		Rs. 35/kg		Rs. 25/kg		Rs. 174/kg		Rs. 174/kg		-		
13	Chunda <i>Solanum torvum</i> Sw. Solanaceae	97	1940	401	8020	1700	19800	570	17100	1135	34050	22	660	NE
		Rs. 20/kg		Rs. 20/kg		Rs. 12/kg		Rs. 30/kg		Rs. 30/kg		Rs. 30/kg		
14	Thelli <i>Canarium strictum</i> Roxb. Bursaracea	-	-	15	2375	-	-	-	-	-	-	25	3250	NE
		-		Rs. 158/kg		-		-		Rs. 130/kg		Rs. 58/kg		
15	Makkunkay <i>Entada gigas</i> (L.) Fawc. & Rendle Leguminosa	-	-	-	-	16	320	38	870	750	24000	895	29025	NE
		-		Rs. 20/kg		Rs. 23/kg		Rs. 32/kg		Rs. 32/kg		Rs. 59/kg		
16	Honey (Small oney)	-	-	-	-	-	-	-	-	375	30350	61	51851	-
		-		-		-		-		Rs. 81/kg		Rs. 850/kg		
17	Honey (Large Honey)	-	-	-	-	-	-	-	-	45	13500	623	244200	-
		-		-		-		-		Rs. 300/kg		Rs. 392/kg		

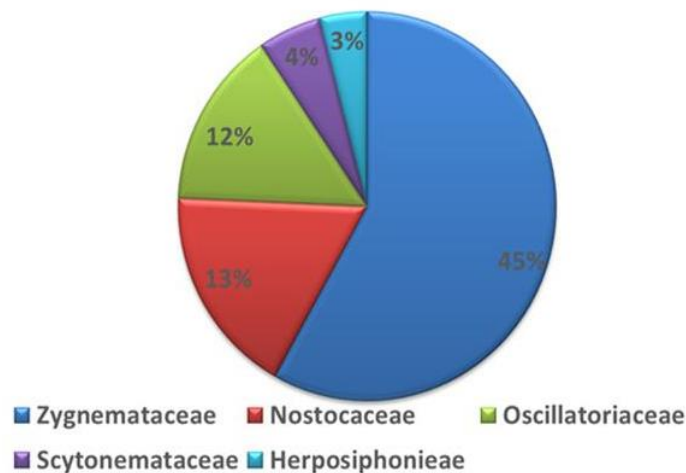
Algal diversity in the HRML study area, Anjunadu valley, Kerala

S.No.	Species name	Family
1	<i>Anabaena beckii</i> G.De Toni	Nostocaceae
2	<i>Anabaena iyengarii</i> Bharadwaja	Nostocaceae
3	<i>Anabaena oscillarioides</i> Bory ex Bornet & Flahault	Nostocaceae
4	<i>Anabaena torulosa</i> Lagerheim ex Bornet & Flahault	Nostocaceae
5	<i>Aphanothece stagnina</i> (Sprengel) A.Braun in Rabenhorst	Aphanothecaceae
6	<i>Aulosira fertilissima</i> S.L.Ghose	Fortieaceae
7	<i>Bambusina borrieri</i> (Ralfs) Cleve	Desmidiaceae
8	<i>Calothrix fusca</i> Bornet & Flahault	Rivulariaceae
9	<i>Calothrix marchica</i> Lemmermann	Rivulariaceae
10	<i>Cephaleuros virescens</i> Kunze ex E.M.Fries	Trentepohliaceae
11	<i>Chaetomorpha antennina</i> (Bory) Kützing	Cladophoraceae
12	<i>Cladophora vagabunda</i> (Linnaeus)	Cladophoraceae
13	<i>Coleofasciculus chthonoplastes</i> (Thuret ex Gomont) M.Siegesmund, J.R.Johansen & T.Friedl	Coleofasciculaceae
14	<i>Cylindrospermum stagnale</i> Bornet & Flahault	Nostocaceae
15	<i>Geitlerinema earlei</i> (N.L.Gardner) Anagnostidis	Coleofasciculaceae
16	<i>Herposiphonia insidiosa</i> (Greville ex J.Agardh) Falkenberg	Herposiphonieae
17	<i>Herposiphonia secunda</i> (C.Agardh) Ambronn	Herposiphonieae
18	<i>Herposiphonia tenella</i> (C.Agardh) Ambronn	Herposiphonieae
19	<i>Kamptonema animale</i> (C.Agardh ex Gomont) Strunecký, Komárek & J.Smarda	Oscillatoriaceae
20	<i>Kamptonema chlorinum</i> (Kützing ex Gomont) Strunecký, Komárek & J.Smarda	Microcoleaceae
21	<i>Kamptonema jasarovense</i> (Vouk) Strunecký, Komárek & J.Smarda	Microcoleaceae
22	<i>Lyngbya confervoides</i> C.Agardh ex Gomont	Oscillatoriaceae
23	<i>Microcoleus paludosus</i> Gomont	Microcoleaceae
24	<i>Microcystis smithii</i> Komárek & Anagnostidis	Microcystaceae
25	<i>Mougeotia adnata</i> M.O.P.Iyengar	Zygnemataceae
26	<i>Mougeotia cherokeana</i> Taft	Zygnemataceae
27	<i>Mougeotia parvula</i> Hassall	Zygnemataceae
28	<i>Mougeotia recurva</i> (Hassall) De Toni	Zygnemataceae
29	<i>Mougeotia tenuissima</i> (De Bary) Czurda	Zygnemataceae
30	<i>Nostoc amplissimum</i> Setchell	Nostocaceae
31	<i>Nostoc calcicola</i> Brébisson ex Bornet & Flahault	Nostocaceae
32	<i>Nostoc carneum</i> C.Agardh ex Bornet & Flahault	Nostocaceae

33	<i>Nostoc linckia</i> Bornet ex Bornet & Flahault	Nostocaceae
34	<i>Nostoc punctiforme</i> Hariot	Nostocaceae
35	<i>Nostoc sphaericum</i> Vaucher ex Bornet & Flahault	Nostocaceae
36	<i>Nostochopsis lobatus</i> H.C.Wood ex Bornet & Flahault	Nostochopsidaceae
37	<i>Oedogonium munnarensis</i> Panikkar & Ampili	Oedogoniaceae
38	<i>Oscillatoria major</i> Vaucher ex Forti	Oscillatoriaceae
39	<i>Oscillatoria ornata</i> Kutzing ex Gomont	Oscillatoriaceae
40	<i>Oscillatoria princeps</i> Vaucher ex Gomont	Oscillatoriaceae
41	<i>Oscillatoria subbrevis</i> var. <i>major</i> (G.S.West) Umezaki & Watanabe	Oscillatoriaceae
42	<i>Oscillatoria tenuis</i> C.Agardh ex Gomont	Oscillatoriaceae
43	<i>Phormidesmis molle</i> (Gomont) Turicchia, Ventura, Komarkova & Kom-arek	Oscillatoriaceae
44	<i>Phormidium acula</i> (Bruhl & Biswas) Anagnostidis & Komarek	Leptolyngbyaceae
45	<i>Phormidium lucidum</i> Kutzing ex Gomont	Oscillatoriaceae
46	<i>Phormidium stagninum</i> Anagnostidis	Oscillatoriaceae
47	<i>Scytonema guyanense</i> Bornet & Flahault	Oscillatoriaceae
48	<i>Scytonema mirabile</i> Bornet	Scytonemataceae
49	<i>Scytonema simplex</i> Bharadwaja	Scytonemataceae
50	<i>Scytonema tolypothrichoides</i> Kutzing ex Bornet & Flahault	Scytonemataceae
51	<i>Sirocladium himalayense</i> Santra & Adhya	Scytonemataceae
52	<i>Sirocladium kumaoense</i> Randhawa	Zygnemataceae
53	<i>Spirogyra ampilii</i> Ushadevi & Panikkar	Zygnemataceae
54	<i>Spirogyra baileyi</i> Schmidle	Zygnemataceae
55	<i>Spirogyra bullata</i> C.-C.Jao	Zygnemataceae
56	<i>Spirogyra crenulata</i> R.N.Singh	Zygnemataceae
57	<i>Spirogyra dictyospora</i> C.-C.Jao	Zygnemataceae
58	<i>Spirogyra flavescens</i> (Hassall) Kützing	Zygnemataceae
59	<i>Spirogyra goetzei</i> Schmidle	Zygnemataceae
60	<i>Spirogyra hymerae</i> Britton & B.H.Smith	Zygnemataceae
61	<i>Spirogyra jaoensis</i> Randhawa	Zygnemataceae
62	<i>Spirogyra jogensis</i> var. <i>minor</i> Iyengar	Zygnemataceae
63	<i>Spirogyra marchica</i> H.Krieger	Zygnemataceae
64	<i>Spirogyra minutifossa</i> C.-C.Jao	Zygnemataceae
65	<i>Spirogyra rhizobrachilis</i> C.-C.Jao	Zygnemataceae
66	<i>Spirogyra rhizopus</i> C.-C.Jao	Zygnemataceae
67	<i>Spirogyra tenuissima</i> (Hassall) Kützing	Zygnemataceae
68	<i>Spirulina labyrinthiformis</i> Gomont	Spirulinaceae
69	<i>Temnogyra punctiformis</i> (Transeau) Yamagishi	Zygnemataceae
70	<i>Tetraedron gracile</i> (Reinsch) Hansgirg	Hydrodictyaceae
71	<i>Tolypothrix magna</i> Bharadwaja	Tolypothrichaceae

72	<i>Trichormus fertilissimus</i> (C.B.Rao) Komárek & Anagnostidis	Nostocaceae
73	<i>Trichormus variabilis</i> (Kützing ex Bornet & Flahault) Komárek & Anag- nostidis	Nostocaceae
74	<i>Westiellopsis prolifica</i> Janet	Hapalosiphonaceae
75	<i>Zygnema atrocoeruleum</i> West & G.S.West	Zygnemataceae
76	<i>Zygnema collinsianum</i> Transeau	Zygnemataceae
77	<i>Zygnema cruciatum</i> (Vaucher) C.Agardh	Zygnemataceae
78	<i>Zygnema cyanosporum</i> Cleve	Zygnemataceae
79	<i>Zygnema exuvielliforme</i> (C.-C.Jao) Krieger	Zygnemataceae
80	<i>Zygnema gedeanum</i> Czurda	Zygnemataceae
81	<i>Zygnema guineense</i> (Gauthier-Lièvre) Stancheva, J.D.Hall, McCourt & Sheath	Zygnemataceae
82	<i>Zygnema heydrichii</i> Schmidle	Zygnemataceae
83	<i>Zygnema himalayense</i> Randhawa	Zygnemataceae
84	<i>Zygnema quadrangulatum</i> C.-C.Jao	Zygnemataceae
85	<i>Zygnema schwabei</i> Krieger	Zygnemataceae
86	<i>Zygnema spontaneum</i> Nordstedt	Zygnemataceae
87	<i>Zygnema talguppense</i> (M.O.P.Iyengar) Krieger	Zygnemataceae
88	<i>Zygnema vaginatum</i> Klebs	Zygnemataceae
89	<i>Zygogonium arjunanii</i> Usha Devi & Panikkar.	Zygnemataceae
90	<i>Zygogonium capense</i> (Hodgetts) Transeau	Zygnemataceae
91	<i>Zygogonium ericetorum</i> Kützing	Zygnemataceae
92	<i>Zygogonium jayaii</i> Ushadevi et Panikkar	Zygnemataceae
93	<i>Zygogonium sakunthalanii</i> Ushadevi et Panikkar	Zygnemataceae
94	<i>Zygogonium sinense</i> C.-C.Jao	Zygnemataceae
95	<i>Zygogonium wilsonii</i> Ushadevi et Panikkar	Zygnemataceae

Major families of Algal species



Checklist of plant species identified in Mankulam survey

Location: A

Sl. No.	Local name	Scientific name	Family	GPS Coordinates		
				Lat.	Long.	Ele.
Plantation species						
1	Elakka	<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	10.118	76.9059	826
Angiosperms						
1	Parangimaavu	<i>Anacardium occidentale</i> L.	Anacardiaceae	10.1255	76.9194	526
2	Vazhana	<i>Cinnamomum malabattrum</i> (Burm.f.) J.Presl	Lauraceae	10.1255	76.9194	526
3	Anachunda	<i>Solanum torvum</i> Sw.	Solanaceae	10.1158	76.9179	606
4	Karpoora thulasi	<i>Ocimum kilimandscharicum</i> Gürke	Lamiaceae	10.1259	76.9191	518
5	Kambilinarakam	<i>Citrus maxima</i> (Burm.) Merr.+	Rutaceae	10.1259	76.9191	525
6	Mylellu	<i>Vitex altissima</i> L.f.	Lamiaceae	10.1255	76.9194	526
7	Venteaku	<i>Lagerstroemia microcarpa</i> Hance	Lythraceae	10.1254	76.9069	659
8	Edana	<i>Olea dioica</i> Roxb.	Oleaceae	10.1253	76.9068	655
9	Karpooram	<i>Cinnamomum camphora</i> (L.) J.Presl	Lauraceae	10.125	76.9062	673
10	Vetti	<i>Aporosa cardiosperma</i> (Gaertn.) Merr.	Phyllanthaceae	10.1243	76.9049	676
11	Alpam	<i>Thottea siliquosa</i> (Lam.) Ding Hou	Aristolochiaceae	10.1242	76.9048	673
12	Sathavari	<i>Asparagus racemosus</i> Willd.	Asparagaceae	10.124	76.9039	708

Location: B

Sl. No.	Local name	Scientific name	Family	GPS Coordinates		
				Lat.	Long.	Ele.
Plantation species						
1	Elakka	<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	10.1565	76.9095	217
2	Rubber	<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.	Euphorbiaceae	10.1561	76.9091	216
3	Vezhampullu	<i>Ochlandra travancorica</i> (Bedd.) Gamble	Poaceae	10.156	76.9089	215
4	-	Mixed	-	10.1544	76.9076	215
Angiosperms						
1	Parangimaavu	<i>Anacardium occidentale</i> L.	Anacardiaceae	10.1599	76.9115	215
2	Nandyarvattom	<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. & Schult.	Apocynaceae	10.1595	76.9113	216
3	Paarakom	<i>Ficus hispida</i> L.f.	Moraceae	10.1595	76.9113	216
4	Ezhilam paala	<i>Alstonia scholaris</i> (L.) R. Br.	Apocynaceae	10.1593	76.9112	217
5	Kurumulaku	<i>Piper nigrum</i> L.	Piperaceae	10.159	76.9111	218
6	Vattaperuvalam	<i>Clerodendrum infortunatum</i> L.	Lamiaceae	10.1587	76.9109	222
7	Mangium	<i>Acacia mangium</i> Willd.		10.1585	76.9107	220
8	Kaattuchembu	<i>Colocasia esculenta</i> (L.) Schott	Araceae	10.1581	76.9105	218
9	Vaathamkolli	<i>Justicia gendarussa</i> Burm.f.	Acanthaceae	10.157	76.9099	217
10		<i>Vanda</i> Spp.		10.1566	76.9096	215

11		<i>Indianthus virgatus</i> (Roxb.) Suksathan & Borchs.	Marantaceae	10.1563	76.9093	220
12		<i>Psidium guajava</i> L.		10.1565	76.9095	217
13		<i>Plumeria alba</i> L.		10.155	76.908	213
14		<i>Hydnocarpus pentandrus</i> (Buch.-Ham.) Oken		10.1525	76.9069	210
15		<i>Garcinia gummi-gutta</i> (L.) Roxb. Male		10.1497	76.9055	209
16		<i>Caryota urens</i> L.		10.1547	76.9078	213
17		<i>Lagerstroemia speciosa</i> (L.) Pers.		10.1619	76.9129	218
18		<i>Mimosa pudica</i> L.		10.1585	76.9107	217
19		<i>Bambusa bambos</i> (L.) Voss		10.1387	76.9246	224
20		<i>Olea dioica</i> Roxb.		10.1618	76.9128	223
Lichens						
1		<i>Parmelia</i> Spp.		10.1559	76.9088	215

Location: C

Sl. No.	Local name	Scientific name	Family	GPS Coordinates		
				Lat.	Long.	Ele.
Plantation species						
1		<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.		10.1502	76.9059	208
2		<i>Theobroma cacao</i> L.		10.15561	76.908	204
Angiosperms						
1		<i>Areca catechu</i> L.		10.1556	76.9087	195
2		<i>Cinnamomum malabattrum</i> (Burm.f.) J.Presl		10.1556	76.9086	202
3		<i>Cyclea peltata</i> (Lam.) Hook.f. & Thomson		10.1555	76.9085	202
4		<i>Artocarpus hirsutus</i> Lam.		10.1551	76.9082	202
5		<i>Elaeocarpus tuberculatus</i> Roxb.		10.1552	76.9082	207
6		<i>Pimenta dioica</i> (L.) Merr.		10.1548	76.9079	203
7		<i>Plumbago auriculata</i> Lam.		10.1548	76.9079	204
8		<i>Crossandra infundibuliformis</i> (L.) Nees		10.1547	76.9079	206
9		<i>Syzygium jambos</i> (L.) Alston		10.1542	76.9074	207
10		<i>Ananas comosus</i> (L.) Merr.		10.1538	76.9074	202
11		<i>Carica papaya</i> L.		10.1528	76.907	202
12		<i>Colocasia esculenta</i> (L.) Schott		10.1528	76.907	200
13		<i>Hydnocarpus pentandrus</i> (Buch.- Ham.) Oken		10.1551	76.9081	205
14		<i>Pueraria phaseoloides</i> (Roxb.) Benth.		10.1522	76.9068	198
15		<i>Glycosmis pentaphylla</i> (Retz.) DC.		10.1521	76.9068	206
16		<i>Saraca asoca</i> (Roxb.) Willd.		10.1505	76.9064	198
17		<i>Garcinia gummi-gutta</i> (L.) Roxb.		10.1551	76.9081	203
18		<i>Caryota urens</i> L.		10.1551	76.9081	201
19		<i>Mimosa pudica</i> L.		10.153	76.9071	205
Pteridophytes						
		<i>Drynaria quercifolia</i> (L.) J. Sm.		10.1556	76.9087	203

		Lichens				
		<i>Usnea</i> Spp.		10.1556	76.9086	202
		<i>Parmelia</i> Spp.		10.1557	76.9087	208

Location: D

Sl. No.	Local name	Scientific name	Family	GPS Coordinates		
				Lat.	Long.	Ele.
Plantation species						
1		<i>Theobroma cacao</i> L.		10.1514	76.9068	18
Angiosperms						
1		<i>Etlingera elatior</i> (Jack) R.M.Sm.		10.1540	76.9065	195
2		<i>Caryota urens</i> L.		10.1518	76.9068	197
3		<i>Justicia adhatoda</i> L.		10.1618	76.9129	213
4		<i>Torenia bicolor</i> Dalzell		10.1478	76.9051	195
5		<i>Homonoia riparia</i> Lour.		10.1492	76.905	198
Pteridophytes						
1		<i>Pteris tremula</i> R. Br.		10.1543	76.9068	185

Location: E

Sl. No.	Local name	Scientific name	Family	GPS Coordinates		
				Lat.	Long.	Ele.
Plantation species						
1		<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.	<i>Euphorbia</i> <i>ceae</i>	10.1389	76.9244	225
2		<i>Ochlandra travancorica</i> (Bedd.) Gamble		10.1379	76.9257	253
Angiosperms						
1		<i>Anacardium occidentale</i> L.		10.159	76.9111	222
2		<i>Ficus hispida</i> L.f.		10.1384	76.9251	240
3		<i>Lantana camara</i> L.		10.1593	76.9112	220
4		<i>Mucuna pruriens</i> var. <i>utilis</i> (Wall. ex Wight) L.H.Bailey		10.1591	76.9111	222
5		<i>Sauropus androgynus</i> (L.) Merr.		10.159	76.9111	222
6		<i>Clitoria ternatea</i> L.		10.1589	76.911	220
7		<i>Hibiscus rosa-sinensis</i> L.		10.1588	76.9109	224
8		<i>Clerodendrum infortunatum</i> L.		10.1391	76.9243	227
9		<i>Gliricidia sepium</i> (Jacq.) Walp.		10.1586	76.9108	222
10		<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.		10.1583	76.9106	223
11		<i>Caryota urens</i> L.		10.1384	76.9251	240
12		<i>Smilax china</i> L.		10.1618	76.9128	231
13		<i>Dillenia pentagyna</i> Roxb.		10.1617	76.9128	222
14		<i>Mimosa pudica</i> L.		10.1391	76.9243	225
15		<i>Alstonia scholaris</i> (L.) R. Br.		10.1385	76.9249	233
16		<i>Macaranga peltata</i> (Roxb.) Müll.Arg.		10.1384	76.9251	240
17		<i>Homonoia riparia</i> Lour.		10.1379	76.9255	253
18		<i>Bombax ceiba</i> L.		10.1379	76.9257	253
19		<i>Utricularia graminifolia</i> Vahl		10.1387	76.9247	240
20		<i>Bambusa bambos</i> (L.) Voss		10.1379	76.9257	251

Bioresources listed in the PBR of Adimali Gramapanchayath

Agrobiodiversity - Adimali						
Scientific name	local name	Family	Trade (Yes/No)	use	Remarks	
Agricultural crops						
	Rajameni	Poaceae				
	IR 8	Poaceae				
<i>Oryza sativa</i>	Chembavu	Poaceae				
	Naynaal	Poaceae				
	Koorikanni	Poaceae				
<i>Anacardium occidentale. Linn</i>	Cashew tree	Anacardiaceae				
<i>Hevea brasiliensis</i>	Rubber	Euphorbiaceae		Medicinal value		
	Chama			Medicinal value		
	Thina			Medicinal value		
<i>Maranat Aurundinaceae</i>	Koova	Marantaceae		Medicinal value		
<i>Solanum tuberosum</i>	Urulakizhangu	Solanaceae				
<i>Benincasa hispida</i>	Kumbalanga	Cucurbitaceae				
<i>Curcuma longa</i>	Manjal	Zingiberaceae	yes	Medicinal value	Antipoison, cosmetics	
<i>zingiber officinale</i>	Ginger	Zingiberaceae	yes	Rhizome		
<i>Theobroma cacao</i>	Cocoa tree	Malvaceae				
<i>cocos nucifera</i>	Coconut tree	Arecaceae				
<i>piper nigrum</i>	Black pepper	Piperaceae				
<i>myristica fragrans</i>	Nutmeg	Myristicaceae				
<i>Manihot esculenta</i>	Tapioca	Euphorbiaceae				

<i>Vigna unguiculata</i>	Valli payar	Fabaceae			
<i>Daucus carota</i> subsp. <i>Satrous</i>	Carrot	Apiaceae			
<i>Glycine max</i>	Soyabean	Fabaceae			
<i>Brassica oleracea</i> var. <i>botrytis</i>	Cauliflower	Brassicaceae			
<i>Cucurbita pepo</i>	Mathanga	Cucurbitaceae			
<i>Cucumis sativus</i>	Vellarika	Cucurbitaceae			
<i>Solanum lycopersicum</i>	Tomato	Solanaceae			
<i>Plectranthus rotundifolius</i>	Koorika	Lamiaceae			
<i>Lagenaria siceraria</i>	Churakka	Cucurbitaceae			
<i>Cicer arietinum</i>	Kadala	Fabaceae			
<i>Vigna mungo</i>	Uzhunnu	Fabaceae			
<i>Vigna radiata</i>	Cherupayar	Fabaceae			
	Thuvvara				
<i>Macrotyloma uniflorum</i>	Muthira	Fabaceae			
	Kurumbullu				
	Godhambu				
<i>Vicia faba</i>	Amarakka	Fabaceae			
<i>Arachis hypogaea</i>	Nilakadala	Fabaceae			
<i>Sesamum indicum</i>	Ellu	Pedaliaceae			
<i>Plectranthus rotundifolius</i>	Madhurakizhangu	Lamiaceae			
<i>Amorophallus paeoniifolius</i>	Chena	Araceae	yes	medicinal	
<i>Dioscorea esculenta</i>	Cherukizhangu	Dioscoreaceae			
<i>Colocasia esculenta</i>	Chembu	Araceae	yes		
<i>Dioscorea oppositifolia</i>	Kachil	Dioscoreaceae			
<i>Fruit crops</i>					
<i>Flacourtia inermis</i>	Lovlolikka	Salicaceae			
<i>Musa</i>	Chorapoovan	Musaceae			

	Thenvarikka								
<i>Artocarpus heterophyllus</i>			Moraceae						
<i>Syzygium cumini</i>	Njaval		Myrtaceae	yes		Medicinal value			
<i>Punica granatum</i>	Pomegranate		Lythraceae	yes					
<i>Artocarpus heterophyllus</i>	Jackfruit tree		Moraceae						
<i>malus sylvestris</i>	Apple		Rosaceae						
	Aakashavellari					Medicinal value		low down diabetics	
<i>Musa</i>	Yethavaazha		Musaceae						
<i>Citrus limon</i>	Cherunaranga		Rutaceae						
<i>Psidium guajava</i>	Common guva		Myrtaceae						
<i>Citrus aurantium</i>	Madhuranaranga		Rutaceae						
<i>Carica papaya</i>	Pappaya		Caricaceae			medicinal			
<i>Passiflora edulis</i>	Passion fruit		Passifloraceae			medicinal			
<i>Garcinia mangostana</i>	Mangosteen		Clusiaceae						
<i>Annona squamosa</i>	Aathakka		Annonaceae						
<i>Manilkara zapota</i>	Sapota		Sapotaceae						
<i>Nephetium lappaceum</i>	Rambutan		Sapindaceae	yes					
<i>Annona muricata</i>	Mullan chakka		Annonaceae						
	Mulberry		Moraceae						
<i>Ananas comosus</i>	Pineapple		Bromeliaceae	yes					
<i>Citrullus lanatus</i>	Watermelon		Cucurbitaceae	yes					
	Cholam		poaceae						
	Veendavalli								
	Pothapullu								
	Karachi								
	Appachedi								
	Kapachedi								
	Panji								

	Shemakonna				
	Kannapullu				
	Theetapullu CO3				
	Ginipullu				
	Sumbabool				
	Azolla				
	Kambam				
	Choriyanam				
	Pemullu				
	Pothappa				
	Ponamkoni				
	Vayalthumba				
	Kozhinji				
	Kakkakumbalam				
<i>Spermacoce alata</i>	kudalchuruki	Rubiaceae		medicinal	
<i>Crassocephalum crepidioides</i>	Appuppanthaadi	Asteraceae		medicinal	
	Pannalchedi				
	pulchedi				
	Varangu				
	Changalipullu				
<i>Chromolaena odorata</i>	Communist pacha	Asteraceae			
<i>Mimosa pudica</i>	Thottavadi	Fabaceae		medicinal	
	Thavalapullu				
	Maravazha				
<i>Mimosa diplotrica</i>	Aanathottavadi				
	Pannalchedi				
	Nellipullu			cattle fodder	

	Snehapullu					
	Parthenium					
	Uppathandu					
	Kayppamvalli					
<i>Mangifera indica</i>	Muvandanmaavu	Anacardiaceae				
	Aattukannan					
	Chorapoovan				Medicinal	
	Cherry					
	Chengadhali	Musaceae				
	Panineer chamba					
	Njalipoovan	Musaceae	yes			
	Kadhali pazham	Musaceae				
	Yethapazham	musaceae	yes			
	Chundilakannan	musaceae				
	Aathapazham					
<i>Carica papaya</i>	Pappaya	Caricaceae	yes			
<i>Artocarpus heterophyllus</i>	Varikkachakka	Moraceae				
	Komanga					
	Njalipoovan	Musaceae				
	Grapes					
	Orange		yes			
	Apple					
<i>Citrus limon</i>	cherunaranga	Rutaceae	yes			
<i>Manilkara zapota</i>	Sapota	Sapotaceae			medicinal	
<i>Psidium guajava</i>	Puliyana pera				antidiabetic	

	Pera	Myrtaceae		medicinal	antidiabetic	
	Chamba					
	Mulberry					
	Mullatha	Annonaceae		medicinal	Anticancerous	
<i>Amnoma Muricata</i>	Peach	Rosaceae				
<i>Prunus persica</i>						
<i>Secinum edule</i>	Seema kathirikka	Cucurbitaceae				
<i>Artocarpus hirsutus</i>	Anjili chakka	Moraceae				
<i>Solanum nigrum</i>	Manithakkali	Solanaceae				
<i>Citrus maxima</i>	Babloos leamon	Rutaceae				
<i>Theobroma cacao</i>	Cacao tree	Malvaceae	yes			
	Gooseberry	Grossulariaceae	yes			
Ayurvedic Plants (Homestead BD)						
	Vishachoola		yes	stem, leaf	medicinal	
<i>Kaempferia rotunda</i> Linn.	Chengazhineer kizhangu	Zingiberaceae		flower, tuber	medicinal	
<i>Mucuna pruriens</i>	Naikurana	Fabaceae	yes	seed	medicinal	
<i>Biophytum sensitivum</i>	Mukkutti	Oxalidaceae		whole plant	medicinal	
<i>Ipomoea obscura</i>	Thiruthali	Convolvulaceae		whole plant	medicinal	
<i>Ruta graveolens</i>	Arutha	Rutaceae		flower, leaf, fruit	medicinal	
<i>Zingiber zerumbet</i>	Mala inji	Zingiberaceae	yes	Rhizome	medicinal	
<i>Curcuma angustifolia</i>	Manja koova	Zingiberaceae	yes	Tuber	medicinal	
<i>Gynodon dactylon</i>	Karuka	poaceae	yes	whole plant	medicinal	
<i>Bacopa monnieri</i>	Brahmi	Plantaginaceae	yes	whole plant	medicinal	
<i>Gmelina arborea</i>	Kumbil	Verbenaceae	yes	root, leaf, fruit, flower	medicinal	
<i>Tabernaemontana divaricata</i>	Nandyarvattam	Apocynaceae		leaf, flower	medicinal	
<i>Aloe vera</i>	Kattarvazha	Asphodelaceae	yes	leaf	medicinal	

<i>Andrographis paniculata</i>	Nilakanjiram	Acanthaceae	yes	stem, leaf	medicinal
<i>Ziziphus rugosa</i>	Thodali	Rhamnaceae		fruit, leaf	medicinal
<i>Nilgiranthus ciliatus</i>	Karimkuriinji	Acanthaceae		whole plant	medicinal
<i>Indigofera tinctoria</i>	Neelamari	Fabaceae	yes	whole plant	medicinal
<i>lemon tree</i>	Cherunarakam	Rutaceae		fruit	medicinal
<i>Datura metel</i>	Neela ummam	Solanaceae	yes	leaf	medicinal
<i>Terminalia bellirica</i>	Thanni	Combretaceae	yes	fruit, bark	medicinal
<i>Piper longum</i>	Thipalli	piperaceae	yes	fruit	medicinal
<i>Leucas aspera</i>	Thumba	Lamiaceae		whole plant	medicinal
	Teak	Lamiaceae	yes	bark	medicinal
	Cardamom	Zingiberaceae	yes	fruit	medicinal
<i>Lawsonia inermis</i>	Milanji	Lythraceae		leaf, flower	medicinal
	Murietti			leaf	medicinal
<i>Saraca asoca</i>	Ashokam	Fabaceae	yes	root, fruit, bark	medicinal
<i>Cyperus rotundus</i>	Muthanga	Cyperaceae	yes	Tuber	medicinal
<i>Hibiscus rosa-sinensis</i>	Chembarathi	Malvaceae		leaf, root, flower	medicinal
<i>Cyanthillium cinereum</i>	Poovamkurunnila	Asteraceae	yes	whole plant	medicinal
<i>Centella asiatica</i>	Kodakan	Apiaceae		leaf, stem	medicinal
<i>Terminalia arjuna</i>	Neelamaruthu	combretaceae		bark	medicinal
<i>Senna tora</i>	Thakara	Fabaceae		leaf	medicinal
<i>Elephantopus scaber</i>	Aanachuvadi	Asteraceae		whole plant	medicinal
<i>Entada rheedii</i>	Makkum kaya	Fabaceae	yes	fruit	medicinal
<i>Syzygium aromaticum</i>	Clove	Myrtaceae	yes	flower	medicinal
	Manjakantham		yes	root	medicinal
<i>Aristolochia indica</i>	Garudakotti	Aristolochiaceae		leaf, root	medicinal
<i>Calotropis</i>	Erukku	Apocynaceae		root, latex, flower	medicinal

<i>Phyllanthus niruri</i>	Keezharnelli	Phyllanthaceae		whole plant	medicinal
<i>Sida cordifolia</i>	Kurunthotti	Malvaceae		whole plant	medicinal
<i>Aegle marmelos</i>	Koovalam	Rutaceae		leaf, fruit, root	medicinal
<i>Rauwolfia serpentina</i>	Sarpagandhi	Apocynaceae	yes	root	medicinal
<i>Amaranthus spinosus</i>	Cherucheera	Amaranthaceae		leaf, stem, root	medicinal
<i>Desmodium gangeticum</i>	Oorila	Fabaceae		root	medicinal
<i>Plumbago indica</i>	Koduveli	Plumbaginaceae		Tuber	medicinal
<i>Azadirachta indica</i>	Aryaveppu	Meliaceae		leaf, bark, fruit	medicinal
<i>Cymbopogon flexuosus</i>	Ginger grass	poaceae	yes	leaf, stem	medicinal
<i>Curculigo orchioides</i>	Nilappana	Hypoxidaceae		leaf, tuber	medicinal
<i>Boerhaavia diffusa</i>	Thazhuthama	Nyctaginaceae		whole plant	medicinal
<i>Clitoria ternatea</i>	Shankupushpam	Fabaceae		root	medicinal
<i>Mentha</i>	Pudina	Lamiaceae		leaf, stem	medicinal
<i>Ixora coccinea</i>	Chethi	Rubiaceae		flower, root	medicinal
<i>Myristica fragrans</i>	Nutmeg	Myristicaceae	yes	fruit	medicinal
<i>Canarium strictum</i>	Thelli	Burseraceae	yes	fruit	medicinal
<i>Hemidesmus indicus</i>	Naruneendi	Apocynaceae	yes	Tuber	medicinal
<i>Moringa oleifera</i>	Muringa	Moringaceae	yes	whole plant	medicinal
<i>Colcaus aromaticus</i>	Panikoorka	Lamiaceae		leaf	medicinal
<i>Asparagus racemosus</i>	Shathavari	Asparagaceae	yes	Tuber	medicinal
<i>Ocimum tenuiflorum</i>	Tulasi	Lamiaceae		leaf, stem, flower	medicinal
<i>Ricinus communis</i>	Avanak	Euphorbiaceae	yes	leaf, root, fruit	medicinal
<i>Justicia adhatoda</i>	Adalodakam	Acanthaceae	yes	stem, leaf, root	medicinal
<i>Tinospora cordifolia</i>	Amruth	Menispermaceae	yes	whole plant	medicinal
<i>Momordica charantia</i>	Pavakka	Cucurbitaceae	yes	fruit	medicinal
<i>Kaempferia galanga</i>	Kacholam	Zingiberaceae	yes	Rhizome	medicinal
<i>Acorus calamus</i>	Vayambu	Acoraceae	yes	stem	medicinal

<i>Mimusops elengi</i>	Illanji	Sapotaceae	yes	wood, flower, fruit	medicinal
<i>Eucalyptus</i>		Myrtaceae	yes	leaf, bark	medicinal
Ornamental plants					
<i>Magnolia champaca</i>	Chembakam	Magnoliaceae	yes	flower	perfume
Timber Tree Plants					
<i>Symplocos racemosa</i>	Pachotti	symplocaceae	yes	wood	
<i>Hopea parviflora</i>	Thambakam	Dipterocarpaceae	yes	wood	
<i>Garcinia gummi-gutta</i>	Kudampuli	Clusiaceae	yes	fruit	
<i>Artocarpus hirsutus</i>	Anjili	Moraceae	yes	wood	
<i>Tectonia grandis</i>	Teak	Lamiaceae	yes	wood	
<i>Swoietenia mahagoni</i>	Mahogany	Meliaceae	yes	wood	
Wild Biodiversity					
<i>Ficus tinctoria</i>	Ellanji	Moraceae	yes	flower, wood	
<i>Artocarpus altilis</i>	Kadaplavu	Moraceae	yes	wood, fruit	
	Aattu teak	Lamiaceae	yes	wood	
<i>Ailanthus excelsa Roxb.</i>	Pongilyam	Simaroubaceae	yes	wood	
<i>Terminalia crenulata Roth</i>	Kari maruthu/ crocodile bark tree	Combretaceae	yes	wood	
<i>Terminalia arjuna</i>	Maruthu/ Arjun tree	combretaceae	yes	wood	
<i>Thespesia populnea</i>	Poovarashu	Malvaceae		wood, flower, fruit	
<i>Terminalia chebula</i>	Kadukka	Combretaceae	yes		
<i>Syzygium cumini</i>	Njaval	Myrtaceae	yes	wood, fruit	
<i>Bombax ceiba</i>	Elavu	Bombacaceae	yes	wood	
<i>Dalbergia latifolia</i>	Karivetti/ Indian rosewood	Fabaceae		wood	
<i>Ipomoea mauritiana</i>	Palmuthukku	Convolvulaceae	yes	Tuber	medicinal

<i>Tragia involucrata</i>	Kodithoova/Chorityanam/ climbing nettle)	Euphorbiaceae	yes	whole plant	medicinal
<i>Cardiospermum Helicacabum</i> Linn	Vallyuzhinja/ Heartseed vine	Sapindaceae	yes	whole plant	medicinal
<i>Oxalis corniculata</i>	Creeping woodsorrel/ Puliyaral	Oxalidaceae	yes	whole plant	medicinal
<i>Vitex negundo</i>	Karinochi	Lamiaceae			medicinal
<i>Solanum toroum</i> SWARTZ	Katuchunda	Solanaceae		fruit	medicinal
<i>Drimys indica</i>	Kattulli/ Inidan squil- plant	Asparagaceae		Rhizome	medicinal
<i>Suaertia chirayita</i>	Kiriyath	Gentianaceae		leaf, flower	medicinal
<i>Celastrus paniculatus</i>	Cherupunna/ Black oil plant	Celastraceae	yes	wood, fruit	
<i>Myristica malabarica</i> LAM.	Kattujattikka/ pathiri	Myristicaceae	yes	fruit, flower	medicinal
<i>Amorphophallus bulbifer</i>	Kattuchena	Araceae	yes	Tuber	medicinal
<i>Dioscorea pentaphylla</i>	Kattukizhangu	Dioscoreaceae		Tuber	
<i>Madhuca longifolia</i>	Indian Butter Tree / tilppa	Sapotaceae			medicinal
<i>Baccourea courtallensis</i>	Mooti Maram/Mootti Pazham	Phyllanthaceae			
<i>Semecarpus anacardium</i>	Cheru	Anacardiaceae			
<i>Ficus microcarpa</i>	Ithi/ Indian Laurel-plant	Moraceae			medicinal
<i>Desmostachya bipinnata</i>	Darbha pullu	poaceae			medicinal
<i>Alstonia scholaris</i>	Ezhilampala/ devil's tree	Apocynaceae			medicinal
<i>Tabernaemontana dichotoma</i> Roxb	Koonampala	Apocynaceae			medicinal
<i>Musa acuminata</i>	Kattuvazha	Musaceae			
<i>Grewia tilifolia</i>	Chadachi	Tiliaceae	yes	wood	
<i>Aporosa lindleyana</i>	Vetti	Phyllanthaceae			
<i>Biancaea sappan</i>	Pathimugam	Fabaceae			

<i>Bridelia retusa</i>	Mulluvenga	Euphorbiaceae				
<i>Pterocarpus marsupium</i>	venga	Fabaceae				medicinal
<i>Gluta travancoria</i>	Shenkuruny	Anacardiaceae				
<i>Mesua ferrea var. ferrea</i>	Churuli	Clusiaceae			root, flower, fruit	medicinal
<i>Hopea ponga</i>	Irubakam	Dipterocarpaceae				
<i>Anthocephalus cadamba</i>	Vella kadambu	Rubiaceae				
<i>Catharanthus .</i>	Shavakotta pacha	Apocynaceae				
<i>Sesbania grandiflora</i>	Akathi	Fabaceae			leaf, flower, fruit	medicinal
<i>Pongamia pinnata</i>	Unga	Leguminosae			seed	medicinal
<i>Pandanus fascicularis Lam.</i>	Kaytha	Pandanaceae				
<i>Cinnamomum verum</i>	Edana	Lauraceae			bark, leaf	
<i>Justicia gendarussa</i>	Vathakodi	Acanthaceae			stem, leaf	medicinal
<i>Cyclea peltata</i>	Paada kizhangu	Menispermaceae			Tuber, leaf	medicinal
<i>Salacia reticulata</i>	Ekanayakam	Celastraceae			whole plant	medicinal
<i>Hugonia mystax</i>	Mothirakanni	Linaceae			whole plant	medicinal
<i>Emilia sonchifolia</i>	Muyal cheviyan	Asteraceae			whole plant	medicinal
<i>Glycosmis pentaphylla</i>	Panal	Rutaceae				medicinal
<i>Begonia floccifera</i>	Kalthamara	Begoniaceae				medicinal
<i>Solanum anguivi Lam</i>	Putharichunda	Solanaceae				medicinal
<i>Spondias mombin</i>	Kattupadavalam	Cucurbitaceae				medicinal
<i>Cissus quadrangularis</i>	Ambazham	Anacardiaceae	yes			medicinal
<i>Leucas zeylanica</i>	Chanamparanda	VITACEAE				medicinal
<i>Helicteres isora</i>	Thumba	Lamiaceae				medicinal
<i>Achyranthes aspera var. aspera</i>	Idampiri Valampiri	Malvaceae				medicinal
<i>Coleus Vettiveroides</i>	Kadaladi	Amaranthaceae			whole plant	medicinal
	Eruveli	Lamiaceae				medicinal

Wild Ornamental Plants						
<i>Ipomoea quamochit</i>	Akasha-mulla	Convolvulaceae	yes			
<i>Jasminum mesnyi</i>	Primrose Jasmine	Oleaceae	yes			
	Sneezweed	Asteraceae	yes			
<i>Lantana camara</i>	Kongini	Verbenaceae	yes			
<i>Utricularia graminifolia</i>	Kakkapoovu	Lentibulariaceae	yes			
<i>Euphorbia pulcherrima</i>	Poinsettia	Euphorbiaceae	yes			
	lily	Liliaceae	yes			
<i>Clerodendrum paniculatum</i>	Krishnakireedam/Orange Tower Flower	Verbenaceae	yes			
<i>Alcea rosea</i>	Hollyhock	Malvaceae	yes			
	Freesia	Iridaceae	yes			
	Lady slipper	Orchidaceae	yes			
<i>Melastoma malabathricum</i>	Kadali Flower / Malabar Melastome	Melastomataceae	yes			

Bioresources listed in the PBR of Munnar Gramapanchayath

Sl. No	Scientific Name	Local Name	Family	Parts Used	Trade	Remarks
Agricultural Crops						
1	<i>Elettaria cardamomum</i>	Nadan	Zingiberaceae	Fruit	Tradable (outside and in local market)	Medicinal
		Therali				
		Green gold				
		Eetta				
		Vellikkanni				
		Kattuthikki				
		Mysore vazhukka				
		Thiruthali				
		Thellani				
Panikulangara						
2	<i>Coffea robusta</i>	Nadan Robusta				
3	<i>Coffea cauveri</i>	Kavery	Rubiaceae	Berry		
4	<i>Coffea arabica</i>	Mettukappu Arabi				
5	<i>Camellia sinensis</i>	China Vella	Theaceae	Leaf		
6	<i>Piper nigrum</i>	Panniyoor 1	Piperaceae	Berry		Medicinal
		Kattuvalli				
		Balankotta Arakkulam munda				

		Kuthiravaali				
		Karimunda				
		Vellamundi				
		Neelamundi				
		Chengannur				
		Vattamundi				
7	<i>Murraya koenigii</i>	Curry leaves	Rutaceae	Leaf		Medicinal
8	<i>Myristica fragrans</i>	Nutmeg	Myristicaceae	Aril, seed		Medicinal
9	<i>Syzygium aromaticum</i>	Clovv	Myrtaceae	Flower bud		Medicinal
10	<i>Moringa oleifera</i>	Drumstick	Moringaceae	Fruit		Medicinal
11	<i>Manihot esculanta</i>	Tapioca	Euphorbiaceae	Tuber		
12	<i>Setaria italica</i>	Thina	Poaceae	Grains		
13	<i>Eleusine coracana</i>	Ragi	Poaceae	Grains		
14	<i>Zea mays</i>	Cholam	Poaceae	Grains		
15	<i>Macrotyloma uniflorum</i>	Horse gram	Fabaceae	Grains		
16	<i>Saccharum officinarum</i>	Sugarcane	Poaceae	Strem		Medicinal
17	<i>Artocarpus altilis</i>	Kadachakka	Moraceae			
18	<i>Carica papaya</i>	Pappaya	Caricaceae			
19	<i>Garcinia gummiigutta</i>	Kudampuli	Guttiferae			Medicinal
20	<i>Tamarindus indica</i>	Vaalampuli	Fabaceae	Fruit		Medicinal
21		Kathipayar (Green)				
		Kathipayar (Violet)				
		Kathipayar (Mixed)				
22	<i>Cajanus cajan</i>	Thuvara	Fabaceae	Fruit, seed		
23	<i>Lablab purpureus</i>	Amara				
24	<i>Cannaia gladiata</i>	Vaalari payar		Fruit		
25	<i>Paspocarpus tetragonalata</i>	Chathurapayar				

26		18 mani payar					
		Pattani payar					
		Amara payar					
27	<i>Phaseola vulgaris</i>	French beans					
		Kothu beans					
		Kutty beans					
		Beans					
		Mutta beans					
28	<i>Cyamopsis tetragonoloba</i>						
		Pumkin- Urundath					
		Pumkin- Neendath					
		Mysore pumkin					
29	<i>Cucurbita moschata</i>						
		Ash goud (Big)					
		Ash goud (Small)					
30	<i>Benincasa hispida</i>						
31	<i>Coccinia grandis</i>	Koval					
32		Vellarikka					
33	<i>Lufa cicutangukla</i>	Peechinga					
34		Churakka					
35		Chochaykka					
36	<i>Daucus carota</i>	Carrot			Apiaceae		
37	<i>Beta vulgaris</i>	Beetroot			Amaranthaceae		
		Radish- Red					
38	<i>Raphanus sativus</i>	Radish- White			Brassicaceae		
39	<i>Curcuma longa</i>	Turmeric			Zingiberaceae	Rhizome	Medicinal
40	<i>Cucurbita sps</i>	Kakkiri					
41	<i>Cucurbita sps</i>	Aakashavallari				Fruit	
43	<i>Zingiber officinale</i>	Ginger- Nadan Ginger- Block			Zingiberaceae	Tuber	Medicinal

		Ginger- Himagiri					
44	<i>Colacasia esculenta</i>	Colacasia- Sheemachembu	Araceae				
		Colacasia- Kannanchembu					
		Colacasia- Kottachembu					
45	<i>Amorphophallus complanulatus</i>	Yam- Neychena					
		Perumchena					
		Onion- small					
46	<i>Allium sepa</i>	Onion- large	Amaryllidaceae				
		Padavalam-Nadan					
47	<i>Trichosantes anguina</i>	Padavalam-Pacha	Cucurbitaceae				
		Paval-Nadan					
48	<i>Momordica charantia</i>	Paval-Pandi	Cucurbitaceae				
		Cucurbitaceae					
49	<i>Trachyspermum ammi</i>	Ayamodakam	Apiaceae		Seed		
50	<i>Solanum lycopersicum</i>	Tomato- nadan	Solanaceae				
		Tomato- apple					
		Mulak					
		Capsicum					
		Vattalmulak					
		Piriyavattal mulak					
51	<i>Capsicum annuum</i>	Palmulak	Solanaceae		Fruit		
		Cheriyamulak					
		Vellamulak					
		Charadan mulak					
		Potato					
52	<i>Solanum tuberosum</i>	Potato			Tuber		
53	<i>Solanum betaceum</i>	Cheerikizhangu					
54	<i>Solanum betaceum</i>	Tree tomato					
55	<i>Solanum melongena</i>	Kathirikka- Nadan					

		Kathirikka- Violet								
		Kathirikka-Sambar								
		Vazhuthana- Nadan								
		Vazhuthana- Violet								
		Vazhuthana-Pacha								
		Vazhuthana-Valiya violet								
		Vazhuthana- Valya pacha								
56	<i>Eryngium foetidum</i>	African Malli	Apiaceae	Leaf						Medicinal
57	<i>Phyllanthus emblica</i>	Amla	Phyllanthaceae							
58	<i>Abelmoschus esculentus</i>	Vendakka- Red	Malvaceae	Fruit						
		Vendakka- Green								
59	<i>Brassica juncea</i>	Mustard	Brassicaceae	Seed						Medicinal
60	<i>Apium graveolens</i>	Celary	Apiaceae							
61	<i>Spinacia oleracea</i>	Palak								
62	<i>Amaranthus dubius</i>	Chuvannacheera	Amaranthaceae							
63		Nadan cheera								
64	<i>Talinum triangulare</i>	Sambarcheera								
65	<i>Amaranthus viridis</i>	Kozhuppacheera								
66	<i>Mentha spicata</i>	Puthina	Lamiaceae	Leaf						Medicinal
67	<i>Sesbania grandiflora</i>	Agathi cheera	Fabaceae							
68	<i>Coriandrum sativum</i>	Malli	Apiaceae							
69	<i>Basella rubra</i>	Vallicheera	Basellaceae							
70	<i>Brassica oleracea</i>	Cabbage- green	Brassicaceae							
		Cabbage- red								
71	<i>Brassica oleracea var. botrytis</i>	Cauliflower	Brassicaceae	Flower						
72	<i>Brassica rapa subsp. rapa</i>	Turnip		Stem						

Fruit Plants						
1	<i>Musa</i> sps.	Poovan	Musaceae	Fruit		Tradable
		Nendran				LT
		Palayamkodan				LT
		Robusta				LT
		Mondan	Moraceae	Fruit		LT
		Koozha				Tradable
		Varikka				Tradable
		Thenvarika				Tradable
2	<i>Artocarpus heterophyllus</i>	Kilichundan	Anacardiaceae	Fruit		LT
		Moovandan				LT
		Stawberry				Tradable
4	<i>Fragaria</i> sps		Rosaceae	Fruit		Tradable
5	<i>Ananas comosus</i>	Pineapple	Bromeliaceae	Fruit		Tradable
6	<i>Annona reticulata</i>	Mullatha	Annonaceae	Fruit		Tradable
7	<i>Citrus aurantiifolia</i>	Currynarakam	Rutaceae	Fruit		LT
8	<i>Citrus lemon</i>	Cherunarakam	Rutaceae	Fruit		LT
9	<i>Citrus reticulata</i>	Orange	Rutaceae	Fruit		LT
10	<i>Malpighia emarginata</i>	Cherry	Malpighiaceae	Fruit		Tradable
11	<i>Solanum betaceum</i>	Tree tomato	Solanaceae	Fruit		Tradable
12	<i>Phyllanthus emblica</i>	Amla	Phyllanthaceae	Fruit		LT
13	<i>Achnas sapota</i>	Sapota	Sapotaceae	Fruit		LT
14	<i>Passiflora edulis</i>	Passion fruit (Manja)	Passifloraceae	Fruit		LT
		Passion fruit (Round)				LT
		Passion fruit (Violet)				LT
Fodder Plants						
1	<i>Cynodon dactylon</i>	Karukapullu	Poaceae	Leaf		LT
2	<i>Desmodia bispinnata</i>	Dharbapullu	Poaceae	Leaf		LT

3	<i>Erythrina variegata</i>	Mullumurikk	Fabaceae	Leaf and bark	LT	Medicinal
4	<i>Erythrina indica</i>	Murikk	Fabaceae	Leaf and bark	LT	Medicinal
5	<i>Albizia lebbek</i>	Vaaka	Fabaceae	Leaf	LT	Medicinal
Weeds and Pest						
1	<i>Emilia sonchifolia</i>	Muyal chevi	Asteraceae	Whole plant		Medicinal
2	<i>Phyllanthus niruri</i>	Keezharnelli	Phyllanthaceae	Whole plant		Medicinal
3	<i>Aerva lanata</i>	Cheroola	Amaranthaceae	Whole plant		Medicinal
4	<i>Eclipta prostrata</i>	Kayyonni	Asteraceae	Whole plant		Medicinal
5	<i>Glorias superba</i>	Menthonni	Colchicaceae	Tuber		Medicinal
6	<i>Amaranthus spinosus</i>	Mullan cheers	Amaranthaceae	Leaf		Food
7	<i>Achyranthes aspera</i>	Kadaladi	Amaranthaceae	Whole plant		Medicinal
8	<i>Vernonia cinerea</i>	Poovamkurunnil	Asteraceae	Whole plant		Medicinal
9	<i>Solanum toroum</i>	Aanachunda	Solanaceae	Fruits and Leaves		Medicinal
10	<i>Solanum anguivi</i>	Cheruchunda	Solanaceae	Fruits and Leaves		Food
11	<i>Mimosa pudica</i>	Thottavadi	Fabaceae	Whole plant		Medicinal
12	<i>Solanum nigrum</i>	Kuttythakkali	Solanaceae	Fruit		Medicinal and Food
13	<i>Cassia tora</i>	Thakara	Fabaceae	Leaf		Medicinal and Food
14	<i>Cardiospermum halicacabum</i>	Uzhinja	Sapindaceae			Medicinal
15	<i>Datura stramonium</i>	Ummam	Solanaceae	Leaf		Medicinal
16	<i>Cyclea peltata</i>	Padathali	Menispermaceae	Tuber		Medicinal
17	<i>Acacia intsia</i>	Inja	Fabaceae	Bark	Tradable	Medicinal
18	<i>Asparagus racemosus</i>	Sathavari	Asparagaceae	Tuber	Tradable	Medicinal and Food
19		Bats	Chiroptera (order)	Flesh		Medicinal

Homestead

Fruits (excluded the ones in first table)

1	<i>Psidium guajava</i>	Perakka	Myrtaceae	Fruit	LT	
2	<i>Syzygium jambos</i>	Chambakka	Myrtaceae	Fruit	LT	
3	<i>Annona squamosa</i>	Seethappazham	Annonaceae	Fruit	LT	
4	<i>Persea americana</i>	Vennapazham	Lauraceae	Fruit	LT	

Medicinal plants

1	<i>Ocimum canum</i>	Cheruthulasi		Leaf	LT	
2	<i>Ocimum canum</i>	Kattuthulasi		Root	LT	
3	<i>Ocimum gratissimum</i>	Karpurathulasi		Leaf	LT	
4	<i>Ocimum basilicum</i>	Ramathulasi	Lamiaceae	Leaf	LT	
5	<i>Ocimum sanctum</i>	Krishnathulasi		Leaf	LT	
6	<i>Coleus zeylanicus</i>	Churna koorcka		Leaf		
7	<i>Coleus aromaticus</i>	Panikoorcka		Leaf	LT	
8	<i>Centella asiatica</i>	Kudangal	Apiaceae	Leaf	LT	
9	<i>Curcuma aromatica</i>	Kasthurimanjal		Rhizome	LT	
10	<i>Kaempferia galanga</i>	Kacholam	Zingiberaceae	Rhizome	LT	
11	<i>Piper longum</i>	Thippali	Piperaceae	Spike	LT	
12	<i>Eclipta alba</i>	Kayyoni	Asteraceae	Whole plant	LT	
13	<i>Vetiveria zizanioides</i>	Ramacham	Poaceae	Root	LT	
14	<i>Anethum graecolens</i>	Shathakuppa	Apiaceae	Whole plant	LT	
15	<i>Aloe barbadensis</i>	Kattavazha	Asphodelaceae	Leaf	LT	
16	<i>Acorus calamus</i>	Vayambu	Acoraceae	Stem	LT	
17	<i>Ageratum conyzoides</i>	Marumupacha	Asteraceae	Leaf	LT	

18	<i>Cyperus rotundus</i>	Muthanga	Cyperaceae	Whole plant	LT	
19	<i>Curculigo orchidoides</i>	Nilapana	Hypoxidaceae	Whole plant	LT	
20	<i>Marantha arundinaceae</i>	Koova	Zingiberaceae	Rhizome	LT	
21	<i>Costus igneus</i>	Insulin pacha	Costaceae	Leaf	LT	
22	<i>Alpinia calcarata</i>	Chittaratha	Zingiberaceae	Rhizome	LT	
23	<i>Cleome viscosa</i>	Kattukaduk	Capparaceae	Seed	LT	
24	<i>Crynum latifolium</i>	Kattulli	Amaryllidaceae	Bulb	LT	
25	<i>Biophytum sensitivum</i>	Mukkutty	Oxalidaceae	Whole plant	LT	
26	<i>Elephantopus scaber</i>	Aanachuvady	Asteraceae	Whole plant	LT	
27	<i>Spinacia ciliates</i>	Kuppamanjal	Asteraceae	Leaf and Flower	LT	
28	<i>Hygrophila auriculata</i>	Vayalchulli	Acanthaceae	Whole plant	LT	
29	<i>Embelia ribes</i>	Vizhal	Primulaceae	Whole plant	LT	
30	<i>Hedyotis herbacea</i>	Narunganam pullu	Rubiaceae	Whole plant	LT	
31	<i>Scoparia dulcis</i>	Kallurukki	Plantaginaceae	Whole plant	LT	
32		Kaphamkolli			LT	
33		Ushnagrundi			LT	
34	<i>Zingiber wightianum</i>	Malayinchi	Zingiberaceae	Rhizome	LT	
35	<i>Cyathula prostrata</i>	Kadaladi	Amaranthaceae	Whole plant	LT	
36	<i>Leucas aspera</i>	Thumba	Lamiaceae	Whole plant	LT	
37	<i>Wedelia chinensis</i>	Manjakayyonni	Asteraceae	Whole plant	LT	
38	<i>Pseudarthria viscida</i>	Moovila	Fabaceae	Leaf	LT	
39	<i>Desmodium gangeticum</i>	Orila	Fabaceae	Leaf	LT	
40	<i>Borreria articularis</i>	Tharthaval	Rubiaceae	Leaf	LT	
41	<i>Tribulus terrestris</i>	Njerinjil	Zygophyllaceae	Whole plant	LT	
42	<i>Gymnema sylvestre</i>	Chakkarakolli	Apocynaceae	Leaf	LT	
43	<i>Glycosmis pentaphylla</i>	Panal	Rutaceae	Whole plant	LT	
44	<i>Desmodium motorium</i>	Thozhukanni	Fabaceae	Leaf	LT	

45	<i>Clerodendron viscosum</i>	Peringalam	Lamiaceae	Leaf and Flower	LT	
46	<i>Alstonia venenata</i>	Analivegam	Apocynaceae	Root	LT	
47		Amari		Leaf, Bark and Root	LT	
48	<i>Adathoda beddomei</i>	Chittadalodakam	Acanthaceae	Leaf	LT	
49	<i>Adathoda vasica</i>	Adalodakam	Acanthaceae	Leaf	LT	
50	<i>Larsonia inermis</i>	Henna	Lythraceae	Leaf	LT	
51	<i>Ruta graveolens</i>	Arootha	Rutaceae	Leaf	LT	
52	<i>Ixora coccinea</i>	Chethy	Rubiaceae	Leaf and Flower	LT	
53	<i>Crossandra infundibuliformis</i>	Kanakambaram	Acanthaceae	Leaf and Flower	LT	
54	<i>Hibiscus rosa chinensis</i>	Chembarathy	Malvaceae	Leaf and Flower	LT	
55	<i>Ricinus communis</i>	Avanakk	Euphorbiaceae	Leaf, Bark, seed and Root	LT	
56	<i>Sida acuta</i>	Vatha kurundotty	Malvaceae	Whole plant	LT	
57	<i>Sida cordifolia</i>	Kurundotty	Malvaceae	Whole plant	LT	
58	<i>Sida rhombifolia</i>	Kurundotty	Malvaceae	Whole plant	LT	
59	<i>Cassia occidentalis</i>	Pommanthakara	Fabaceae	Leaf	LT	
60	<i>Vitex sps</i>	Vellanochi	Lamiaceae	Leaf and Root	LT	
61	<i>Vitex negundo</i>	Karinochi	Lamiaceae	Leaf and Root	LT	
62	<i>Calotropis procera</i>	Eruk	Apocynaceae	Whole plant	LT	
63	<i>Melia azadiracta</i>	Malaveppu	Meliaceae	Whole plant	LT	
64	<i>Azadiracta indica</i>	Nem	Meliaceae	Whole plant	LT	
65	<i>Sarraca indica</i>	Ashokam	Fabaceae	Bark	LT	
66	<i>Cassia fistula</i>	Kanikonna	Fabaceae	Bark	LT	
67	<i>Strychnos nux-vomica</i>	Kanjiram	Loganiaceae	Leaf and bark	LT	
65	<i>Tabernanmontana heyneana</i>	Koonan pala	Apocynaceae	Leaf, bark and Exudation	LT	
8	<i>Embllica officinalis</i>	Nelli	Phyllanthaceae	Fruit and bark	LT	
69	<i>Syzygium cumini</i>	Njaval	Myrtaceae	Seed and bark	LT	
70	<i>Calotropis gigantea</i>	Vellerukk	Apocynaceae	Leaf and Root	LT	

71		Arali		Apocynaceae	Leaf and fruit	LT	
72	<i>Cascabela thevetia</i>	Manjaarali		Apocynaceae	Leaf and fruit	LT	
73	<i>Aegle marmelos</i>	Koovalam		Rutaceae	Leaf and fruit	LT	
74	<i>Piper betle</i>	Vettila		Piperaceae	Leaf	LT	
75	<i>Ipomea seiparia</i>	Thiruthali		Convolvulaceae	Leaf	LT	
76	<i>Boerhaavia diffusa</i>	Chuvanna thazhuthama		Nyctaginaceae	Whole plant	LT	
77	<i>Clitoria ternatea</i>	Neela / Vella shangupushpam		Fabaceae	Whole plant	LT	
78	<i>Tinospora cordifolia</i>	Chittamruth		Menispermaceae	Whole plant	LT	
79	<i>Hemidesmus indicus</i>	Naruneendi		Apocynaceae	Tuber	LT	
Timber Trees							
1	<i>Mangifera indica</i>	Mavu		Anacardiaceae	Trunk	LT	
2	<i>Artocarpus heterophyllus</i>	Plavu		Moraceae	Trunk	LT	
3	<i>Syzygium cumini</i>	Njaval		Myrtaceae	Trunk	LT	
4	<i>Butea monosperma</i>	Plasu		Fabaceae	Trunk	LT	
5	<i>Grevillea robusta</i>	Silver oak		Proteaceae	Trunk	LT	
6		Eucalyptus		Myrtaceae	Trunk	Tradable	
7	<i>Albizia lebbek</i>	Nenmenivaaka		Fabaceae	Trunk	LT	
8	<i>Artocarpus hirsutus</i>	Anjili		Moraceae	Trunk	LT	
9	<i>Dalbergia latifolia</i>	Eetty		Fabaceae	Trunk	LT	
10	<i>Tectona grandis</i>	Thekk		Lamiaceae	Trunk	LT	
11	<i>Swietenia macrophylla</i>	Mahogany		Meliaceae	Trunk	LT	
12	<i>Albizia chinensis</i>	Pulivaka		Fabaceae	Trunk	LT	
13	<i>Albizia amara</i>	Vaaka		Fabaceae	Trunk	LT	
14	<i>Casuarina equisetifolia</i>	Kaatady		Casuarinaceae	Trunk	LT	

Wild Species of Importance- Trees

1	<i>Cullinia exarillata</i>	Vediplavu	Malvaceae			
2	<i>Mesua ferrea</i>	Nanku	Calophyllaceae			
3	<i>Palaequium ellipticum</i>	Pali	Sapotaceae			
4	<i>Gluta travancorica</i>	Chenkuringi	Anacardiaceae			
5	<i>Nageia wallichiana</i>	Nirambali	Podocarpaceae			
6	<i>Calophyllum austroindicum</i>	Katupunna	Calophyllaceae			
7	<i>Garcinia rubro-echinata</i>		Clusiaceae			
8	<i>Gymnema sylvestre</i>	Gummur	Apocynaceae			
9	<i>Garcinia gummi-gutta</i>	Kudampuli	Clusiaceae			
10	<i>Mallotus philippensis</i>	Red Kamala	Euphorbiaceae			
11	<i>Coscinium fenestratum</i>	Maramanjil	Menispermaceae			
12	<i>Pygeum gardneri</i>		Rosaceae			
13	<i>Schefflera racemosa</i>		Araliaceae			
14	<i>Chiomanthus ramiflorus</i>		Oleaceae			
15	<i>Rhododendron arboreum</i>		Ericaceae			
16	<i>Mahonia napaulensis</i>		Berberidaceae			
17	<i>Elaeocarpus recurvatus</i>		Elaeocarpaceae			
18	<i>Ilex denticulata</i>		Aquifoliaceae			
19	<i>Magnolia nilagirica</i>		Magnoliaceae			
20	<i>Actinodaphne bourdillonii</i>		Lauraceae			
21	<i>Litsea wightiana</i>		Lauraceae			
22	<i>Garcinia travancorica</i>		Clusiaceae			
23	<i>Diospyros barberi</i>		Ebenaceae			
24	<i>Memeylon subramanii</i>		Melastomataceae			
25	<i>Memeylon gracile</i>		Melastomataceae			

26	<i>Goniothalamus rhynchantherus</i>			Annonaceae			
27	<i>Vernonia travancorica</i>			Asteraceae			
Wild Species of Importance- Plants							
1	<i>Derris trifolia</i>	Thirudanchedi		Fabaceae			
2	<i>Ruellia prostrata</i>	Upp thaali		Acanthaceae			
3	<i>Cocculus garsutus</i>	Kattukodi		Menispermaceae			
4	<i>Creataeva religiosa</i>	Neermathalam		Capparaceae			
5	<i>Cocculus villosa</i>	Paathala garudakodi		Menispermaceae			
6	<i>Cromolena odorata</i>	Assam pacha		Asteraceae			
7	<i>Ensete superbum</i>	Kalluvazh		Musaceae			
8	<i>Pennisetum typhoides</i>	Kambu		Graminae			
9	<i>Paspalum scrobiculatum</i>	Varak		Poaceae			
10	<i>Hordeum vulgare</i>	Barley		Poaceae			
11	<i>Muchlembika platycladus</i>						
12	<i>Cissus discolor</i>						
13	<i>Curcuma caesia</i>						
14	<i>Salacia fruticosa</i>						
15	<i>Schleichera oleosa</i>						
16	<i>Syzygium mundagon</i>						
17	<i>Rubus glomeratus</i>						
18	<i>Baccaurea courtallensis</i>						
19	<i>Dioscorea hispida</i>						
20	<i>Dioscorea pentaphylla</i>						

Bioresources listed in the PBR of Vattavada Gramapanchayath

Scientific name	Local name	Family	Trade (Yes/No)	Used parts	Remarks
<i>Agave americana</i>	Kattala (Agave)	Asparagaceae			
<i>Agave sisalana</i>	Agave	Asparagaceae			
<i>Agave angustifolia</i>	Agave	Asparagaceae			
<i>Anthurium andreanum</i>	Anthurium	Araceae			
<i>Argyranthemum frutescens</i>	Jamanthi	Asteraceae			
<i>Bougainvillea glabra</i>	kadalasu poovu	Nyctaginaceae			
<i>Caesalpinia pulcherrima</i>	Rajamalli	Fabaceae			
<i>Callistephus chinensis</i>	Aster	Asteraceae			
<i>Cestrum elegans</i>	Butterfly Flower	Solanaceae			
<i>Cestrum nocturnum</i>	Night Jessamine	Solanaceae			
<i>Clitoria ternatea</i>	Shankhupushpam	Fabaceae			
<i>Dahlia hortensis</i>	Dahlia	Asteraceae			
<i>Euphorbia lophogona</i>	Euphorbia	Euphorbiaceae			Conservation status - VU
<i>Furcraea foetida</i>	Mania Agova	Asparagaceae			
<i>Gardenia jasminoides</i>	Gandharajan	Rubiaceae			
<i>Gerbera jamesonii</i>	Gerbera	Asteraceae			
<i>Gladiolus dzroakheticus</i>	Gladiolus	Iridaceae			
<i>Hibiscus rosa-sinensis</i>	Chembarathi	Malvaceae			
<i>Holmskioldia sanguinea</i>	Cup-and-saucer-plant	Lamiaceae			
<i>Impatiens balsamina</i>	Garden balsam	Balsaminaceae			
<i>Jasminum sambac</i>	Jasmine/mulla	Oleaceae			
<i>Nerium oleander</i>	Arali	Apocynaceae			
<i>Papaver somniferum</i>	Opium Poppy	Papaveraceae			
<i>Polianthes tuberosa</i>	Tube rose	Asparagaceae			

<i>Rosa banksiae</i>	Lady Banks' rose	Rosaceae			
<i>Rosa centifolia</i>	Cabbage rose	Rosaceae			
<i>Rosa gallica</i>	French rose	Rosaceae			
<i>Rosa indica</i> L.	Rose	Rosaceae			
<i>Saraca asoca</i>	Ashoka tree	Fabaceae			
<i>Tabernaemontana divaricata</i>	Nanthiyarvattam	Apocynaceae			
<i>Tagetes erecta</i>	Chendu malli/ Bandhi	Asteraceae			
<i>Vanda</i> sps	Maravazha	Orchidaceae			
Timber trees					
<i>Acrocarpus fraxinifolius</i>	Korangatti	Fabaceae			
<i>Artocarpus heterophyllus</i>	Plavu	Moraceae			
<i>Eucalyptus globulus</i>	Grandis	Myrtaceae	Yes		
<i>Eucalyptus macrocarpa</i>	Eucalyptus	Myrtaceae	Yes		
<i>Ficus racemosa</i>	Athi	Moraceae			
<i>Homonoia riparia</i>	Vanji maram	Euphorbiaceae			
<i>Macaranga peltata</i>	Vatta	Euphorbiaceae			
<i>Mangifera indica</i>	Maavu	Anacardiaceae			
<i>Phyllanthus emblica</i>	Nelli	Phyllanthaceae			
<i>Syzygium cumini</i>	Njaval	Myrtaceae			
Other cultivated plants					
<i>Colocasia gigantea</i>	Sheema chembu	Araceae			
<i>Nicotiana tabacum</i>	Tobacco	Solanaceae			Used only by tribes
<i>Saccharum officinarum</i>	Chenkarimbu, Vellakarimbu, Ramakarimbu	Poaceae			Used for making jaggery
Domesticated Animals					
<i>Acridotheres fuscus</i>	Jungle myna	Sturnidae			
<i>Anas platyrhynchos</i>	Tharavu	Anatidae			

<i>Bos indicus</i>	Cow	Bovidae			
<i>Canis familiaris</i>	Dog	Canidae			
<i>Capra aegagrus hircus</i>	Goat	Bovidae			
<i>Felis domestica</i>	Cat	Felidae			
<i>Gallus gallus</i>	Girirajan kozhi	Phasianidae			
<i>Lepus nigricollis</i>	Muyal	Leporidae			
<i>Meleagris gallopavo</i>	Turkey	Phasianidae			
<i>Mule</i>	Kovar kazhutha	Equidae			
<i>Numida meleagris</i>	Guinea fowl	Numididae			
<i>Pittacula cyanocephala</i>	Parrot	Pittaculidae			
Wild Grass					
<i>Axonopus compressus</i>	Padappan pullu	Poaceae		Stem, Leaf	
<i>Bambusa bambos</i>	Mula	Poaceae		Stem	
<i>Bambusa vulgaris</i>	Manja mula	Poaceae		Stem	
<i>Cymbopogon citratus</i>	Theruvupullu	Poaceae	Yes	Leaf	
<i>Cymbopogon martinii</i>	Mechil pullu	Poaceae		Leaf	
<i>Cynodon dactylon</i>	Karuka pullu	Poaceae		Leaf	
<i>Desmostachya bipinnata</i>	Dharba/Yezhukku	Poaceae		Leaf, Root	
<i>Ochlandra traancorica</i>	Eetta	Poaceae		Stem, Leaf	
Wild Ayurvedic Plants					
<i>Datura stramonium</i>	Kattumom	Solanaceae			
<i>Acorus calamus</i>	Vayambu	Acoraceae	Yes	Tuber	
<i>Boerhaavia diffusa</i>	Narthaval	Nyctaginaceae		Root, Leaf, Stem	
<i>Chenopodium album</i>	Nattachedi	Amaranthaceae		Whole plant	
<i>Colocasia sps.</i>	Kattuchembu	Araceae			
<i>Emilia sonchifolia</i>	Muyal cheviyan	Asteraceae		Whole plant	
<i>Ensete superbum</i>	Kalluvazha	Musaceae	Yes	Fruit	
<i>Mimosa pudica</i>	Thottavadi	Fabaceae		Whole plant	
<i>Musa sps.</i>	Kattuvazha	Musaceae			

<i>Plectranthus hadiensis</i>	Iruveli	Lamiaceae		Leaf, Bark
<i>Saccharum arundinaceum</i>	Naaykarimbu	Poaceae		Stem
<i>Sansevieria roxburghiana</i>	Nagakattala	Asparagaceae		Whole plant
<i>Spilanthes clava</i>	Naaymanjal	Asteraceae		Whole plant
<i>Tragia involucreta</i>	Kodithuva	Euphorbiaceae		
Wild Tubers				
<i>Allium cepa</i>	Kattusavala	Liliaceae	Yes	Tuber
<i>Amorphophallus paeoniifolius</i>	Kattuchena	Araceae	Yes	Tuber
<i>Asparagus racemosus</i>	Shathavari	Asparagaceae	Yes	Tuber
<i>Canna indica</i>	Cheenivazha (yellow, green, orange)	Cannaceae		Tuber is used as food
<i>Criminum latifolium</i>	Kattulli	Amaryllidaceae	Yes	Tuber
<i>Curculigo orchioides</i>	Neelapana	Hypoxidaceae		Tuber
<i>Dioscorea pentaphylla</i>	Nooron	Dioscoreaceae		Tuber
<i>Ipomoea mauritiana</i>	Paalmuthuku	Convolvulaceae	Yes	Tuber
Wild Creeper Plants				
<i>Acacia concinna</i>	Cheevakaya	Fabaceae	Yes	Bark, Fruit
<i>Caesalpinia bonduc</i>	Kazhanji	Fabaceae	Yes	Leaf, Bark, Seed
<i>Calamus rotang</i>	Chooral	Areaceae	Yes	Stem
<i>Cardiospermum halicacabum</i>	Uzhinja	Sapindaceae	Yes	Whole plant
<i>Clematis zeylanica</i>	Vathakodi	Ranunculaceae		Stem, Leaf
<i>Cucumis trigonus</i>	Kattuvellari	Cucurbitaceae		Fruit
<i>Mucuna pruriens</i>	Naykarunam	Fabaceae	Yes	Seed
<i>Trichosanthes lobata</i>	Kattupadavalam	Cucurbitaceae	Yes	Whole plant

Present Conservation Status and Trade Statistics of Minor Forest Products (MFPs) in Idukki District, Kerala.

Sl. No.	Local name	Species name	IUCN Status	Family	Products	Uses	Collection point	Product name	Procurement Agency	Marketing			Nature of exports		
										Trading period		Quantity (kg)		Buying Value (Rs/Kg)	Selling Value (Rs/Kg)
										1995-97					
1	Kunni Kunnikuru.	<i>Abrus precatorius</i> L.	-	Leguminosae	Roots Leaves Seeds	Medicinal	-	-	-	-	-	-	-		
2	Kareenja Kareenja-patta	<i>Acacia pennata</i> (L.) Willd.	-	Leguminosae	Bark	Fish nets Stilt leather Substitute for soap	-	-	-	-	-	-	-		
3	Anthochini, Attu, Incha, Inna	<i>Acacia torta</i> (Roxb.) Craib	-	Leguminosae	Bark	Toilet soap	Wild	Soap-bark	Kerala SC/ST Fed.	1,435,74	11.4	12	No		
4	Vayambu	<i>Acorus calamus</i> L.	LC	Acoraceae	Rhizome	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	117	14.25	15	No		
5	Adalodakam Adathoda	<i>Justicia adhatoda</i> L.	-	Acanthaceae	Root	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	1584	95	100	No		
6	Dhup, Mattipal Perumaram Pongalilyam	<i>Alantthusstripisa</i> (Dennst.) Alston	-	Simaroubaceae	Softwood and Gum-oleoresin	Match Agarbathis and Plywood industries	Wild	-	Kerala SC/ST Fed.	-	38	40	No		

7	Ankolam Arinjil, Azhinni, Kumbi Thouttan	<i>Alangium salviifolium</i> (L.f.) Wangerin	LC	Cornaceae	Roots Root-bark Stem-bark Leaves	Medicinal	-	-	-	-	-	-	-
8	Aratha Kolinchi Peraratha	<i>Alpinia galanga</i> (L.) Willd.	-	Zingiberaceae	Rhizome	Medicinal Perfume industry	Wild or Cultivated	-	Kerala SC/ST Fed.	5119	14.25	15	Rs. 0.32 million (1980-81); Rs. 0.52 million (1990-91)
9	Kadalavanakk Nangin-kuru Pella	<i>Anamirta cocculus</i> (L.) Wight & Arn.	-	Menispermaceae	Seeds	Medicinal Antidote for chloral poison and morphine	Wild	Cocculus	Kerala SC/ST Fed.	-	-	-	No
10	Ara-anjili Aranj alli Maravuri Nettavil	<i>Antiaris toxicaria</i> Lesch.	LC	Moraceae	Bark	Bed fibre, resinous gum	-	-	-	-	-	-	No
11	Chemrnaram Karagil Malampuvam	<i>Aphanamixis polystachya</i> (Wall.) R.Parker	LC	Meliaceae	Seeds and bark	Medicinal	-	-	-	-	-	-	No
12	Eshwaramulla, Garudakodi Karalagam Karalvekam Karendavalli	<i>Aristolochia indica</i> L.	-	Aristolochiaceae	Roots	Antidote for snake and insect poisons	Wild	-	Kerala SC/ST Fed. AndPvt. Agencies	151	5	-	-
13	Shathavari	<i>Asparagus racemosus</i> Willd.	-	Asparagaceae	Tuberous root	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	14,402	4.3	5	-
14	Illi, Moongil Mula	<i>Bambusa bambos</i> (L.) Voss	-	Poaceae	Culms Grains	Industries Edible	Wild	-	Kerala SC/ST Fed.	-	-	-	No

15	Kunglium Parankisambani, Vellakunthirikam Guggulukuntirikam, Kundiikkamararam	<i>Boswellia serrata</i> Roxb. ex Colebr.	-	Burseraceae	oleo-gum-resin	Industries and Medicinal	Wild	Indian Olibanum or Frankincense or Guggul Salai	Kerala SC/ST Fed.	-	-	-	Quantity (166.2 tonnes) @ Rs. 2.66 million (1977-78). ; Quantity (444.4 tonnes) @ Rs. 6.52 million (1978-79); Quantity (235.9 tonnes) @ Rs. 4.13 million (1979-80); Quantity (261.8 tonnes) @ Rs. 4.27 million (1980-81)
16	Palasin-samatha Pupalasu	<i>Butea monosperma</i> (Lam.) Taub.	DD	Leguminosae	Bark Flowers Fruits	Medicinal Industries	Wild	Butea gum or Bengal gum or Moodoooga oil	Kerala SC/ST Fed.	1507	19	20	No
17	Kazhanchi Kazhanchikay Kazhanchi-kuru	<i>Caesalpinia bonduca</i> (L.) Roxb.	LC	Leguminosae	Seeds	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	-	-	-	No
18	Ottamoodan Pacha-chural	<i>Calamus gambleri</i> Becc.	-	Areaceae	Cane	Industries	-	-	-	-	-	-	-
19	Chooral	<i>Calamus pseudo-tennis</i> Becc.	-	Areaceae	Cane	Industries	-	-	-	-	-	-	-

20	Panni-chooral Thadiyan- chooral, Valiyachooral, Vandi chooral	<i>Calamus thwaitii</i> Becc.	-	Arecaceae	-	-	-	-	-	-	-	-	-	-
21	Ari-chooral Cheruchooral Kattu-chooral	<i>Calamus travancoricus</i> Bedd. ex Becc.	-	Arecaceae	Cane Leaves	Medicinal Industries	-	-	-	-	-	-	-	-
22	Chooral	<i>Calamus vattayila</i> Renuka	-	Arecaceae	Cane	Industries (Furniture)	-	-	-	-	-	-	-	-
23	Cheruthekku Naikumbil Thinperivelam	<i>Calli-carpa tomentosa</i> (L.) L.	-	Lamiaceae	Roots Softwood	Medicinal	Wild	-	Kerala SC/ST Fed.	2753	9.5	10	-	-
24	Karutha- kunthirikam Kunthirikam Kunthirikapayin, Thelli Viraka	<i>Canarium strictum</i> Roxb.	-	Burseraceae	Resin	Industries (Paint)	Wild	Black Damma r	Kerala SC/ST Fed.	2,87,673	75	-	-	-
25	Kanchavu Kanchavuchedi	<i>Cannabis sativa</i> L.	-	Cannabaceae	Leaves	Industries (Narcotic, Sedative, Anodyne)	Wild	Bhang, Charas, Marijuana, Ganja, Hashish	Kerala SC/ST Fed.	-	-	-	-	-
26	-	<i>Yushania densifolia</i> (Munro) R.B.Majumdar	-	Poaceae	slender culm	Industries (baskets)	-	-	-	-	-	-	-	-
27	Kattu-karuva Kattu karuva patta	<i>Cinnamomum malababrum</i> (Burmf.) J.Presl	LC	Lauraceae	Bark	Medicinal	Wild	Vazhan a-poovu	Kerala SC/ST Fed.	2096	57	60	-	-
28	Elavarangam	<i>Cinnamomum sulphuratum</i> Nees	VU	Lauraceae	Bark Leaves	Medicinal	-	-	-	-	-	-	-	-

29	Kattu-valli Malathangi Pattu-valli	<i>Cissampelos parira</i> L.	-	Menispermaceae	Roots Leaves Bark	Medicinal	-	-	-	-	-	-	-
30	Changalam-paranda	<i>Cissus quadrangularis</i> L.	-	Vitaceae	Stem Leaves	Medicinal	Wild	-	Kerala SC/ST Fed.	-	-	5	-
31	Ana-koova Cannu-kuva Channa-koova) Chennakkava	<i>Cheilocostus speciosus</i> (J.Koenig C.D.Specht	-	Costaceae	Rhizome	Medicinal	-	-	-	-	-	-	-
32	Neervalam Nir-matholam Nirvala	<i>Crateva nurrala</i> Buch.-Ham.	-	Capparaceae	Bark Root Fruit	Medicinal	-	-	-	-	-	-	-
33	Nilappana Nilappana-kizhangu	<i>Curculigo orchioides</i> Gaertn.	-	Hypoxidaceae	Tuber	Medicinal	-	-	-	-	-	-	-
34	Manga-inchi	<i>Curcuma amada</i> Roxb.	-	Zingiberaceae	Rhizome	Medicinal	-	-	Kerala SC/ST Fed.	-	-	-	-
35	Adavi-kachola Kachuri-kizhangu Kasturimanjal Kattu-kuva	<i>Curcuma zedoaria</i> (Christm.) Roscoe	DD	Zingiberaceae	Rhizome	Medicinal	Wild or Cultivated	Zeodary roots	Kerala SC/ST Fed.	30	11.4	12	Quantity (77 tonnes) @ Rs. 0.38 million (1980-81). Quantity (39.5 tonnes) @ Rs. 0.67 million (1990-91).
36	Padathali	<i>Cyclea peltata</i> (Lam.) Hook.f. & Thomson	-	Menispermaceae	Root	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	1168	47.5	50	-
37	Inchi-pullu Kodi-pullu Theruvai Vattu-pullu	<i>Cymbopogon flexuosus</i> (Nees ex Steud.) W.Watson	-	Poaceae	Leaves	Medicinal Industries	Wild or Cultivated	Lemongrass oil	Kerala SC/ST Fed.	-	-	-	Quantity (313.4 tonnes) (1980-81). Quantity (53 tonnes) @ Rs. 10.2

38	Kattu-nannari Mahali- kizhangu	<i>Decalepis hamiltonii</i> Wight & Arn.	EN	Apocynaceae	Root	Medicinal	-	-	-	-	-	-	million (1990-91). 1945-46 Rs. 70 million, Exported to US, UK and Germany
39	Kal-mugil	<i>Dendrocalamus strictus</i> (Roxb.) Nees	-	Poaceae	Culms	Industry (Paper)	-	-	-	-	-	-	-
40	Orila	<i>Desmodium gangeticum</i> (L.) DC.	-	Leguminosae	Root	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	38,726	12	-	No
41	Chakari-nuran Chaval, Korna-pidan, Nuran Nurankizhang u	<i>Dioscorea pentaphylla</i> L.	-	Dioscoreaceae	Tubers Bulbils	Edible	-	-	-	-	-	-	-
42	Vella-agil	<i>Dysoxylum malabaricum</i> Bedd. ex C.DC.	EN	Meliaceae	Wood	Medicinal	-	-	-	-	-	-	-
43	Eelam Eelakka	<i>Elettaria cardamomum</i> (L.) Maton	-	Zingiberaceae	Fruit Seed	Industry (Beverage)	Cultivated	Cardamom Oleo-resin	Kerala SC/ST Fed.	6559	-	-	Quantity (3210 tonnes) @ Rs. 346.6 million (1980-81). Quantity (1878 tonnes) @ Rs. 266.4 million (1990-91).
44	Cillu, Irikki Kakka-valli.	<i>Entada rheedii</i> Spreng.	-	Leguminosae	seed	Edible Medicinal	Wild	-	Kerala SC/ST Fed.	1,54,583	5	-	-
45	Koda-puli	<i>Garcinia gummi</i>	-	Clusiaceae	Rind of	Edible	Wild or	-	Kerala	8746	85.5	90	No

	Kodam-puli Meen-puli Pinam-puli Punnangan Puram-puli	- <i>gutta</i> (L.) Roxb.			fruits	Medicinal	Cultivated		SC/ST Fed.						
46	Menthoni Mettonni Ventorii	<i>Gloriosa superba</i> L.	LC	Colchicaceae	Tuber	Medicinal	-	-	-	-	-	-	-	-	-
47	Chakkara- koli Sharkara-kolli	<i>Gymnema sylve</i> <i>stre</i> (Retz.) R.Br. ex Sm.	-	Apocynaceae	Leaves	Medicinal	-	-	-	-	-	-	-	-	-
48	Kunnala, Kumbil, Kunnilu	<i>Gmelina arborea</i> Roxb.	LC	Lamiaceae	Root	Medicinal	Wild	-	Kerala SC/ST Fed.	1306	5	-	-	-	-
49	Edampiri- valampiri	<i>Helicteres isora</i> L.	-	Malvaceae	Fruit	Medicinal	Wild	-	Kerala SC/ST Fed.	1109	1.5	-	-	-	-
50	Nannari Naru-neenti	<i>Hemidesmus ind</i> <i>icus</i> (L.) R.Br. ex Schult.	-	Apocynaceae	Tuber	Medicinal	Wild or Cultivated	Indian Sarassap arila	Kerala SC/ST Fed.	756	47.5	50	Quantity (3.25 tonnes) @ Rs. 85000 (1990- 91).	-	-
51	Chittelam	<i>Heraclium rigen</i> <i>s</i> Wall. ex DC.	-	Apiaceae	Root	Medicinal	Wild	-	Kerala SC/ST Fed.	-	47.5	50	-	-	-
52	Ada-kodian Adapathiyam	<i>Holostemma ada</i> <i>-kodian</i> Schult.	-	Apocynaceae	Root	Medicinal	Wild	-	Kerala SC/ST Fed.	300	95	100	-	-	-
53	Irumbakam Irupu, Kambakam, Thambakam	<i>Hopoa parviflora</i> Bedd.	LC	Dipterocarpaceae	Bark	Industry (Leather)	-	-	-	-	-	-	-	-	-
54	Kotti, MarottiMarav etti, Neervalam Neervetti	<i>Hydnocarpus pe</i> <i>ntandrus</i> (Buch. -Ham.) Oken i	VU	Achariaceae	Seed	Medicinal	Wild	-	Kerala SC/ST Fed.	2925	23.75	25	-	-	-

55	Paal-vally	<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton	-	Apocynaceae	Root	Medicinal	Wild	-	Kerala SC/ST Fed.	-	-	-
56	Chewari	<i>Yushania wightiana</i> (Nees) R.B.Majumdar	-	Poaceae	Culms young shoots	Edible Industry (Basket)	-	-	-	-	-	-
57	Kattinchi Kattu-inchi-koova, Kattukolinji	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	DD	Zingiberaceae	Rhizome	Medicinal	-	-	-	-	-	-
58	Kattumurikku Mullilam	<i>Zanthoxylum rhetsa</i> DC.	LC	Rutaceae	Fruit Seed	Medicinal	Wild	-	Kerala SC/ST Fed.	6.65	7	-
59	Vembadam Vembadam-patta, Sural	<i>Ventilago maderaspatana</i> Gaertn.	-	Rhamnaceae	Root bark	Industry (Dye) Medicinal	-	-	-	-	-	-
60	Payin, Perumpayin, Vellaunthirikkam, Vellapayin	<i>Vateria indica</i> L.	VU	Dipterocarpaceae	Bark (oleo-resin)	Medicinal	Wild	White Dammar	Kerala SC/ST Fed.	40	-	-
61	Orila	<i>Uraria lagopoides</i> (L.) DC.	-	Leguminosae	Root	Medicinal	-	-	-	-	-	-
62	Valli-pala	<i>Tylophora indica</i> (Burm. f.) Merr.	-	Apocynaceae	Root	Medicinal	-	-	-	-	-	-
63	Kattupadavalam, Padavalam, Papatolam, Peppadal	<i>Trichosanthes cucumerina</i> L.	-	Cucurbitaceae	Whole	Medicinal	Wild	-	Kerala SC/ST Fed.	28.5	30	-
64	Nerinjil Nerinnil	<i>Tribulus terrestris</i> L.	LC	Zygophyllaceae	Fruit	Medicinal	-	-	-	-	-	-

65	Mathagiri- vembu,vembu	<i>Toona ciliata</i> M. Roem.	LC	Meliaceae	Bark Flowers	Medicinal	-	-	-	-	-	-	-	-	-
66	Alpam Kottashari	<i>Thottia siliquosa</i> (Lam.) Ding Hou	-	Aristolochiaceae	Root	Medicinal	-	-	-	-	-	-	-	-	-
67	Kadukka	<i>Terminalia cheb- ula</i> Retz.	-	Combretaceae	Fruit	Medicinal	Wild	Chebuli c Myrobal an	Kerala SC/ST Fed.	12,399	4.2	4.5	-	-	
68	Thanni Thannika Tusham	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	-	Combretaceae	Fruit	Medicinal	Wild	Belliric Myrobal an	Kerala SC/ST Fed.	-	3.3	3.5	-	-	
69	Naga, Nanga Njara, Njaval Perunnaval	<i>Syzygium cumini</i> (L.) Skeels	LC	Myrtaceae	Fruit	Edible	-	-	-	-	-	-	-	-	
70	Kambli-vetti Pachotti	<i>Symplocos cochinchinensis</i> var. <i>laurina</i> (Retz.) Noot.	-	Symplocaceae	Bark	Medicinal	Wild	-	Kerala SC/ST Fed.	37040	6.65	7	-	-	
71	KatakamTerra , Terramparal, Thettamparal	<i>Strychnos potatorum</i> L.f.	-	Loganiaceae	Seeds Roots	Medicinal	Wild	-	Kerala SC/ST Fed.	-	4.75	5	-	-	
72	Kanjiram Mazhukanjira m	<i>Strychnos nux- vomica</i> L.	-	Loganiaceae	Seeds Roots	Medicinal	Wild	-	Kerala SC/ST Fed.	21	6	-	-	-	
73	Karing-kura Pathiri, Pupathiri, Poopathiri	<i>Stereospermum tetragonum</i> DC.	-	Bigoniaceae	Bark Flowers	Medicinal	Wild	-	Kerala SC/ST Fed.	17897	70	80	-	-	
74	Ananaru Vakka	<i>Sterculia villosa</i> Roxb.	-	Malvaceae	Bark-fibre	Industry (Rope)	-	-	-	-	-	-	-	-	
75	Kavalam Thondi	<i>Firmiana simplex</i> (L.) W.Wight	-	Malvaceae	Bark	Industry (Textiles)	Wild	Indian Tragaca nth	Kerala SC/ST Fed.	-	-	-	-	Quantity (647 tonnes), (1980- 81).Quantity	

																		(598 tonnes) @ Rs. 42.3 million (1990- 91).
76	Cheruchunda Puthirichunda	<i>Solanum violaceum</i> Ortega	-	Solanaceae	Root	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	1,82,207	6.65	7	-					
77	Kurumthotti	<i>Sida rhombifolia</i> L.	-	Malvaceae	Root	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	104960	9.5	10	-					
78	Cheruparuva	<i>Sida acuta</i> Burm.f.	-	Malvaceae	Tender stem Leaves	Medicinal	-	-	-	-	-	-	-					
79	Thaluram	<i>Shorea roxburghii</i> G.Don	VU	Dipterocarpaceae	Wood	Industry (Construction)	-	-	-	-	-	-	-					
80	Cherinkuru Cheru, Sambiri Thembrakay Thenkotta	<i>Semecarpus anacardium</i> L.f.	-	Anacardiaceae	Fruit	Industry (Textile and Paint)	Wild	-	Kerala SC/ST Fed.	-	9.5	10	-					
81	Puvam	<i>Schleichera oleosa</i> (Lour.) Merr.	LC	Sapindaceae	Flowers	Medicinal	Wild	-	Kerala SC/ST Fed.	325	12.35	13	-					
82	Cherumula Chittu Nanyura	<i>Schizostachyum beddomei</i> (C.E.C.Fisch.) R.B.Majumdar	-	Poaceae	Culms	Industry (Basket)	-	-	-	-	-	-	-					
83	Odal, Somavalli, Somalatha, Vellaodal	<i>Sarcostigma kleinii</i> Wight & Arn.	-	Icacinaceae	Seeds	Medicinal	Wild	-	Kerala SC/ST Fed.	85	-	4	-					
84	Somalatha Soma	<i>Sarcostemma acidum</i> (Roxb.) Voigt	-	Apocynaceae	Stem	Medicinal	-	-	-	-	-	-	-					

85	Asokam	<i>Saraca asoca</i> (Roxb.) Willd.	VU	Leguminosae	Bark, Leaves, Flower	Medicinal	-	-	-	-	-	-	-	-
86	Pasakotta Urulingi	<i>Sapindus</i> <i>trifolatus</i> L.	-	Sapindaceae	Fruit	Medicinal Industry (Soap)	Wild	Soap Nut	Kerala SC/ST Fed.	36307	7	-	-	Quantity (20 tonnes), (1980- 81).Quantity (42 tonnes), (1990-91).
87	Chandanam Chandanamar am	<i>Santalum album</i> L.	VU	Santalaceae	heartwood	Medicinal Industry (Soap, Perfume)	Wild	-	Auctioned by the Forest Department.	-	-	-	-	Wood-chips and sandal powder, Quantity (732.5 tonnes) @ Rs. 15.4 million (1980- 81).: Quantity (4281 tonnes) @ Rs. 311.1 million (1990- 91).:Sandalwo od oil Quantity (37.6 tonnes) @ Rs. 29.6 million (1980- 81)Quantity (37.4 tonnes) @ Rs. 132.75 million (1990- 91).
88	Manchatti Mangishta Shivalkodi	<i>Rubia cordifolia</i> L.	-	Rubiaceae	Root Leaves	Medicinal Industry (Dye)	Wild	Indian Maddar	-	-	-	-	-	-
89	Kalur-vanchi	<i>Rotula aquatica</i> Lour.	LC	Boraginaceae	Root	Medicinal	-	-	-	-	-	-	-	-

90	Amalpori Chuvanna-amalpori Sarpagandhi Suvapaval-poriyan	<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz	-	Apocynaceae	Root	Medicinal	Wild	Rauwolfia alkaloid	Kerala SC/ST Fed.	1283	98	100	RootQuantity (4 tonnes) @ Rs. 47,000 (1980-81); Rauwolfia alkaloid, Quantity (786 kg) @ Rs. 87,415 (1966-67). Quantity (566 kg) @ Rs. 43,184 (1967-68).
91	Athithippali Anachukiri Hattimaravala Anatippali	<i>Rhapidophora decursiva</i> (Roxb.) Schott	-	Araceae	Stem Inflorescence	Medicinal	-	-	-	-	-	-	-
92	Chora-venga Karinthakara Malanthakara Venga	<i>Pterocarpus marsipium</i> Roxb.	NT	Leguminosae	Bark Wood	Medicinal	Wild	Gum-kino	-	-	-	-	-
93	-	<i>Pseudoxytenanthera ritcheyi</i> (Munro) H.B.Naithani	-	Poaceae	Culms	Industry (Baskets)	-	-	-	-	-	-	-
94	Watte	<i>Pseudoxytenanthera monadelphae</i> (Thwaites) Soderstr. & R.P.Ellis	-	Poaceae	Culms	Industry (Baskets)	-	-	-	-	-	-	-
95	Arambu Kambu	<i>Pseudoxytenanthera bourdillonii</i> (Gamble) H.B.Naithani	-	Poaceae	Stem	Industry (domestic combs)	Wild	-	Kerala SC/ST Fed.	6,48,358	-	-	-

96	Moovila	<i>Pseudarthria viscida</i> (L.) Wight & Arn.	-	Leguminosae	Root	Medicinal	Wild	-	Kerala SC/ST Fed.	34,906	14.25	15	No
97	Minari, Pungu Punnu, Ungu	<i>Pongamia pinnata</i> (L.) Pierre	LC	Leguminosae	Seed	Industry (Leather) Medicine	-	-	-	-	-	-	-
98	Chitaratha Thumpakoduveli Vella-koduveli	<i>Plumbago zeylanica</i> L.	-	Plumbaginaceae	Root	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	-	14.25	15	-
99	Magadhi Pippali Thippali	<i>Piper longum</i> L.	-	Piperaceae	Fruit	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	12,782	13.3	14	Quantity (28.7 tonnes) @ Rs. 2.3 million (1990-91).
100	Amalakam Nelli Nellika-mararam	<i>Phyllanthus emblica</i> L.	-	Phyllanthaceae	Fruit	Medicinal Edible	Wild or Cultivated	Indian Gooseberry	Kerala SC/ST Fed.	5,69,943	3.6	3.8	Quantity (25 tonnes) @ Rs. 0.1 million (1980-81).
101	Kulamavu Ooravu	<i>Persa mncrantha</i> (Nees) Kosterm.	-	Lauraceae	Leaves	Medicinal	-	-	-	-	-	-	-
102	Choppala Kattu-illupa Pachendi Pala, Pali	<i>Palaequium ellipticum</i> (Dalzell) Bail.	-	Sapotaceae	Seeds	Industry (Soap)	Wild	-	Kerala SC/ST Fed.	50,500	3.2	3.5	-
103	Eeetta, Kareetta, Vei	<i>Ochlandra travancorica</i> (Bedd.) Gamble	-	Poaceae	Culms	Industry (Pulp and Paper)	Wild	-	Auctioned by the Forest Department.	25400	-	-	-
104	Anna Kolangi Ottal	<i>Ochlandra scriptoria</i> (Dennst.) C.E.C.Fisch.	-	Poaceae	Culms	Industry (Mats and Basket)	-	-	-	-	-	-	-

105	Chorla Pinari	<i>Nothapodytes nimmoniana</i> (J. Graham) Mabb.	-	Icacinaceae	Fruits	Edible Medicinal	Wild	-	Kerala SC/ST Fed.	4339	10	-	-
106	Karim-kuringi	<i>Nilgiritanthus ciliatus</i> (Nees) Bremek.	VU	Acanthaceae	Root Basal Stem	Medicinal	Wild	-	Kerala SC/ST Fed.	-	-	7	-
107	Nangu Peri, Velutha-champakam Velutha-pala	<i>Mesua ferrea</i> L.	-	Calophyllaceae	Seed	Industry (Soap)	Wild	-	Kerala SC/ST Fed.	754	9.5	10	-
108	Elengi	<i>Mimusops elengi</i> L.	LC	Sapotaceae	Flower	Industry (Perfume)	-	-	-	-	-	-	-
109	Naicorn Naicornam	<i>Mucuna pruriens</i> (L.) DC.	-	Leguminosae	Seed	Medicinal	Wild or Cultivated	-	Kerala SC/ST Fed.	-	9.5	10	-
110	Kattu-jathika Panampalka Pathiri-poov Ponnamp-poov	<i>Myristica malabarica</i> Lam.	VU	Myristicaceae	Fruit	Medicinal	-	-	-	-	-	-	-

Questionnaire for survey in for the identification of tradable bio-resources with ABS potential

1	Local name of the plant	:	
2	Habit	:	
3	Wild/Cultivated	:	
4	Habitat	:	
5	Part used	:	
6	Dried/ Fresh	:	
7	Distribution Status	:	
8	Changes in abundance of the plants for the last 10 years	:	
9	Processing details	:	
10	Used in single/Combination	:	
11	Is it sold	:	
12	Quantity sold per day/month/year	:	
13	Amount collected per year	:	
14	Buyers	:	
15	Price/kg	:	
16	Condition of the plant sold (Dry/Fresh)	:	
17	Brought to the Market (daily/ Weekly/ Monthly)	:	
18	% of the people in the area doing the business	:	
19	Availability	:	
20	How much sold now as compared to the last 10 years (more/ Same/ Less)	:	
21	Why? (less available for harvest/any other reason)	:	
22	What kinds of Traditional methods are being used for the processing after harvesting	:	
23	What are the problems faced in this business	:	
24	Any other uses	:	

List of bio-resources transported through selected check posts in divisional forest office, Devikulam and Munnar, Idukki District, Kerala

1. Name of Range : Devikulam						
Forest Check Post : Palar						
Date of data collection : 23-10-2019						
Name of Bio-resources :						
Common name	Species	Family	IUCN red list category and criteria	Part used for trade	Source of collection	Sale/trade destination
<i>Eucalyptus</i>	<i>Eucalyptus</i> spp.	Myrtaceae	-	Wood	Kundala, Idukki District	Perumbavoor
Silver oak	<i>Grevillea robusta</i> <i>A.Cunn. ex R.Br.</i>	<i>Proteaceae</i>	Least Concern ver 3.1 ^a	Wood	<i>Eco-point, Munnar</i>	Perumbavoor
2. Name of Range : Devikulam						
Forest Check Post : Bodimettu						
Date of data collection : 23-10-2019						
Name of Bio-resources :						
Ginger	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Data Deficient ver 3.1 ^b	Rhizome	Rajakumary, Idukki district	Theni District, Tamil Nadu
Cardamom	<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	-	Fruit/Seed	Border of Bodimettu, Kerala	Nedumbassery market for both domestic and world over trade
Black pepper	<i>Piper nigrum</i> L.	Piperaceae	-	Fruit	Nedumkandam, Idukki district	Erode District, Tamil Nadu

3. Name of Range : Neriyamangalam		Forest Check Post : Thalakode		Date of data collection : 30-10-2019		Name of Bio-resources:	
Ginger	Zingiber officinale Roscoe	Zingiberaceae	Data Deficient ver 3.1 ^b	Rhizome	Various places in Idukki District	Ernakulam, Thrissur and other places in Kerala	
Tea	Camellia sinensis (L.) Kuntze	Theaceae	Data Deficient ver 3.1 ^c	Leaf	Munnar, Kerala	Ernakulam for both domestic and world over trade.	
Black pepper	<i>Piper nigrum</i> L.	Piperaceae	-	Fruit	Various places in Idukki District	Ernakulam, Thrissur and other places in Kerala	
Reeds	Ochlandra travancorica (Bedd.) Gamble	Poaceae	-	Wood	Reserve forests in Idukki District	Kerala State Bamboo Corporation Ltd. Angamaly in Kerala.	
Sandalwood	Santalum album L.	Santalaceae	Vulnerable A2de ver 3.1 ^d	Wood	Marayoor Government Depot	various places in Kerala	

1. Name of Range : Adimali Forest Check Post : Panamkutty Date of data collection : 02-11-2019 Name of Bio-resources :									
Theetta pullu / Co3 / Co5	Pennisetum purpureum Schumach.	Poaceae	Least Concern ver 3.1 ^e	Tender stem and leaves	Various Patta Land in Adimali	Maniyaran kudi, Vazhathoppu, Idukki District			
Jack Fruit Tree	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	-	Wood	Various places, Idukki District	Perumbavoor			
Tree of Heaven	<i>Ailanthus excelsa</i> Roxb.	Simaroubaceae	-	Wood	"	Perumbavoor			
Vatta	<i>Macaranga peltata</i> (Roxb.) Müll.Arg.	Euphorbiaceae	-	Wood	"	Perumbavoor			
Mango tree	<i>Mangifera indica</i> L.	Anacardiaceae	Data Deficient ver 2.3 ^f	Wood	"	Perumbavoor			
Neem	<i>Azadirachta indica</i> A.Juss.	Meliaceae	Least Concern ver 3.1 ^g	Wood	"	Perumbavoor			
Rubber	<i>Hevea brasiliensis</i> (Willd. ExA.Juss.)Müll.Arg.	Euphorbiaceae	Least Concern ver 3.1 ^h	Wood	"	Perumbavoor			
Anjili	<i>Artocarpus hirsutus</i> Lam.	Moraceae	Least Concern ver 3.1 ⁱ	Wood	"	Perumbavoor			
Cashew tree	<i>Anacardium occidentale</i> L.	Anacardiaceae	-	Wood	"	Perumbavoor			
Small-leaved Mahogany tree	<i>Swietenia mahogani</i> L.	Meliaceae	Near Threatened A2cd ver 3.1 ^j	Wood	"	Perumbavoor			
Murik	<i>Erythrina variegata</i> L.	Leguminosae	Least Concern ver 3.1 ^k	Wood	"	Perumbavoor			
Silver oak	<i>Grevillea robusta</i> A.Cunn. ex R.Br.	Proteaceae	Least Concern ver 3.1 ^a	Wood	"	Perumbavoor			

^a<https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T61956847A61956849.en>

^b<https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T88308170A88308174.en>

^c<https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T62037625A62037628.en>

^d<https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T31852A2807668.en>

^e<https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T18963209A117199421.en>

^f<https://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T31389A9624842.en>

^g<https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T61793521A61793525.en>

^h<https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T62003521A62003529.en>

ⁱ<https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T61220325A61220328.en>

^j<https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T32519A68104916.en>

^k<https://dx.doi.org/10.2305/IUCN.UK.2012.RLTS.T19891448A20072331.en>

^lThe Gazette of India, REGD. NO. D. L.-33004/99, Extraordinary,

PART II – Section 3 – Sub-section (ii), No. 858, New Delhi, Thursday, April 7, 2016.

^mThe Gazette of India, REGD. NO. D. L.-33004/99, Extraordinary,

PART II – Section 3 – Sub-section (ii), No. 3098, New Delhi, Tuesday, November 07, 2017.

Steps for preparing Species Selective Index (SSI) for bio-resource selection

Positive criteria	Availability	Frequency of the targeted species is calculated	> 80%	5
			60-80%	4
			40-60%	3
			25-40%	2
			< 25%	1
	Price	Price at which the bio-resource is available to the primary consumers.	> Rs. 400/kg	5
			Rs. 200-400/kg	4
			Rs. 100-200/kg	3
			Rs. 50-100/kg	2
			< Rs. 50/kg	1
	Market availabilities	The distance from the point of collection to the nearest market available.	< 5 km	5
			5-10 km	4
			10-20 km	3
			20-40 km	2
			> 40 km	1
Traditional knowledge and diversified uses	No. of different traditional knowledge associated to the targeted species.	Traditional knowledge and uses >=4	5	
		Traditional knowledge and uses = 3	4	
		Traditional knowledge and uses = 2	3	
		Traditional knowledge and uses = 1	2	
		No Traditional knowledge	1	
Industrial demand	Percentage of bio-resource being sold from the Mandis to the industries.	100% sold	5	
		70-100% sold	4	
		50-70% sold	3	
		30-50% sold	2	
		< 30% sold	1	
Negative	labour cost	Labour Cost associated with	Highest extreme value	-5

criteria	individual species is calculated per kg of extraction.	> than median value but < Highest extreme value	-4
		Median Value	-3
	> than median value but < Highest extreme value	-2	
	Lowest extreme value	-1	
	< 4 months	-5	
	4 months	-4	
	6 months	-3	
	9 months	-2	
	>9 months	-1	
	> 8 hours	-5	
	< 2 hours	-4	
	4-6 hours	-3	
	6-8 hours	-2	
	2-4 hours	-1	
	> 10	-5	
	8-10	-4	
	6-8	-3	
	4-6	-2	
	< 4	-1	
	> 15 days	-5	
	10-15 days	-4	
	7-10 days	-3	
	3-7 days	-2	
	< 3 days	-1	
	Storage issues	Only air-drying storage mechanism is considered.	

Courtesy: Khan S, Seal S, Sharma S, Joshi U, 2019. Species Selection Index (SSI): A novel tool designed for bio-resource selection under Access and Benefit Sharing (ABS) mechanism. Archives of Agriculture and Environmental Science. 4(2): 163-170 <https://doi.org/10.26832/24566632.2019.040206>

PROJECT II

REVIEW OF ECOLOGICAL AND DEVELOPMENT HISTORY OF VARIOUS SECTORS AND CHANGES IN SELECTED ECOLOGICAL UNITS IN GEF- MUNNAR LANDSCAPE PROJECT AREA

1. Introduction

The Western Ghats Range is one of the 36 Global Biodiversity Hot spots and is home to the largest population of Tigers and Asian elephants in the world, as well as the threatened dholes and gaurs, endangered Nilgiri Tahr and Lion-tailed macaques. It stretches from the northern Tapi River to the southern tip of India parallel to the west coast. It covers an area of 14000 sq. km through the major states of India, namely Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra, and Gujarat. The Western Ghats are considered older than the Himalayas, and their formation started when the earth's crust was being formed. Factually, the Ghats are not true mountains, but faulted edges of an elevated plateau. The Western Ghats are home to many nationally important animals. It also includes wildlife sanctuaries, Tiger reserves and national parks. Within the boundaries of the Ghats, protected areas like Radhanagari Wildlife Sanctuary, Kalakkad Mundanthurai Tiger Reserve, Karian Shola National Park, Pushpagiri Wildlife Sanctuary and Chandoli National Park are appropriate sites to catch a glimpse of the rare fauna of the region.

Thirty nine sites in the Western Ghats in the States of Kerala, Karnataka, Tamil Nadu and Maharashtra were inscribed in the UNESCO World Heritage List in 2012, considering their outstanding universal value and high levels of endemism. There are many hills, valleys and other tourist attractions located in Western Ghats. These hills attract a large number of tourists every year. The major hill stations of Western Ghats are Ooty, Mahabaleshwar, Lonavala, Khandala, Munnar, Ponmudi, Coonoor and Vythiri. Other places of tourist interest like Kodaikanal, Lovedale, Mattupetty, Meghamalai and Valparai are also located in this region.

Elevation and distance from the equator are the major factors influencing the climate of different parts of the Western Ghats. In the lower reaches, the climate is tropical and humid due to its proximity to the sea. Areas that lie at an elevation of 1500 meters and above in the north and at 2000 meters and above in the south

exhibit a more temperate climate. The average annual temperature for the whole of the Ghats is about 15 °C whereas the mean temperature ranges from 20 °C in the south to 24 °C in the north. In the winter months, frost is common in some places, and the temperature at times drops to freezing point. During the monsoon season from June to September, the Western Ghats act as a major barrier to the winds that carry rain from the south-west. Moist clouds are thus forced to rise, eventually causing heavy rain on the windward side. Rainfall in this region averages 3000 to 4000 mm, with some points witnessing up to 9000 mm. The eastern part of the Western Ghats receives less rainfall, averaging 1000 mm, which ultimately leads to the region's annual average of 2500 mm.

Study Area

The project area (PA) of High range Mountain Landscape(HRML) spans from Athirappilly in the west at 76° 26' 18.78"E to Vattavada in the east at 77° 16' 52.98"E and to the south at 9° 58' 54.32"N which spans an area of 2293.82 square kilometers. It is a sparsely distributed area with Edamal and Pooyamkutti valleys in the north, connected to Anamalai, Palani Hills and Agasthyamalai Reserved Forest to the east bordering Tamil Nadu, Periyar Tiger Reserves further down the south and bordering urban areas of Ernakulam and Thrissur. The project areas include Athirappilly, Kuttampuzha, Adimali, Mankulam, Edamalakudy, Munnar and Devikulam Grama Panchayats, and Marayoor, Kanthalloor, Vattavada and Chinnakanal which lies in the rain shadow region. The vegetation chiefly consists of sholas, grasslands, dry mixed deciduous forest, moist deciduous forest, forest plantations (eucalyptus, wattle, pine, teak, sandal), commercial plantations, agricultural fields and mixed farms. The study area has 260 square kilometers of protected areas in Eravikulam National Park (NP), Chinnar Wildlife Sanctuary (WLS), Idukki WLS, Kurinjimala WLS, Anaimudishola NP, Pampadumshola NP, Mathikettanshola NP, Thattekkad WLS. The land use pattern in areas such as Munnar, Marayoor, Mankulam, Malayattoor, Kothamangalam arise as a result of commercial plantations like tea, cardamom, coffee, mixed cultivation and human

dominated home gardens. Sandal Reserves of Marayoor are the only compact tract of natural Sandal forest with mature sandal trees remaining in the country. The Chinnar WLS is located in the rain shadow region of Western Ghats and represents a large number of flora and fauna unique to thorny vegetation

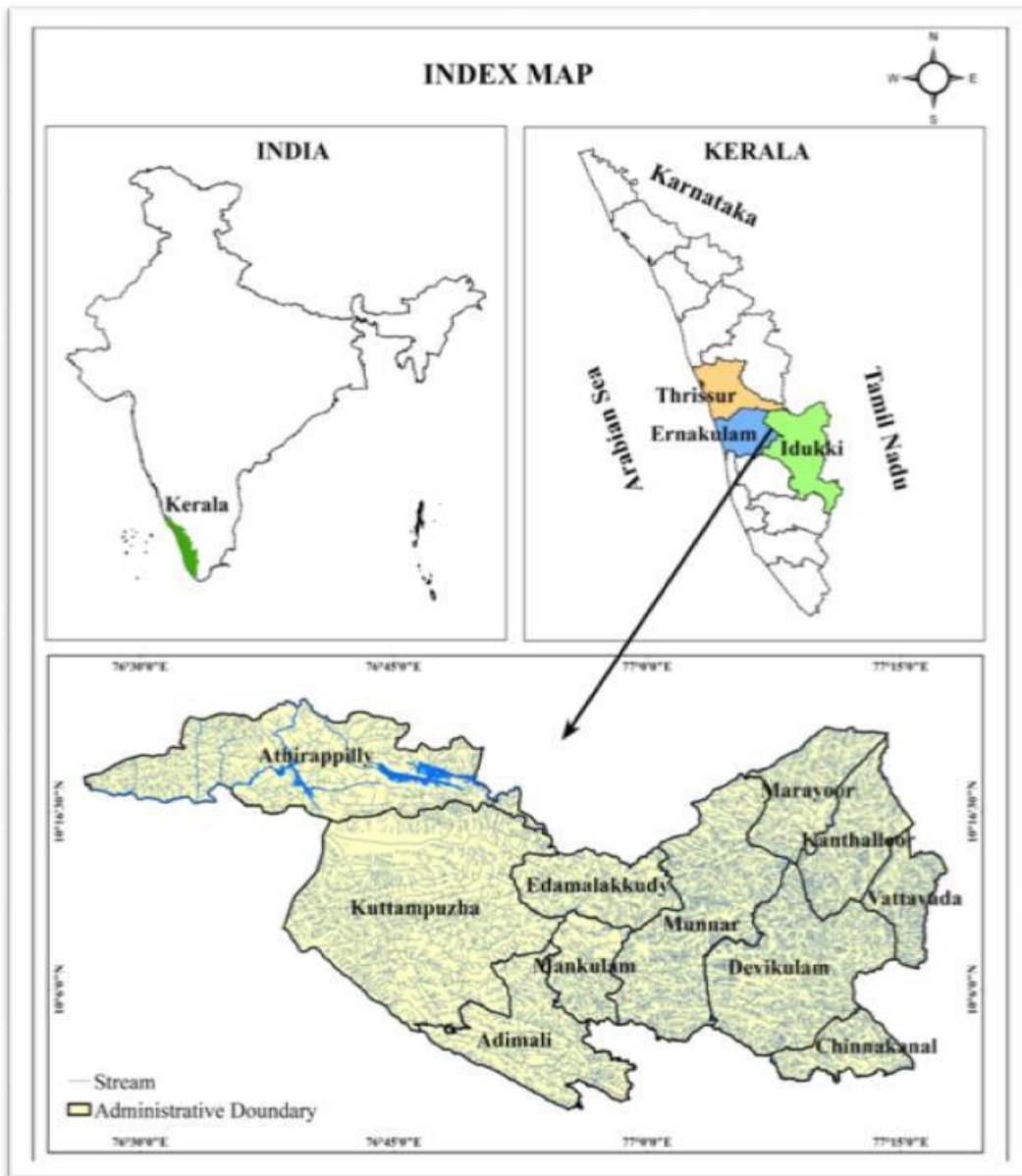


Fig.1: The Study Area

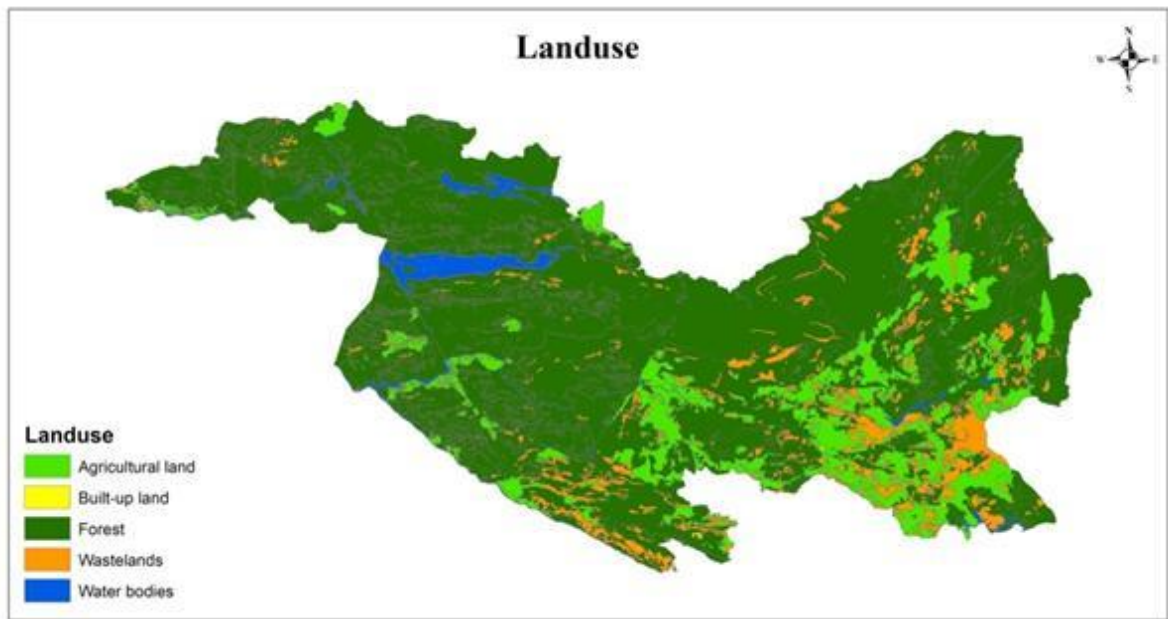


Fig.2. Landuse pattern of the Study Area.

2. Objectives

- 1) Identification and documentation the ecological past, drivers and process of modification of various ecological elements in the landscape and their consequent impacts.
- 2) Documenting various development activities, projects, drivers of change, agencies, and agents of development, institutions and their impacts in the indigenous and migrant settler communities in the HRML.
- 3) Reviewing development trajectories of various communities and social institutions that have consequences to implementation of HRML programme activities.

Several consultative meeting and expert opinion were sought and main thrust activities identified based on the objectives were:

- 1) Explore the hydro-geological, and land use changes over a period and Identification and documentation of the ecological drivers and process of modification of various ecological elements in the landscape and their consequent impacts on biodiversity in the Munnar region.

- 2) Identify the major drivers for biodiversity change such as developmental activities/ institutions and its socio-economic, cultural and livelihood impacts on different groups of local (tribal) communities.
- 3) Suggest appropriate policies for mainstreaming biodiversity concerns in the regional planning/strategies

3. Methodology

Exploration of the biodiversity and socio-economic dynamics in the study areas (time series data and time line analysis):

- a) Through the secondary data from the concerned Govt. Department.
- b) through the primary data from native and tribal communities in the study area by
 - i). **Transect Walk / Observation:** A transect walk is a participatory method in which participants along with facilitators make a walk through an area of interest observing, asking, making different zones, listening, seeking problems, and possible solutions. Villagers and facilitators interact while walking and villagers point out various physical aspects of the area. Both natural and manmade aspects of the area are sketched out. Geographical conditions like soil type, water management, crop types are taken into account, and interaction with participants in real-time gives an in-depth understanding of its causes and suggests overcoming measures. The transect walk took approximately 3-4 hours each day which was done with both tribes and natives. The team had covered around 12 km on both tribal and rural areas of the Panchayat.
 - ii). **Key Person Interview with farmers**
 - iii). **Focus Group Discussions:** Focus group discussion (FGD) with different user groups of biodiversity ideally with a 5-8-member group guided by a facilitator. It is a qualitative method to get in-depth ideas

of the people about their problems and their perceptions. The group members discuss among themselves the topic suggested by the facilitator. The discussion evolved within the members but the facilitator always controlled the entire discussion indirectly to not let discussion slip out of topic. FGDs with different stakeholders like women, farmers, forest dwellers give us the perceptions in each group's perspective. Forest dwellers can tell us how the availability of resources from forests has changed over the years. Women would be able to give us information on how resource change has affected a family as a whole and in tribal areas women are frequent visitors into forests for firewood. This tool helps to bring out the perceptions of weaker stakeholders on the issues they face.

- iv). **Participatory Rural Appraisal:** Participatory rural appraisal (PRA) Or participatory learning and action (PLA) is the fieldworkers' use of a participatory approach. PRA is a methodology used for interactive processes of social development: It is a way of learning from people, with the people, and by the people. It is, therefore, a methodology for analyses, planning, monitoring, and evaluation (encyclopedia-of-action-research).
- v). Rapid Rural Appraisal - RRA refers to a set of approaches that emphasize learning rapidly from local people directly. It differs from conventional approaches that involve field workers gathering information on their own in consultation with local people. In RRA information is gathered and used according to the needs and agenda of field workers.

The PRA and RRA was conducted at a pilot scale at Mankulam Gram panchayat to understand the biodiversity change in the panchayat that affects the life of the common people who live both in rural and tribal areas of the panchayat, and make people aware and understand how they could contribute to the betterment of their agriculture, animal husbandry, and forest-dwelling based livelihoods

- a) Through discussions with Biodiversity Management Committee members at 10 Grama Panchayath in Idukki, Ernakulum and Thrissur district.
- b) Use of Geographic Information System (GIS)

GIS is a computer- based system for the collection of data, input, manipulation, transformation, visualization, combination, modeling, query, analysis and output, with excellent data processing capacity in natural disaster assessment. The spatial and temporal thematic information derived from remote sensing, thematic maps and ground-based information needs to be integrated with field data. Specifically, GIS has the potential of performing landslide susceptibility using various thematic layers. GIS analysis helps in determining macroscopic variables such as elevation, slope gradient, slope aspect, drainage density, etc. from Digital Elevation Model (DEM). Thus analysis of maps to understand the dynamics / trends on: land use, vegetation covers and its nature (forests and agriculture practices), build-up areas, hydrological parameters (surface and ground water availability and flow), geological criteria (types of rocks and its characteristics), soil characteristics, etc. on different periods (2006, 2016 and 2020) through toposheets, geological map, soil map, satellite data, Landsat images, rainfall data were undertaken

- Sectors of drainage pattern, geomorphology, lineaments, lithology, soil texture, soil depth, road networks were prioritized for analyzing land use changes and the required maps procured.
- Daily Rainfall Data analysis from 2014 to 2019 for landslide and drought mapping,
- Soil and water quality analysis

These studies were conducted in all the 11 panchayats of study area.

Data Acquisition

Data acquisition is the process of sampling signals that measure real-world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems, abbreviated by the initials DAS or DAQ, typically convert analog waveforms into digital values for processing. Data has been acquired mainly from different sources, like Toposheets, Geology map, Benchmark of Soils of Kerala. Drought indices and Land Use Land cover (LULC) derived from satellite sources and Land Use Board and rainfall data from India Meteorological Department (IMD).

a) Toposheets

The distinctive characteristic of a topographic map is the use of elevation contour lines to show the shape of the Earth's surface. These maps depict in detail ground relief (landforms and terrain), drainage (lakes and rivers), forest cover, administrative areas, populated areas, transportation routes and facilities (including roads and railways), and other man-made features. Older maps show additional features such as trails, buildings, towns, mountain elevations, and survey control points. Those will be added to more current maps over time.

b) Geology Map

Geology is the study of the Earth, including the materials that it is made of, the physical and chemical changes that occur on its surface and in its interior, and the history of the planet and its life forms. A geologic map or geological map is a special-purpose map made to show various geological features. Rock units or geologic strata are shown by color or symbols. Bedding planes and structural features such as faults, folds, are shown with strike and dip or trend and plunge symbols which give three-dimensional orientations features.

Digital geologic maps are interactive electronic documents that put earth science issues into geospatial frameworks. They capture the size, the shape, the depth, and

the physical and chemical contexts of earth materials, and they blend data display with the results of interpretive research. The combination of geologic maps and GIS databases help us address a great variety of complex geologic and hydrologic issues.

c) Soil Map

Soil mapping involves locating and identifying the different soils that occur, collecting information about their location, nature, properties, and potential use, and recording this information on maps and in supporting documents to show the spatial distribution of every soil. Sometimes soils are mapped with a specific aim in mind, such as the suitability of soils for a particular crop, suitability for irrigation, erosion risk, and many other specific needs or environmental threats. Most organized soil surveys in the past have been general-purpose surveys.

d) Satellite Data

Landsat images

Landsat satellites have the optimal ground resolution and spectral bands to efficiently track land use and to document land change due to climate change, urbanization, drought, wildfire, biomass changes (carbon assessments), and a host of other natural and human-caused changes. The Landsat Program, a joint effort of the U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA), was established to routinely gather land imagery from space. Landsat images consist of eight spectral bands with a spatial resolution of 30 meters. The Landsat satellites have repetitive, circular, sun-synchronous, near-polar orbits, providing full coverage between 81°N and 81°S.

e) Rainfall Data

Rainfall data were collected from IMD (Indian Meteorological Division) for 5 years (2014-2019). Rainfall includes all forms of water particles, whether liquid (for example, rain or drizzle) or solid (hail or snow), that fall from clouds and reaches

the ground. The rain gauge is the standard instrument for recording rainfall, which is measured in millimeters. Rainfall is generally observed daily at 9 am local time - this is a measure of the total rainfall that has been received over the previous 24 hours. More frequent observations of rainfall are also available for selected sites.

4. Detailed Progress Report

4.1 Objective: Identification and documentation the ecological past, drivers and process of modification of various ecological elements in the landscape and their consequent impacts.

4.2 Activity: Explore the hydro-geological, and land use changes over a period and Identification and documentation the ecological drivers and process of modification of various ecological elements in the landscape and their consequent impacts on biodiversity in the Munnar region.

Geographic information systems are utilized in multiple technologies, processes, techniques, and methods. It is attached to various operations and numerous applications that relate to engineering, planning, management, transport/logistics, insurance, telecommunications, and business. For this reason, GIS and location intelligence applications are at the foundation of location-enabled services that rely on geographic analysis and visualization.

Data like Toposheets, Geology map, Benchmark of Soils of Kerala, and Land Use Board Drought indices and Land Use Land cover (LULC) derived from satellite sources and rainfall data from the India Meteorological Department (IMD) were acquired for exploring hydro-geological land use changes and the ecological drivers over a period of time.

Table1: Thematic layers, their geometry, attribute, and data sources

Sl. No.	Thematic layers	Geometry	User-defined Attributes	Data Sources
1	Study area	Polygon	Nil	SOI Toposheets
2	Drainage pattern	Line	Stream order	SOI Toposheets, Land Use Board
3	Watersheds	Polygon	Watershed code	SOI Toposheets, Land Use Board
4	Waterbody	Polygon	Waterbody Name	SOI Toposheets, Land Use Board
5	Road Network	Line	Road name	SOI Toposheets, Land Use Board
6	Geomorphology	Polygon	Geomorphologic units	SOI Toposheets, Land Use Board
7	Lithology	Polygon	Rock types	Geological Map from GSI, Land Use Board
8	Soil Texture	Polygon	Type of soil	Benchmark Soils of Kerala, Land Use Board
9	Soil Depth	Polygon	Soil depth	Benchmark Soils of Kerala/Landuse Board
10	Lineaments	Line	Nil	SOI Toposheets, Land Use Board
11	Land use/Landcover	Polygon	Type of land use/Landcover	Land Use Board & Satellite images
12	Rainfall	Polygon	Rainfall	India Meteorological Department

Geographical and demographic outline of the Study area

The decadal growth rate of Kerala's population is estimated at 4.9 percent, the lowest among Indian states. (Economic review2016, State Planning Board).The population of the district between 1971-81 showed an increase of about 27 percent as against an increase of 19 percent for the state as a whole. Since most part of the district is covered with dense forests and plantations there is lesser area for habitation. There is also large scale conversion of forest areas into arable lands for

past two decades. This has resulted in the increase in population in the hilly Taluks of the district, especially in Udumbanchola and eastern parts of Thodupuzha Taluk. From 1991 to 2001 census in Idukki district shows an increase of 7.03 percentages in total population growth.

i. Kuttampuzha

Kuttampuzha Panchayat is located in Kothamangalam Taluk of Ernakulam district in the Indian state of Kerala with a total area of 543.07 sq km. The total population of the panchayats is 21,765 as per the 2011 census with a density of 40.08. There are about 5,419 houses in Kuttampuzha village.

Kuttampuzha panchayat has two major rivers that are Periyar River and the Chalakkudy River with several small streams in the area that vary in stream order 1 to 8. Kuttampuzha is majorly covered by Denudational Structural Hills. Piedmont zone covers western and some of the northern parts of the panchayat covering most of the waterbody. A very small part of the western side of the panchayat has Denudational Hills which is covered by the Piedmont zone. Also, very few parts of the panchayat have Pediplain Weathered geography, and also a very little Pediplain and lower plateau are found in this area. The lineament structure of Kuttampuzha Panchayath shows a major fault running from northwest to south direction. Lithological unit of Kuttampuzha majorly Peninsular Gneissic Complex except in the western part, where Charnockite Group of Rocks is also found in the central region) and Migmatite Complex is found. Very few places are scattered with Basic Rock.

Most of the areas in this Panchayath are covered with forest so the road network is very scarce. Road networks are scattered in the south, southwestern, west and northwestern part of the panchayat. Roads in the rest of the area are mostly mud roads. Soil depth analysis in Kuttampuzha Panchayath reveals majorly deep soil that is Sandy Loam and very deep soil found in the northern and western region of a panchayat which is also Sandy Loam. Moderately deep, very deep are also

across the panchayat. Rock Outcrops and Sandy Clay Loam are scattered towards southern and central parts respectively.

ii. Mankulam

Mankulam is a small village in Idukki district in the Indian state of Kerala. The panchayat is also famous for being the first panchayat to generate its electricity for its use and sell it to the Kerala State Electricity Board. The population of the panchayat was 9,595 at the 2011 census. The total area of this panchayat is 123 sq km with a density of 78.01. According to the census 2011, the total tribal population of the panchayat is 2099.

The Periyar is the major river basin in the Panchayath that flows with stream order from 1 to 6 and this panchayat is generally receiving good rainfall every year. When examining the geomorphology, Denudational Structural hills are most prevalent in this area. A very small area in the western regions of the panchayat has Pediplain Hill units. While analysing the lineament the panchayat, there are about 5 faults in various parts of the panchayat aligning to the centre in a northwest-southeast direction. The lithological unit Peninsular Gneissic Complex covers most of the areas except in the east, where the Migmatite complex is found. The road network map of Mankulam Panchayath has many small and large roads covering less than 50% of the panchayat where most of these roads are dilapidated. Most of the roads to tribal settlement areas are narrow and broken.

Soil Depth Map shows Deep to Very Deep soil at southern, central, eastern, and western regions that is Sandy clay loam. Sandy loam covers the entire northern region that is Deep soil. Rock outcrops and very deep soil depths are also found in smaller areas at different parts of the panchayat. Gravelly sandy clay loam soil texture is also scattered across.

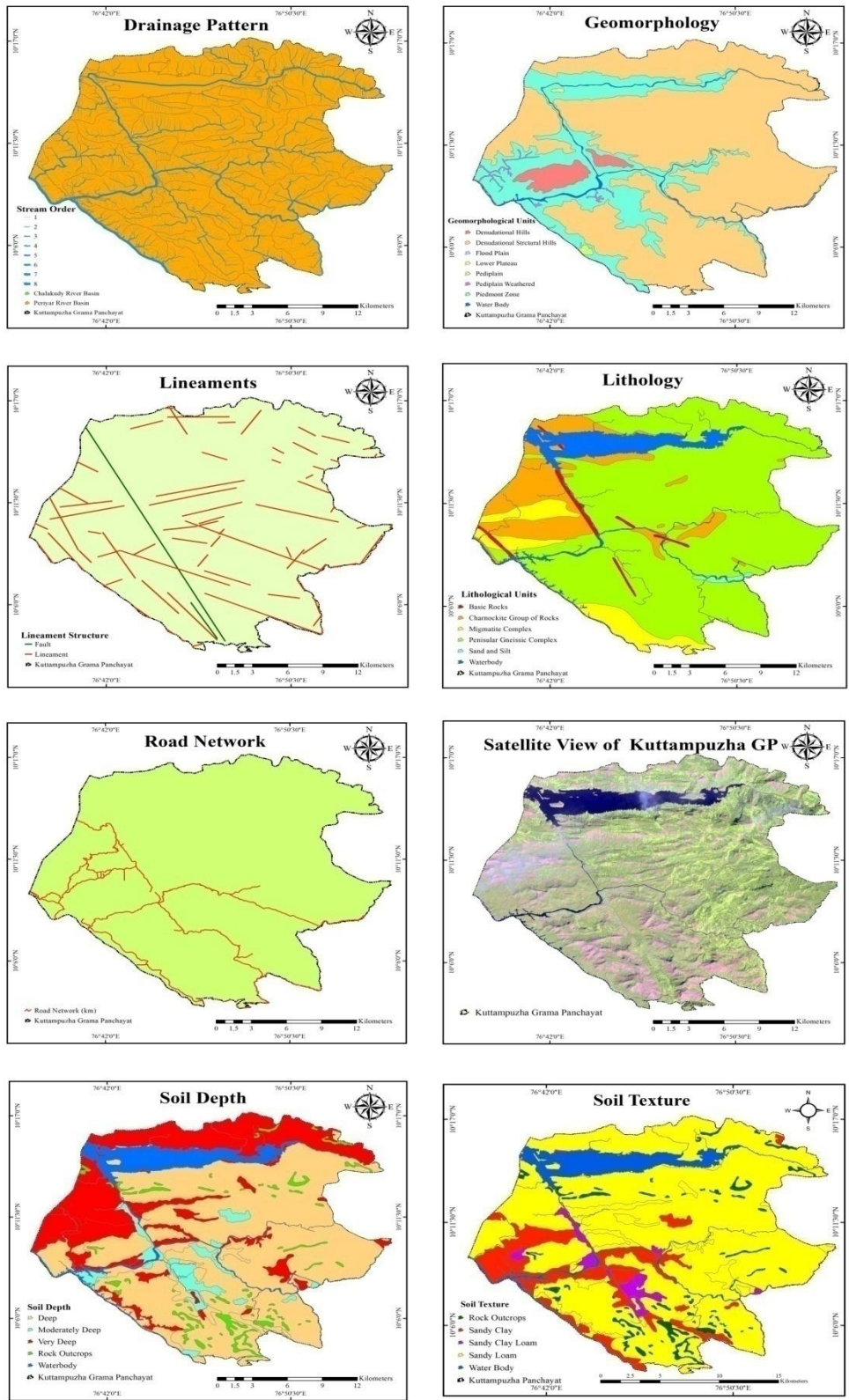


Fig.3 Kuttampuzha

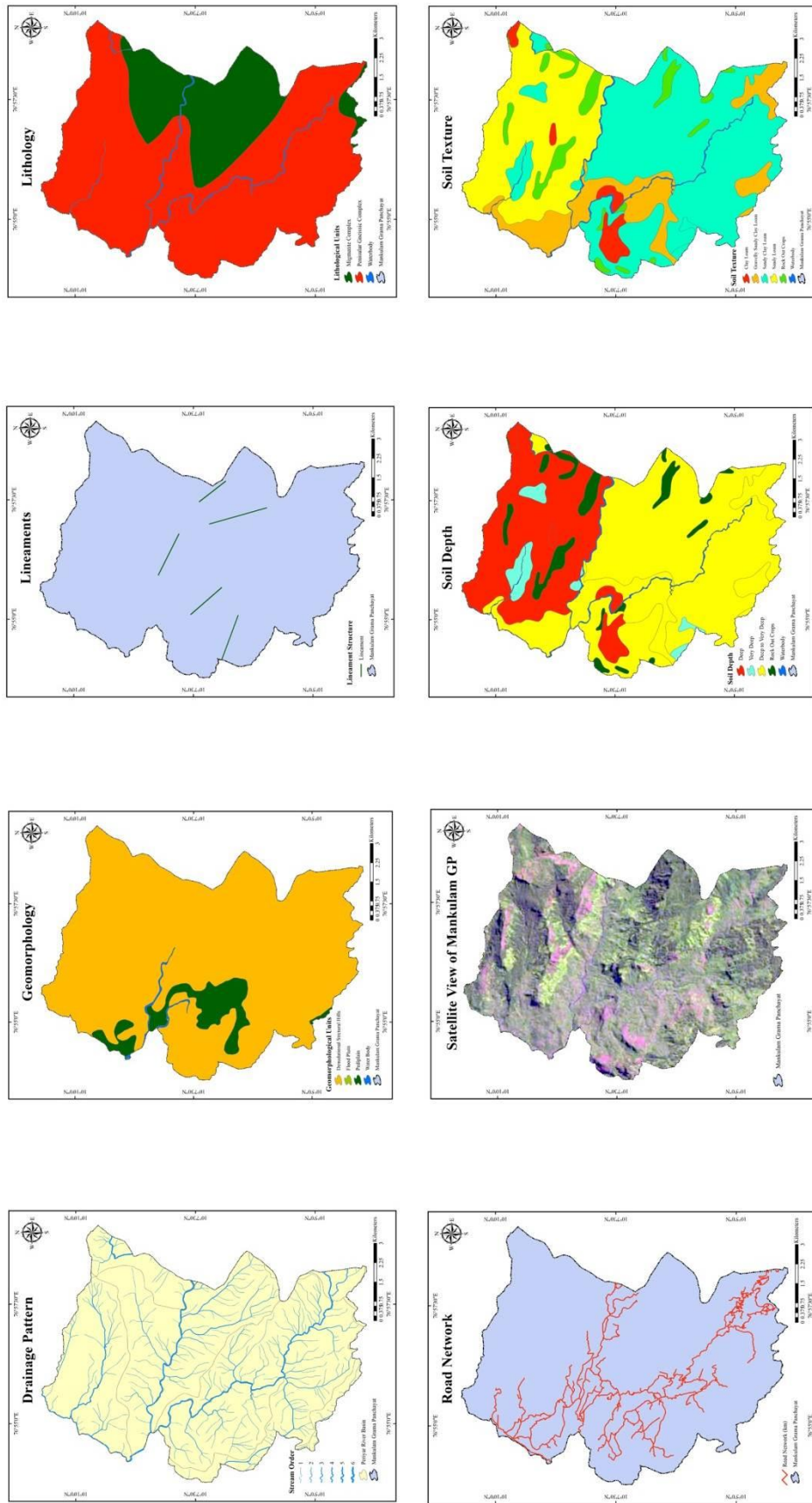


Fig 4 Mankulam

iii. Athirappilly

Athirappilly Grama Panchayat is located in Chalakkudy Taluk, Thrissur district in the state of Kerala, India. The total area of the panchayat is 489 sq. Km. the total population of the panchayats is 9153 with a density of 18.72.

Three major rivers flow making many large and small streams. The major river basins are the Periyar, Chalakkudy, and Karuvannur with stream orders 1 to 6. Looking at the geomorphology, the panchayat is mostly denudational structural hills, and Piedmont zone units are found in the western region. Rock exposure is found in small patches in many parts of the panchayat. The lineament map of Athirappilly panchayat shows 3 faults onwards from north to south of the panchayat at the central region. Various lineaments are found in almost all regions. The lithology of Athirappilly panchayat is mostly Charnockite group of rocks. Peninsular gneissic complex rock is found in central to eastern regions covering the southeast, Migmatite complex is in the north. Basic and Alkaline rocks are also found in very small areas.

The road network of the Athirappilly panchayat is very poor. However, a very dense road network is located in the Southeast part of the panchayat with connections going to the western region. Most regions of Athirappilly have deep soil that is Clay loam. Very deep soil is scattered across the panchayat with rock outcrops and habitation soils seen at isolated points in between. Sandy clay loam soil texture is found scattered at some parts.

iv. Chinnakanal Grama panchayat

Chinnakanal Grama Panchayat is located in the Devikulam block of the Idukki district in the state of Kerala. The total area of the panchayat is 66.74 sq km. As per the 2011 census, the total population of the panchayats is 11,553 with a density of 173.1. The Periyar is the only river that flows through the Chinnakanal Grama Panchayath with stream order 1 to 6.

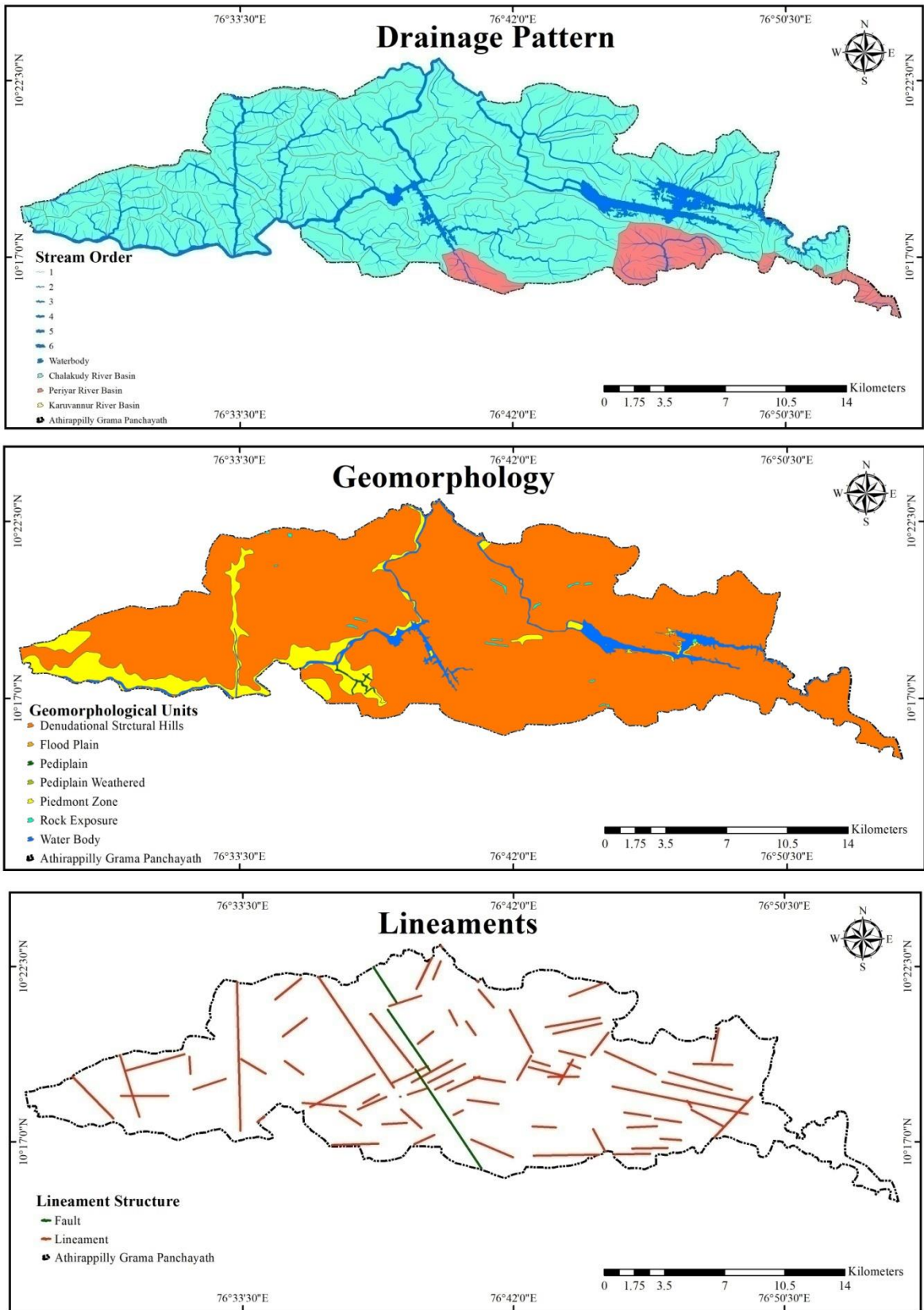


Fig. 5 Athirappilly

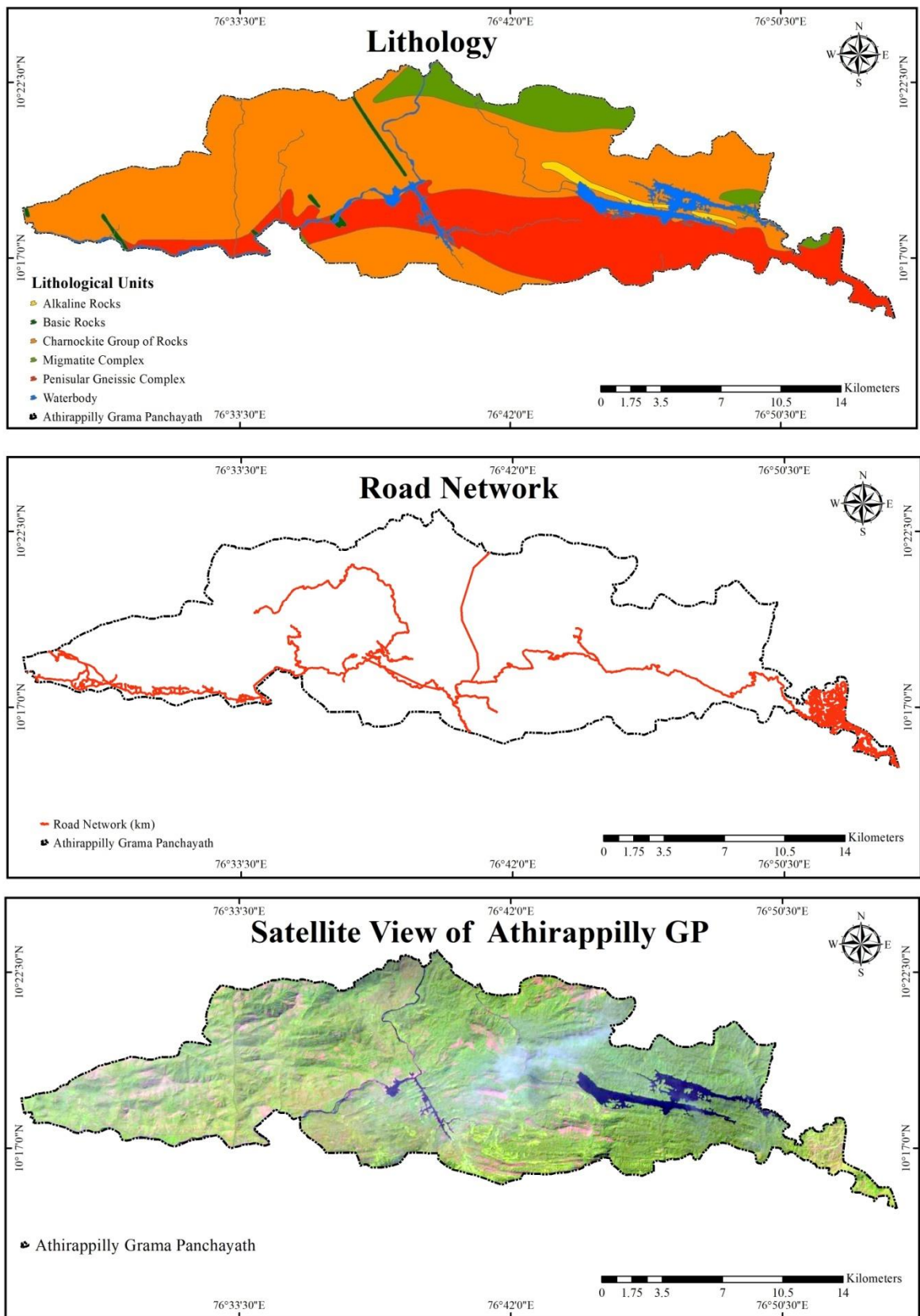


Fig. 5 Athirappally

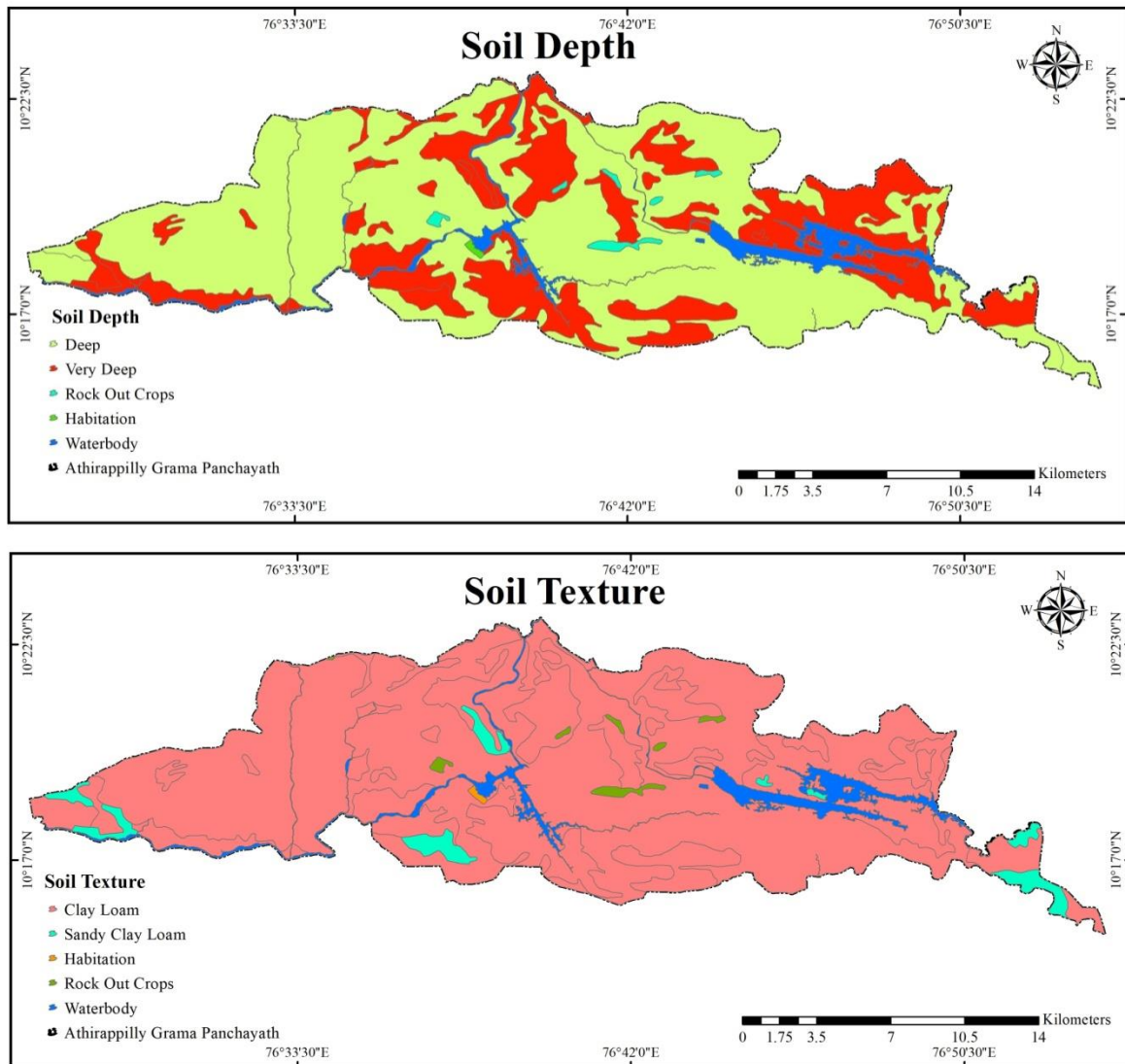


Fig. 5 Athirappilly

Denudational structural hills are the major geomorphological units of this Panchayath. Pediplain units are also found here. A very small area Piedmont zone is also found in the southern region. The Lineament Map of Chinnakanal shows a Fold Axis running from western to southern region and some lineaments running mainly through the central region. Most of the area is covered with peninsular gneissic complex rock. Also, lithological units of Acidic rock and the Khondalite group of rock are found in very small areas in this panchayat in eastern and northeastern regions. The road network can be seen very widely in Chinnakanal panchayat.

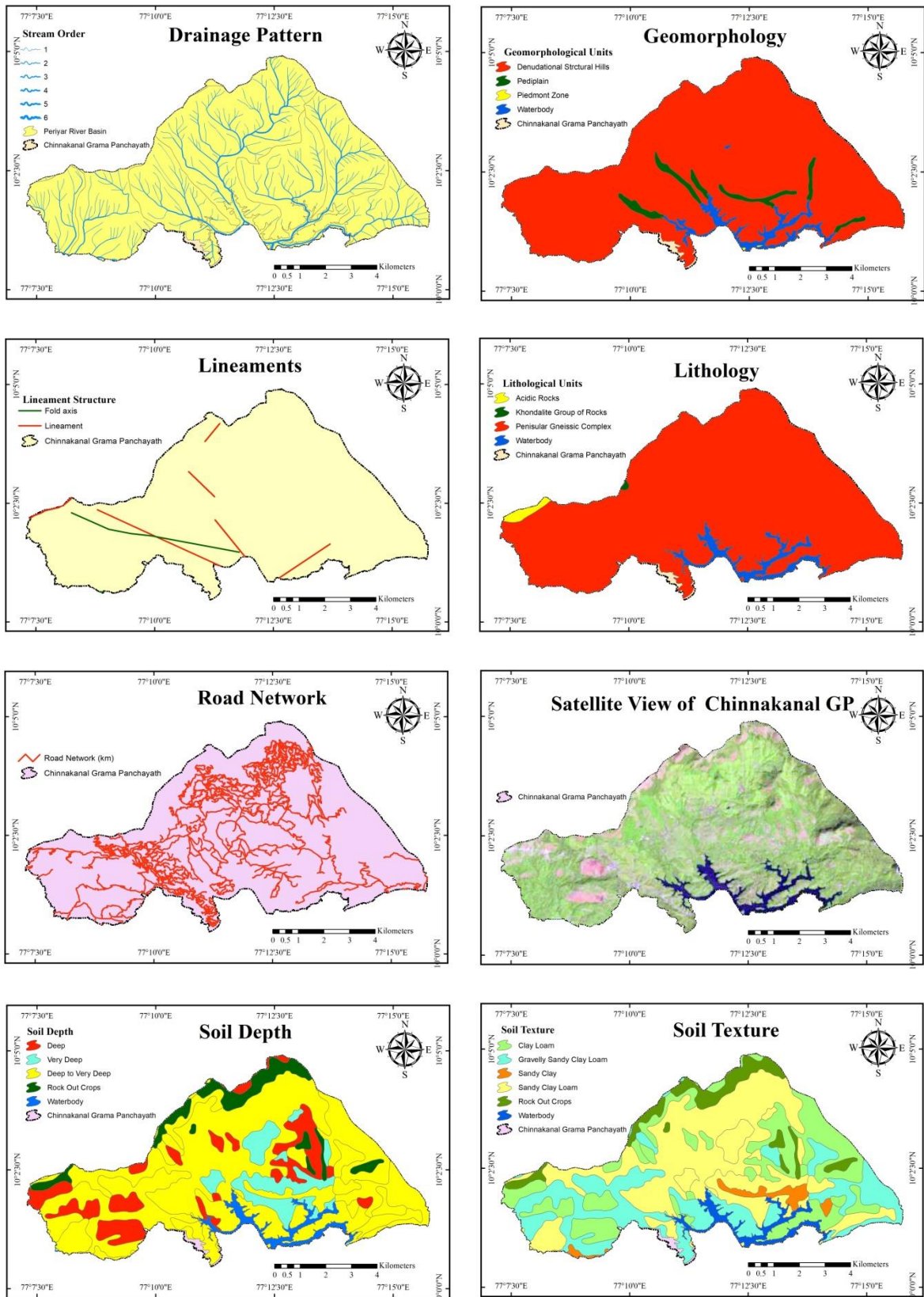
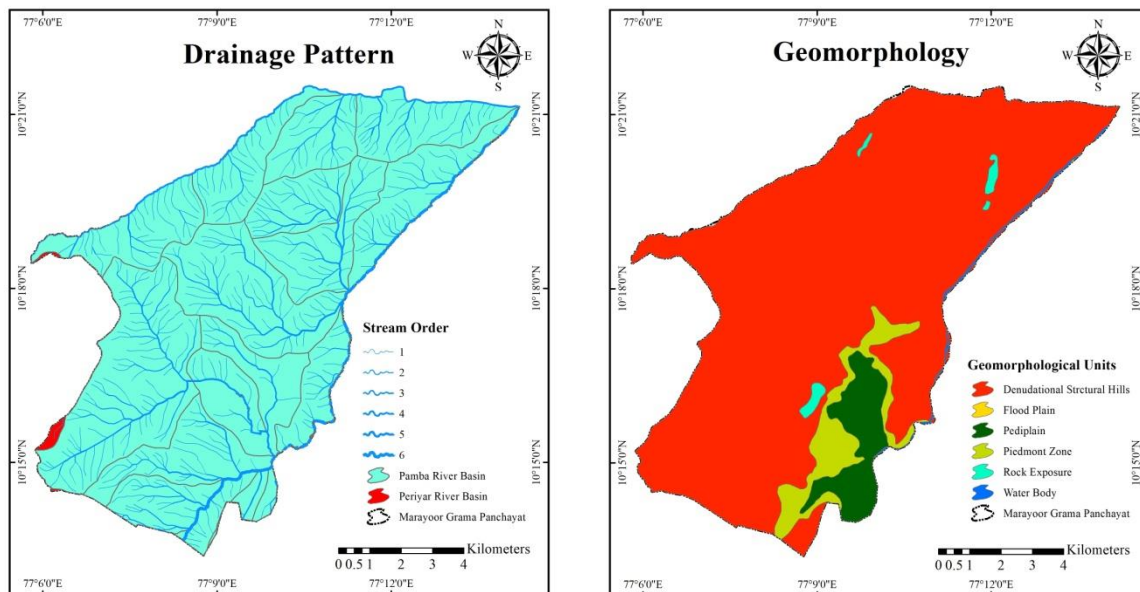


Fig. 5 Chinnakanal

This will help in easy access to different parts of the panchayat. Most of the areas of Chinnakanal panchayat is covered with Deep to Very Deep Soil. Very Deep soil is found in the central region and deep soils are scattered throughout the Panchayat. Sandy clay loam, Gravelly sandy clay loam is found mostly in this Panchayath at central and southern regions respectively. Rock outcrop is also seen in the panchayat at northern some near central parts. Clay loam is found scattered and Sandy clay is also found in near central regions in small sizes.

v. Marayoor

Marayoor Grama Panchayat is located in the Devikulam block of Idukki district in the Indian state of Kerala. The total area of the panchayat is 108.7 sq. km. The population of the panchayat is 12,399 with a density of 114.07.



The climate in Marayoor is characterized by mild wet winters and hot dry summers. Marayoor area is rain shadow region so the rain fall is very less in this area. The water availability in this area depends upon the rain fall in the highland region of Munnar area. The Pampa and the Periyar are the major river basins making streams of orders from 1 to 6. Periyar river basin covers the majority area of the panchayat except in the southwest region drained by Pampa. Denudational structural hills form the major geographical unit that covers areas except

southeast, where Piedmont zone, Pediplain and Rock exposure geographical units are present. The lineament structure of the panchayat shows two Fold axis, one at southwest and one at north east, both running in southwest to northeast direction. There are also lineaments running through the panchayat. The major lithological units are the peninsular gneissic complex rocks covering the entire western region and Migmatite complex covering the entire eastern region.

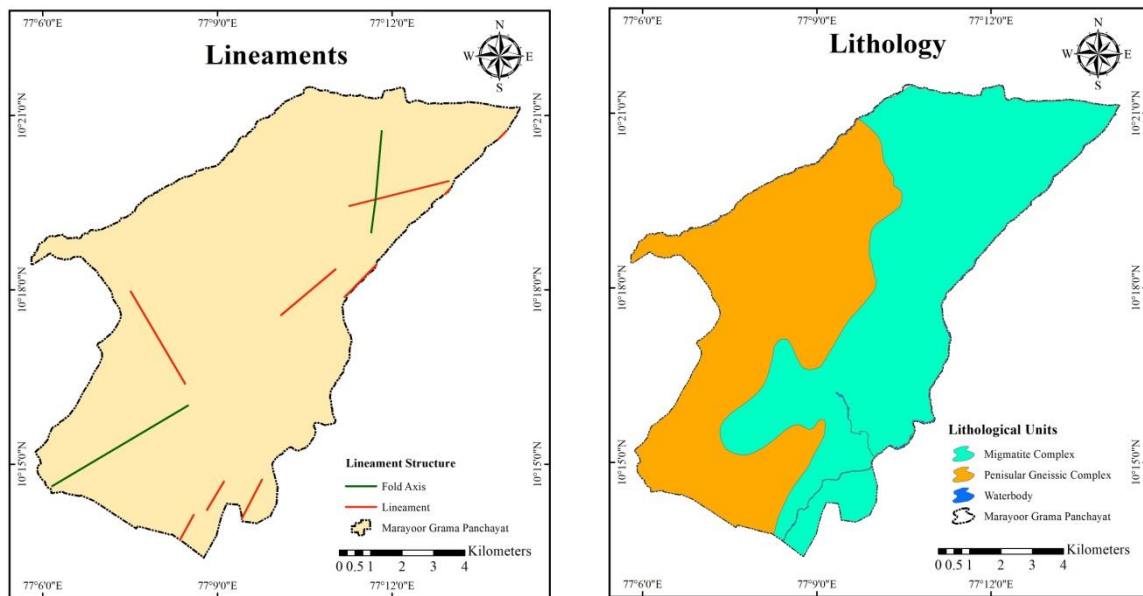


Fig. 5 Marayoor

The Panchayat has poor road network with some concentrated in the south eastern region. The Panchayat has mainly Clay loam soil that is deep to Very Deep in most parts and deep in near south regions. Sandy Clay Loam soil is found in northern and southeastern regions where it is Very Deep and deep to very deep respectively. Rock outcrops and habitation soil is found scattered in isolated regions. In Marayoor region, paddy was a major crop cultivated since 18th century. But now the majority of the paddy lands were converted into sugarcane plantations. At present, some tribal settlement only cultivate paddy. The main reason for this is because of the less availability of water, the expense for paddy cultivation is much more than sugarcane cultivation, and if once they plant sugarcane in an area harvesting can be done thrice. Several factors contributed to the failure of paddy cultivation. The attractive wages in the cash crops sector was

one among them. Originally the paddy fields were rich in fertility and with the supply of water. When people started cultivating on steep side slopes, without proper soil conservation measures, the eroded soil got deposited in the paddy fields and the cultivation became difficult and less profitable. Recently the changes in cultivation that is the paddy to sugarcane introduced some sugarcane manufacturing industries in this area. Mainly there are 3 industries and they are sugarcane manufacturing society, MAPCO and MAHARD.

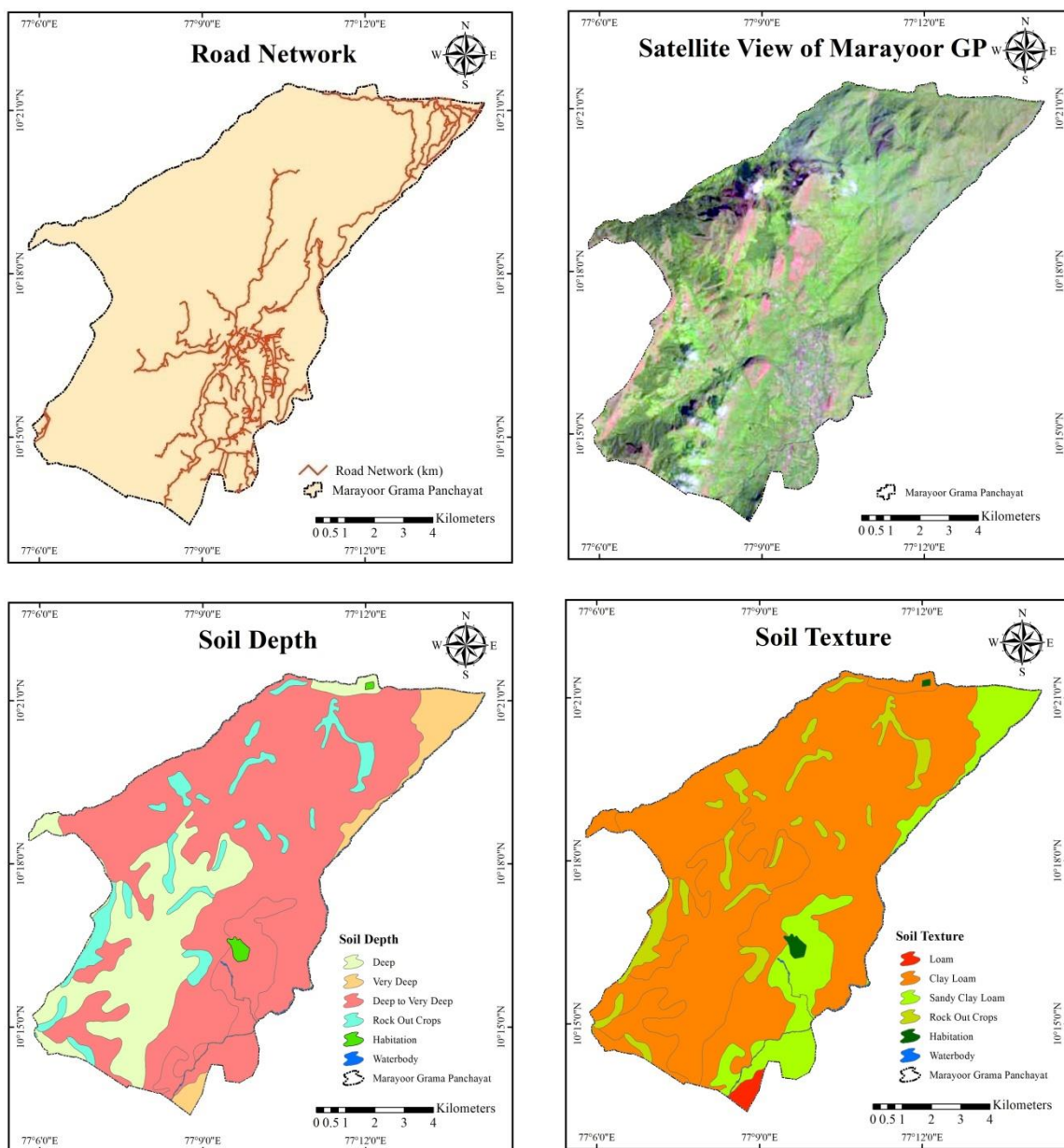


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The tribal people are cultivating different types of agricultural and cash crops. Mainly there are 13 tribal settlements. Hill Pulayas and Muthuvans are present in Marayoor Grama Panchayath. A tribal welfare society is present in Marayoor town area. The main collected NTFP are Lemon grass, sugarcane, large honey, small honey, Kodampuli, Ragi, Gooseberry, Kadukka, Padavalakodi are the main produce collected by the tribes. The tribal welfare society directly collect this item from Tribals. The people in some tribal settlements are cultivating paddy and vegetables in their settlement.

In Marayoor Panchayath more than 345 ha of sugarcane cultivation is present. Other cultivations are 50 ha beans (butter beans and muringa), two tribal

settlements are cultivating coconut. Potato cultivation is also done by the tribal people. Lease cultivation is the main cultivation practice in this area. People take land for lease for a fixed period of time and cultivate crops and give rent for the land to the land owners. Recently the agricultural department has taken up an initiative for the promotion of paddy cultivation in the upland area

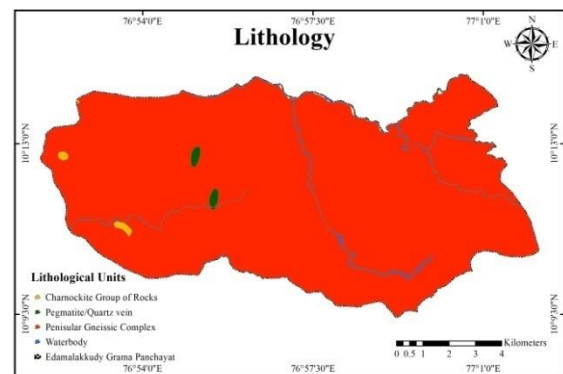
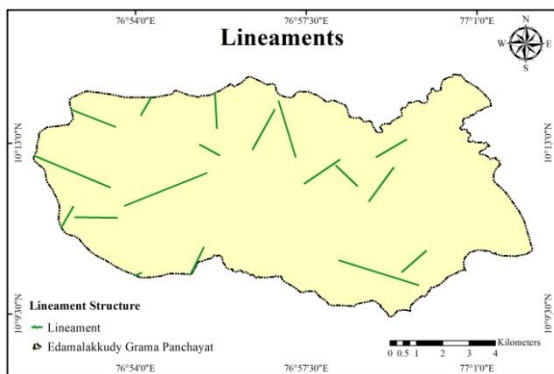
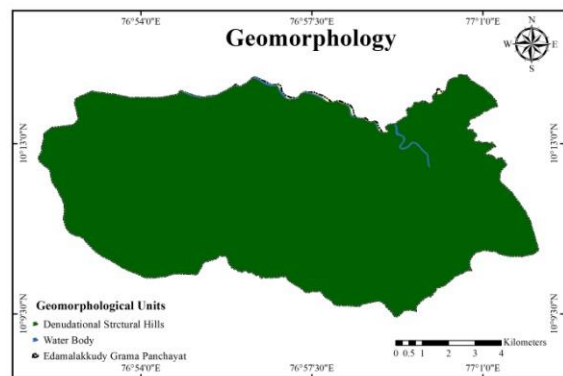
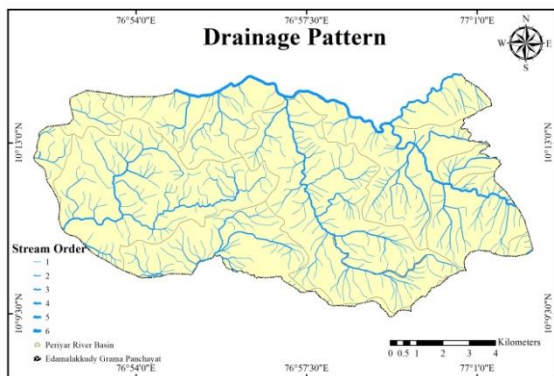
Marayoor sandal forest is the highlight of the area. Marayoor sandal division collect the fallen sandal woods from forest due to fire, rainfall, wild animal attacked trees. They collect them and process the wood and give grades and store them at the sandal forest divisional office. The processing jobs are done by the selected tribal people. All activities are done by the guidance and keen observations of forest officials in each section. They sell this wood through E-auction and each piece of wood have different price depending up on the grade of the wood.

One VSS is working in Marayoor. During the field work, the team interacted with the Secretary of Marayoor VSS, and discussed about their organisation "Chilla", tribes getting opportunity to sell the Non timber forest produce through auction. They can directly sell their products to other states (Tamil Nadu) such as Butterbeans, Kaattupadavalam (177 per Kg) and honey. The people from outside and vegetable sellers are directly participating in this auction. One of the important thing is that most of the products in here are organic, and the tribal people are getting reasonable rate of amount to their product. The residents of the tribal settlement lying on the periphery of the sanctuary also depend on the sanctuary for the same. The tribes mainly collect items such as honey, gooseberry, lemon grass and poles for construction of houses. The NWFP collection is without any regulatory mechanism and the rights to NWFP under the Forest Rights Act is yet to be settled. The quantity of NWFP collected and removed is not available and there is lack of correct data on the quantity of materials collected by the tribes.

vi. Edamalakudy

Edamalakudy is a small village in Devikulam Taluk, Idukki district in the state of Kerala, India. Edamalakudy is also the first tribal Grama panchayat in the state to be formed in 2010. Edamalakudy tribal settlements are known for the Muthuvan tribes. The tribal settlement has 26 Muthuvan hamlets, each lying three to four km away from each other. The Muthuvan tribe here is one of the most reclusive forest tribes in the State. The total population of Edamalakudy was 2,236 with a density of 21.09.

The drainage of the panchayat is contributed by the Periyar river basin with stream orders from 1 to 6. The only geomorphological unit here is the Denudational Structural Hills. There are also several lineaments mostly in the northern region of the panchayat, also in the southern and western regions. The major lithological unit in Edamalakudy is Peninsular Gneissic Complex and it is spread almost all over areas of the panchayat except Pegmatite and Charnockite groups of rocks are rarely found in some patches.



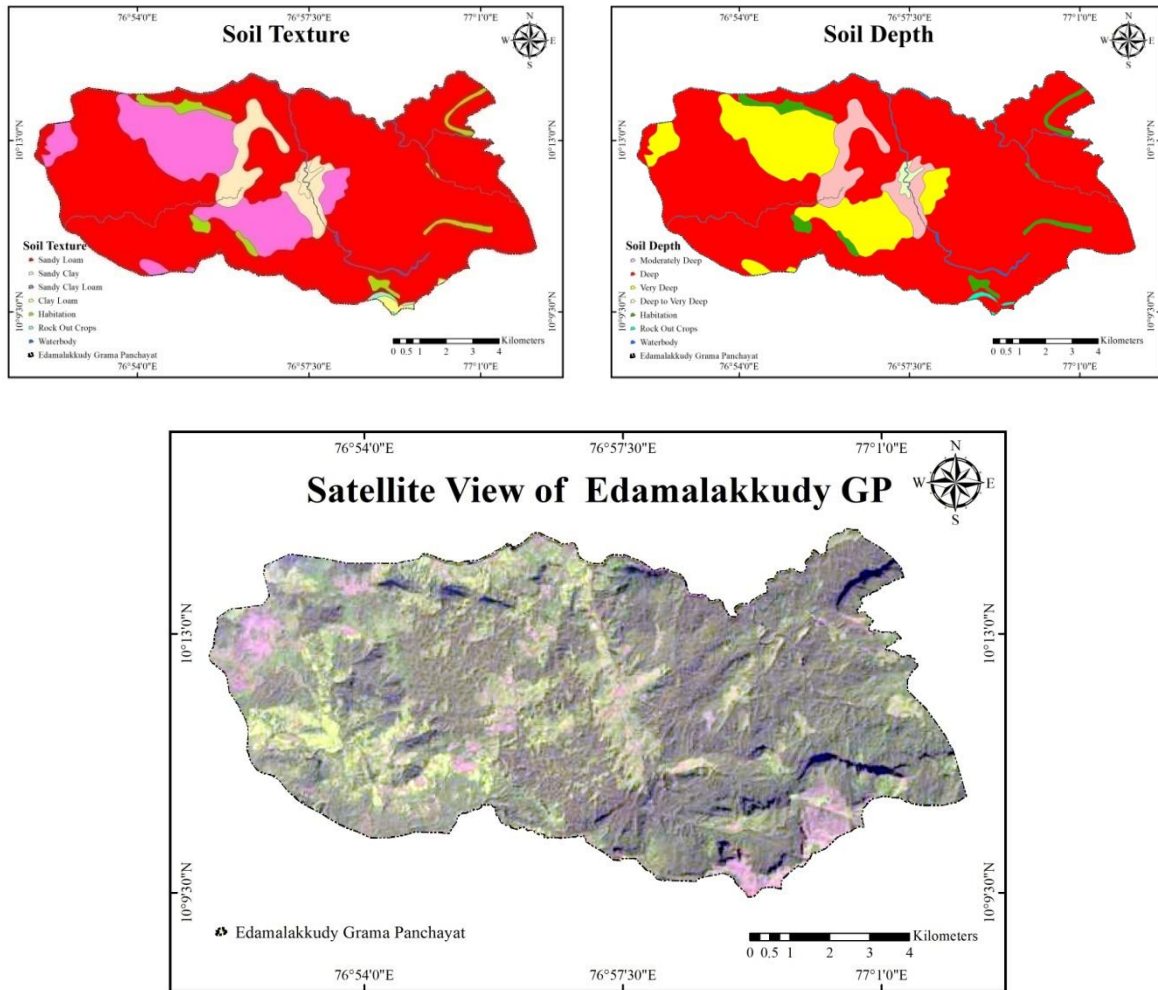


Fig. 5 Idamalakudy

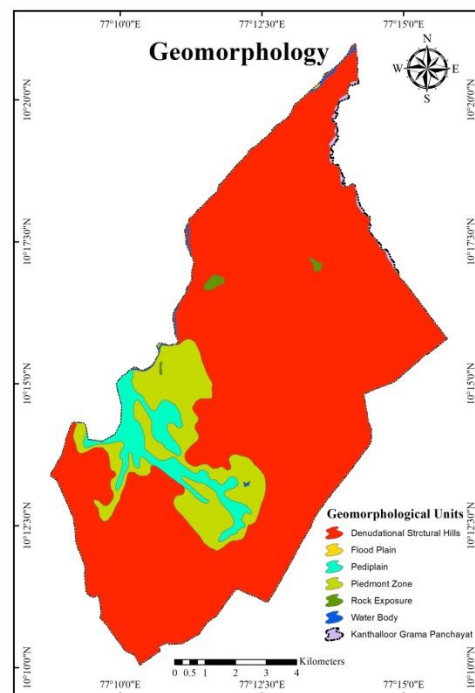
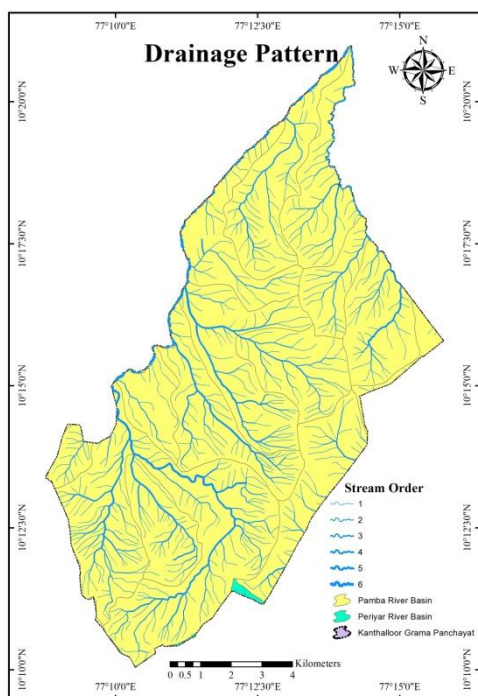
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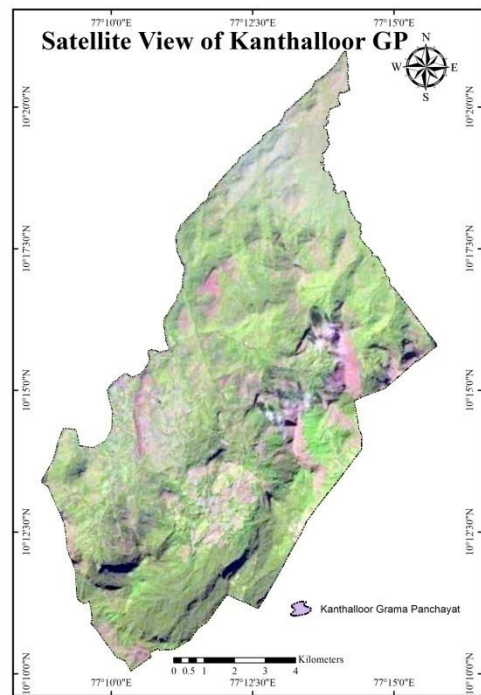
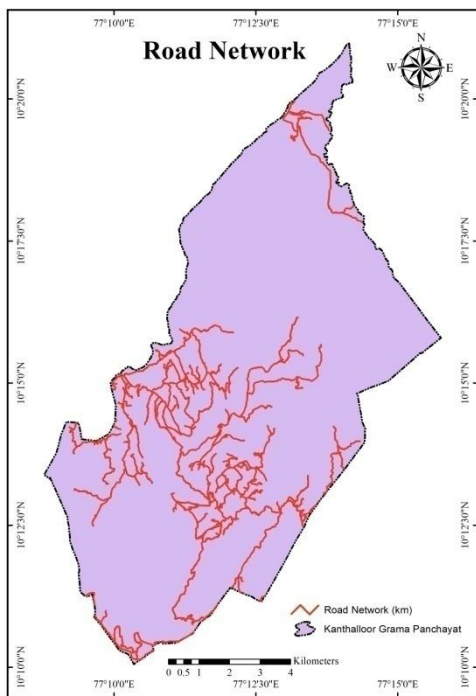
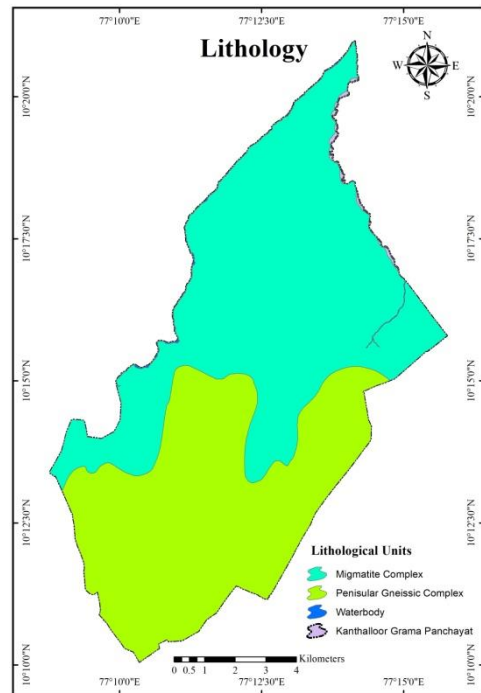
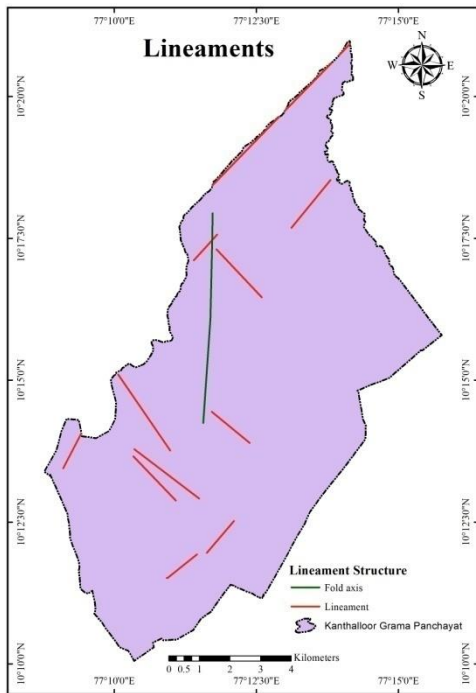
The soil depth of Edamalakkudy panchayat is mostly deep and very deep that is Sandy loam. Deep to very deep and moderately deep soils are found in different areas of the panchayat in central regions. Some areas with sandy clay loam, sandy

clay, clay loam, habitation found in small parts in central regions of the panchayat. Very little areas in the south of the panchayat have rock outcrop soil.

vii. Kanthalloor

Kanthalloor Grama Panchayath is located in Devikulam block of Idukki district in the Indian state of Kerala. The total geographical area of the panchayat is 116 sq km. According to the 2011 census, the total population of the panchayat is 10963 with a density of 94.51. Kanthalloor Panchayath was awarded for the most rice cultivated Panchayath in 2010. Unlucky, the paddy cultivation declined and the remaining paddy fields exist only in one ward (Keezhanthalloor). Wheat was cultivated about 15 years ago. Coconut, areca nut and sugarcane are cultivated in the hotter climate and vegetables in colder areas. The main winter season vegetable cultivation are carrot, beetroot, cabbage, green peas, garlic; beans. Eucalyptus plantation exists in most of the areas. Sugarcane cultivation is reported only from one tribal ward. Ragi is cultivated in some tribal settlements. Other major plantation crops are tea, cardamom, coffee. Most of the areas are under the control of plantation industries which include Tata tea limited, Harrison Malayalam, Thalayar estate etc. are the main tea plantations in this area.





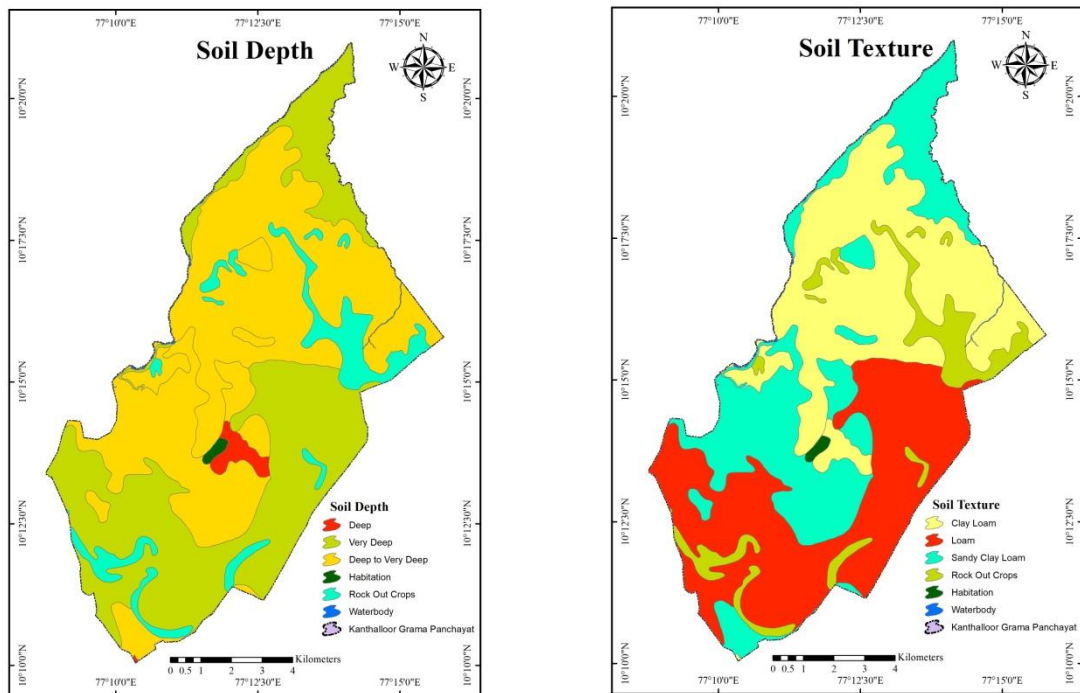


Fig. 9 Kanthalloor

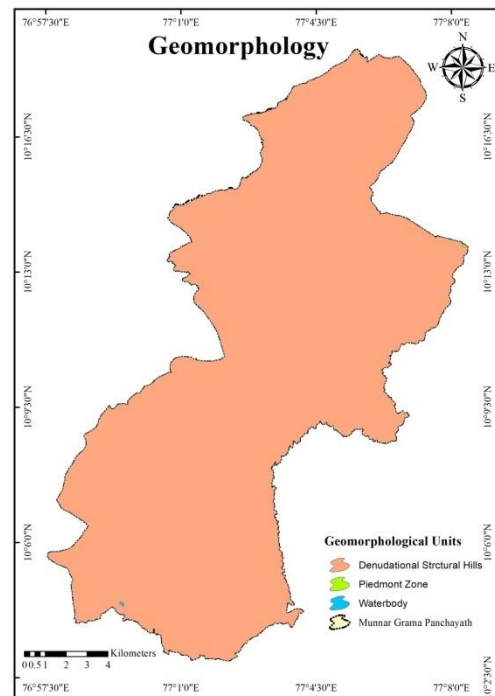
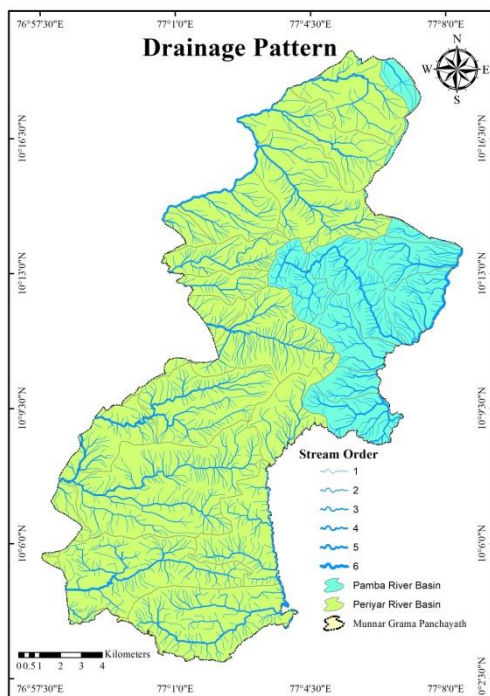
Migrations of people from Tamil Nadu to Kanthalloor are due to the availability of plantation job. So the people in this area have mixed culture. The main water sources are streams in this area, some hilly areas and tribal settlements face water scarcity. Most of areas are covered with eucalyptus plantation. In summer season, some of areas catch forest fire. Animal husbandry is the important source of income. Most of the family is doing animal husbandry in small scale and large scale

The Periyar and the Pampa are the two major river basins of the Kanthalloor panchayat with only a small part of the Panchayat drained by Periyar mostly and also by Pampa in southeast region. Their stream order ranges from 1 to 6. Examining the geomorphology, the most commonly found hills are Denudational structural hills. The Peidmont zone and the Pediplain areas are very few and distributed towards the center to the west of the Panchayat. Rock exposure geomorphological unit is found in small isolated regions to the north. The lineament map of the Kanthalloor panchayat shows a vertical Fold axis from the

north to the central part of the Panchayath and lineaments running through the panchayat at the central as well as northern and southern regions. The two major lithological units found in this Panchayath are migmatite complex rock and peninsular gneissic complex rock that covers northern and southern parts respectively. The road network covers only some regions nearing the central region from the south. Deep to very deep and very deep soils are most prevalent in different parts of the Panchayath that are clay loam & sandy clay loam soil and loam & sandy clay loams respectively. Rock outcrops, deep and Habitation soils are also found in very few areas of the panchayat in a scattered manner.

viii. Munnar

Munnar Grama Panchayat is located in Devikulam Taluk, Idukki district in the Indian state of Kerala. It covers an area of 187 sq km. The total population of the panchayat is 32029 with a density of 171.28. Many domestic and international tourists visit this place year after year and enjoy the beauty of the place.



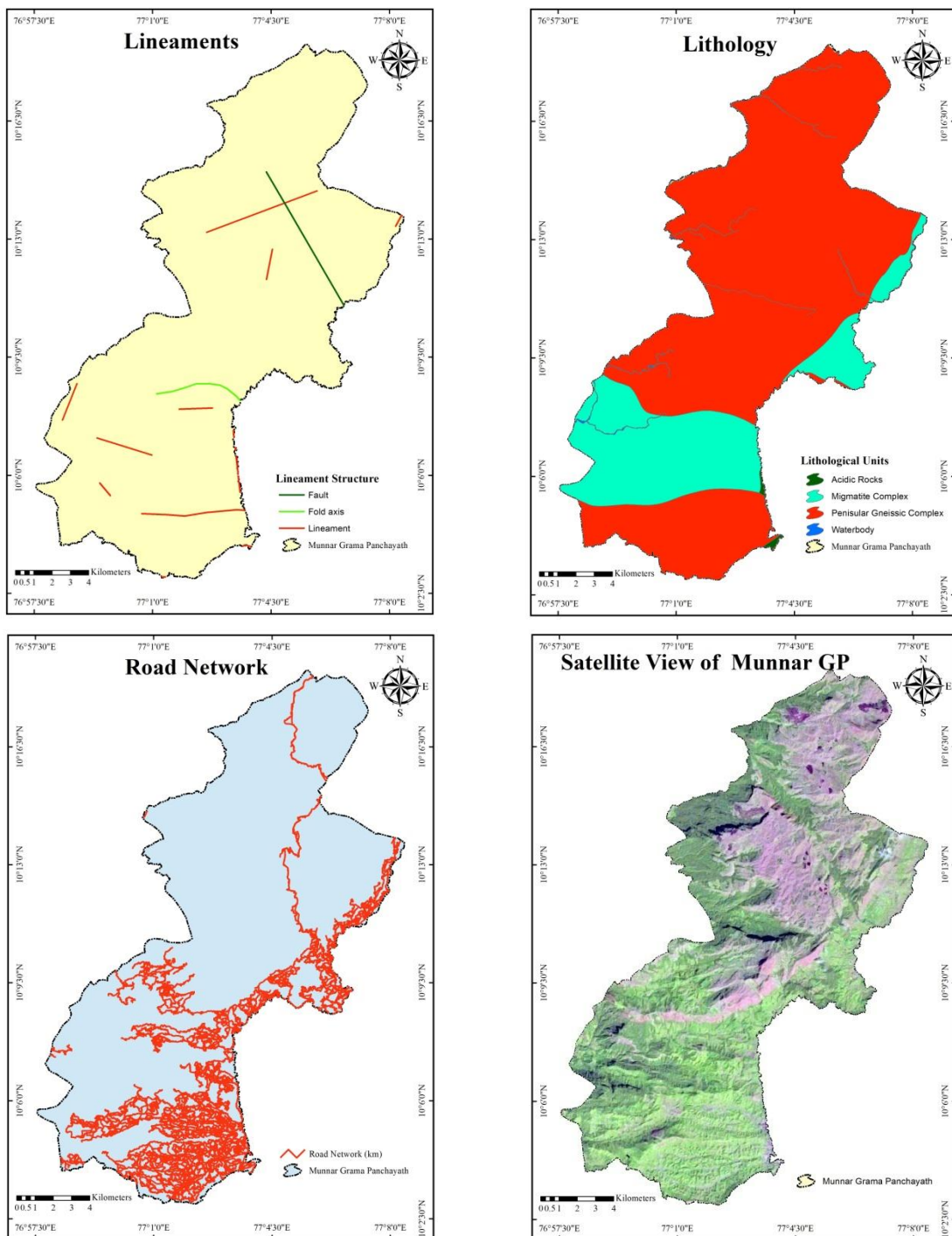


Fig.10: Munnar

The Pampa and the Periyar are the two river basins that drain Munnar panchayat. Majorly drained by Periyar with Pampa covering the northeastern region. Both drains with stream orders 1 to 6. Examining the geomorphology of this Panchayath shows Denudational structural hills covering the entire panchayat.

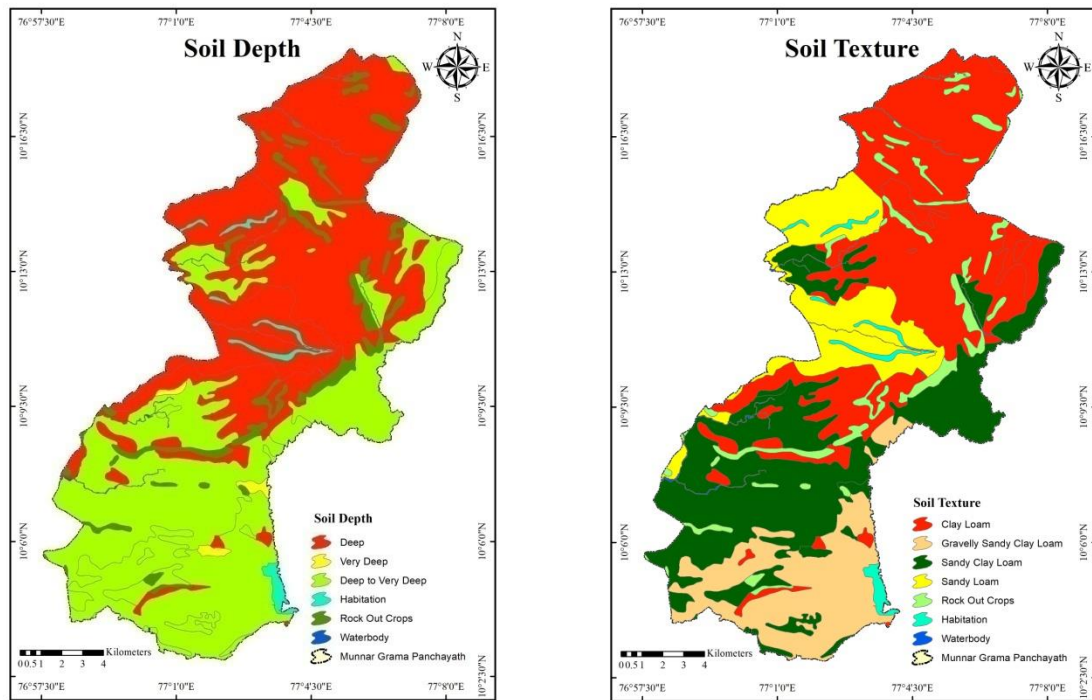


Fig.10: Munnar

Looking at the lineament structure of the panchayat, there is a Fault running from north to northeast, a fold axis from the centre to the east, and some lineaments running on the south as well as north regions. The Lithological unit in Munnar panchayat is a majorly peninsular gneissic complex rock with a Migmatite complex covering the south-central region. Some Acidic rocks are also found in the southeast region. As a result of increased tourism, very dense road networks are present, but only in the southern and eastern borders.

Soil depth analysis of Munnar panchayat shows that a major part of the panchayat areas is covered with deep to very deep and deep soil that is Clay loam, the northern part of the panchayat is widely covered with Deep soil and the southern part of the panchayat with Deep to Very deep soil. Very deep and Rock outcrops are also found in this panchayat but scattered. Soil texture shows a wide variety of soil types - Clay loam, sandy clay loam, sandy loam, and Gravelly sandy clay loam is clustered in northern, south-central, north-central, and southern regions. The soil texture in Munnar forest division, in the midland area is yellowish red colored

with clayey loamy gravel present in surface. In the mid upland area the texture type is reddish brown to yellowish red with clayey loamy in texture the upland area texture is black to yellowish red with loamy to clayey. The high land elevation MSL level 600 to 900 is covered with reddish brown to red in colour with clayey loamy. The highland the elevation MSL level 900 to 1200 is covered with dark yellowish brown to red with clayey loamy. The highland the MS Level is 900 to 1200 is covered by the texture of dark reddish brown to yellowish red with silty clay. The mountainous region is the elevation MSL level of above 1200 is covered with the texture of dark reddish brown to reddish yellow with silty, loamy, and clayey in nature (Work plan Munnar forest division 2010-11 to 2019-20).

From 2010 onwards Grama Panchayat has restricted permit for the construction of high rise buildings. Livelihood of local people depends on the KDH Company, and it provides all their requirements .KDH permit some plots of land for local people for the purpose of agriculture (non-commercial purpose). The climate is more or less temperate in high altitude areas. The temperature varies from 6 to 26°C. Minimum temperature during the last ten years was 6.4°C recorded in February, 1997 and maximum was 25.9°C as recorded in March 2004.

The highly elevated undulating terrain which receives heavy rains from southwest and north east monsoons results in the formation of network of rivers and streams and hence there is no scarcity of water in the western slope of tract for the area is well drained. Another attraction in this area is mainly the tourism. Munnar is a very large and popular tourist destination. The tourists are increasing day by day in this area. The data shows that the number of foreign visitors in Munnar in 2012 was 29326. In 2018, the number of foreign visitors in Munnar decreased to 24293. But at the same time the domestic tourist in Munnar increased. In 2012, the number of domestic tourist visitors in Munnar is 307595. In 2018, it is surprisingly increased to 782681. This increased number of tourist in this area is creating lots of hazardous problems like air pollution, solid and liquid waste; increased number of vehicles, noise pollution, and soil erosion. Vast area was being utilized just to

construct hotels and restaurants. A study conducted in Munnar both the marketing of macro small and medium enterprises providing tourist accommodation in Idukki district. It is reported that 78% of accommodation unit in Munnar belongs to category of resorts, 19% homestay category 3%, service villa. More than 238 commercial buildings are here.

In Munnar Panchayath most of the land is under the control of KDH Company. With this area under tea crops is 23239.06 acres of land. Area under fuel trees are 16898.91 acres. The area under grazing is 1220.77 acres. The area under buildings, sites, roads, workers garden etc. is 2617.69 acres. Area under streams and swamps is 2465.20 acres. The area under uncultivable land is 6393.59 acres. The area under interspersed in estates and in between estates is 4523.92 acres. (Working plan Munnar forest division). Large forest area was demolished for the plantation of tea. The KDH Company mainly cultivated tea plantation, eucalyptus plantation, jasmine plantation, rose plantation, etc. The company have lots of factories in Munnar region. For the purpose of processing tea they needs lots of firewoods therefore the company introduced eucalypts plantation in the Munnar area for their own purpose. The eucalypts plantations raised and managed by cooperate tea companies are exclusively for the fuel requirements of the tea factories and labourlanes. The studies show that the transformation from vegetable farming to eucalypt plantations leads to waters shortages in the areas.

The private eucalyptus plantations in the high-altitude but low rain fall areas of Vattavada and Kanthalloor are reportedly causing acute water shortage in the valley bottoms. There is also a recent tendency to convert the vegetable farms to eucalyptus plantations which lead to disruption of local livelihood, cultural drift, impoverishment of local communities as well as ecosystem malfunctioning (Landuse management plan for production landscape in Munnar, 2015).

In 1986, there was paddy cultivation in Munnar. Day after day the paddy cultivation area got vanished instead the settlement got increased. The settlement area increased to 5% to 10% because of the increase in population (www.ijrsg.com

volume 4, issue3, May, 2015). Animal husbandry is the major activity of the people in here. Panchayath wise reports. In 2007 shows that, 140 male and 2565 female exotic and crossbreed cattle's are here.

Landuse changes in Western Ghats over the last century caused agricultural expansion, conversion to plantations and infrastructural projects. This resulted in loss of forest and grass land (Kumar, 1993, Jha et al., 200, Khan et al., 1997). These changes are also a driving force to landslide problems. The flood in the last year also affected the Munnar region which affected the area adversely. Roads and buildings are destroyed. Many lands under cultivation were badly affected by the land slide. The main vegetable cultivated in this area are cabbage, carrot, potato, beans, garlic and the other cashcrops in this area are cardamom, pepper etc. The potato is the other largest vegetable cultivated in this area, 90 hector of land is used for cultivation and the production is 1080 tonne.

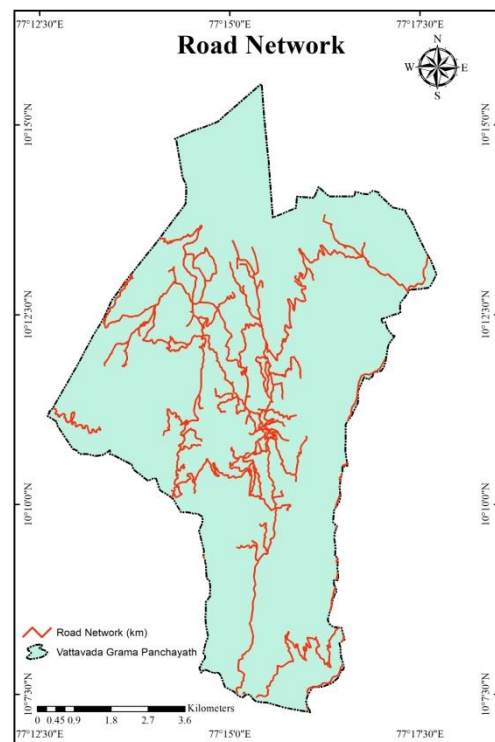
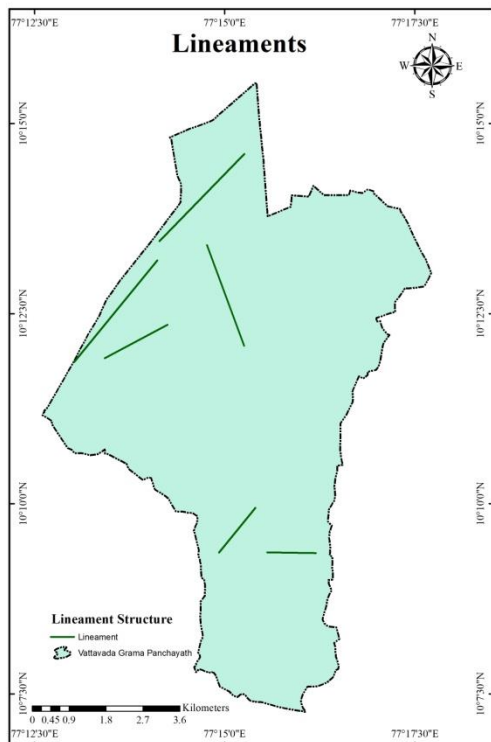
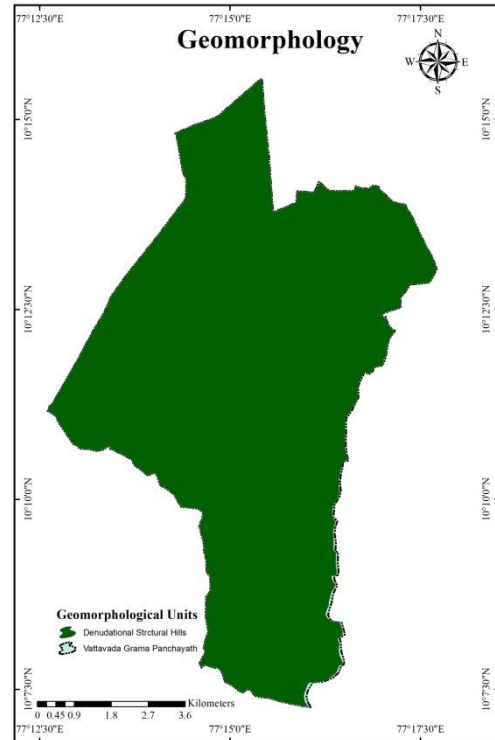
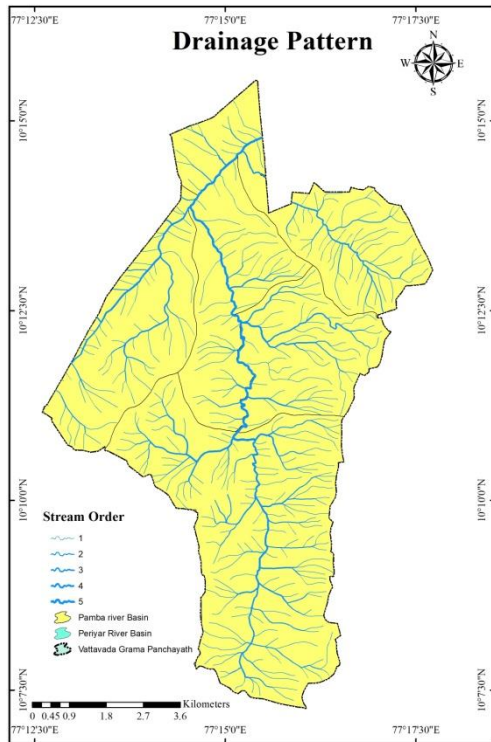
ix. Vattavada

Vattavada is a panchayat located in the Devikulam block of the Idukki district in Kerala, India. The total area of the panchayat is 67.81 sq. km. The panchayat has a total of 13 wards. The total population of Vattavada village is 5697 with a density 84. Out of this total population, 572 Adivasis are in this panchayat. Pampa and Periyar are the 2 major river basins in Vattavada Panchayath with Pampa draining most of the regions. The stream orders of these river basins range from 1 to 5.

While examining the geographical units of this panchayat the Denudational structural hills cover the entire area. The lineament structure shows Lineaments running in the northern region also two lineaments to the south-central region. The Peninsular gneissic complex lithological unit covers the panchayat except in a small part of a northern region where a Migmatite type of rock is present.

The road networks are mainly focused on the central regions as there is a lack of transportation facilities to reach Vattavada. A limited number of buses are doing service from Munnar to Vattavada and return. Very deep and loamy soil, Deep to

Very Deep and Gravelly clay loam & Sandy clay loam, and Rock outcrop soil are found in many areas. Habitation soils are present in isolated regions near deep to very deep soil.



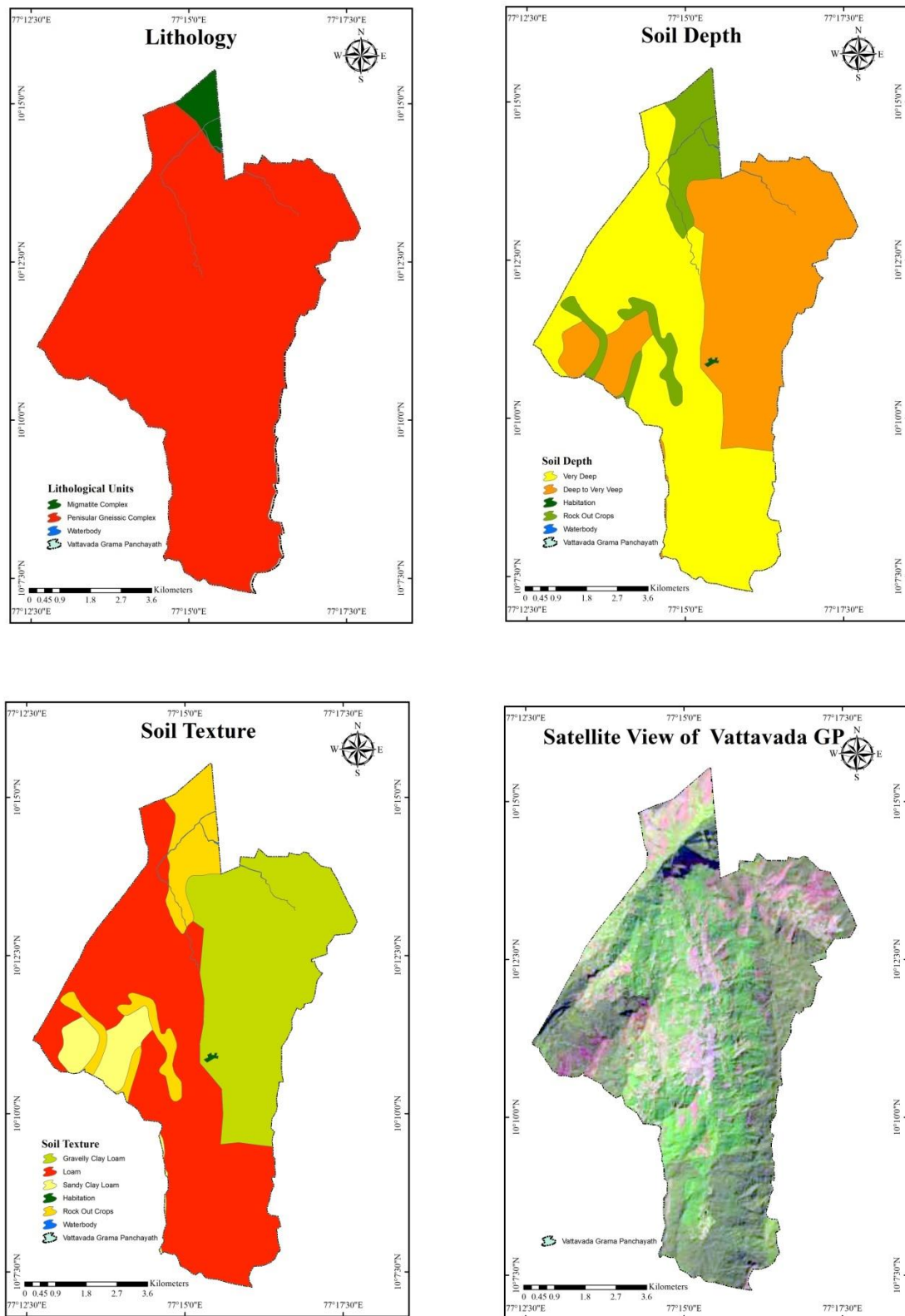
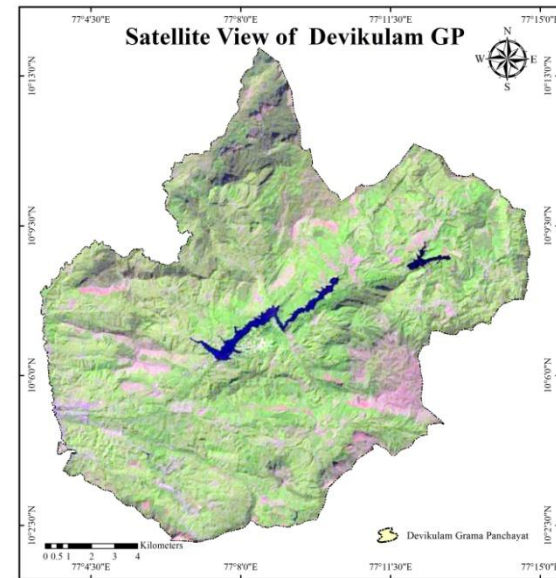
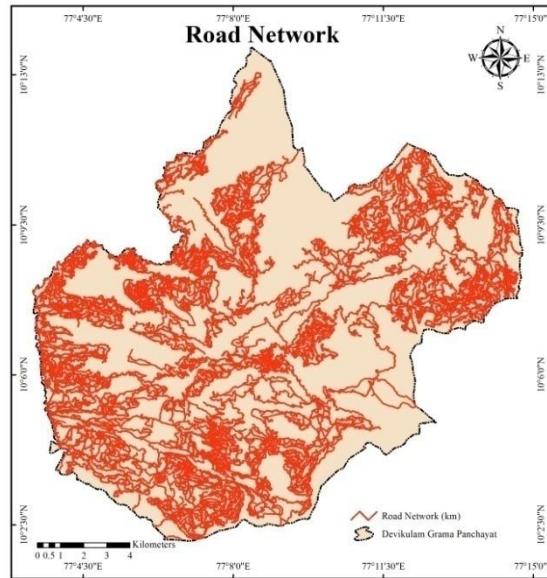
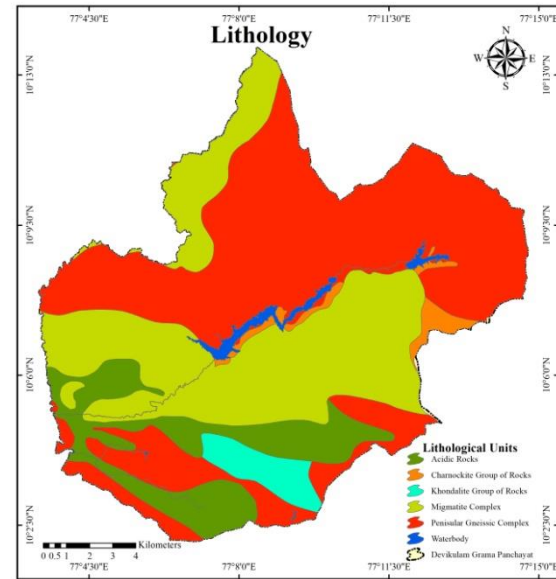
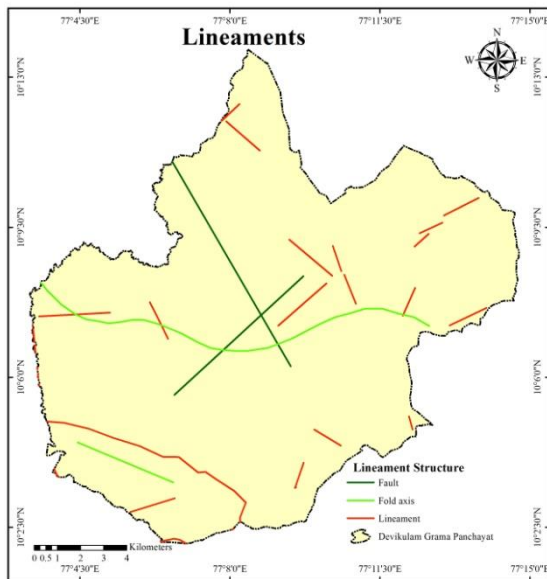
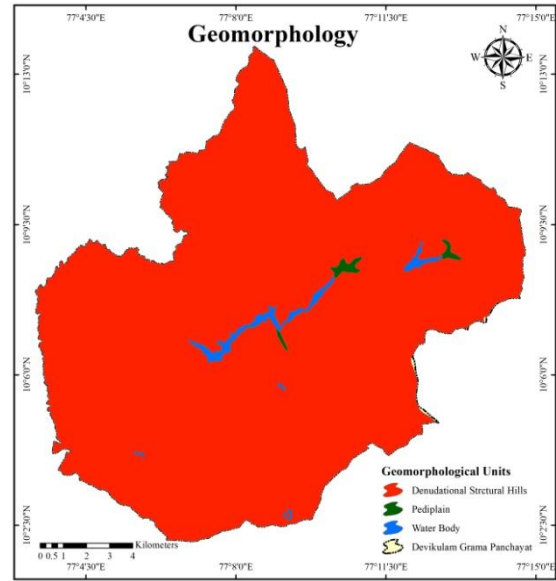
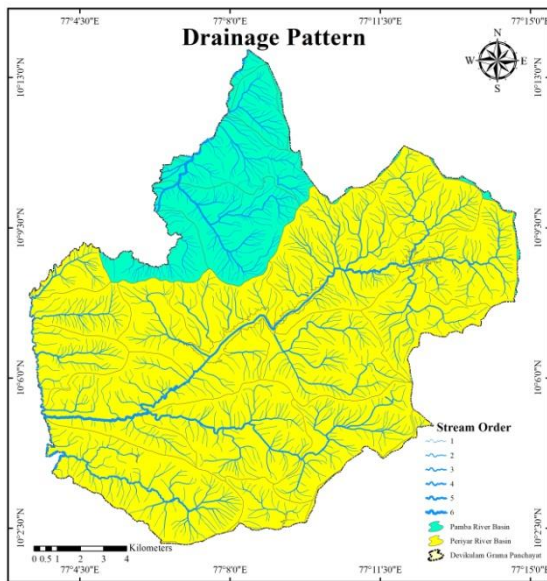


Fig.11 Vattavada

x. Devikulam

Devikulam Panchayat is located in the Devikulam block of the Idukki district in the Indian state of Kerala. The total area of the panchayat is 215 sq km. There are a total of 18 wards in this panchayat. The total population of the panchayat is 23709.

The area has winter crops cultivation (vegetables). Main crops are kale, cabbage, cauli flower, green peas, carrot, fenugreek, beet root, potato, garlic, rose, jasmine, strawberry, passion fruit, and tomato. The data from agricultural department shows that 80% of land was under the KDHP Company and Harrison Malayalam private limited company. In this Panchayath land in the Santosh colony is used for agricultural purpose and 150 families were here. In the 500 acres of land, 250 acre is eucalyptus plantation and the remaining land is used for agricultural use and resident area. The tourism in this area is also increasing day by day. The main attractive places in Devikulam area are Mattupetty Lake, Eravikulam national park, Sita Devi Lake, Keezharkuthu falls, Blossom International Park, Kundala Lake, and Thoovanam falls. These are the major tourist attractive places in Devikulam area. Nearly more than 1500 resorts are in Munnar and Devikulam area. The agricultural cultivation is decreasing day by day due to conversion of land from agricultural crops to cash crop and plantation. Some places are facing the problem of wild animal attacks and due to that agricultural products are destroyed by wild animals, therefore the people are not interested to cultivate agricultural products. In this area 400 ha is used for winter crops (vegetable). About 20 cents were used for strawberry cultivation. Other major crops in this area cabbage, cauliflower, carrot, beetroot, passion fruit, strawberry, potato, rose, jasmine, green peas, coriander, and garlic and tamarind tree, tomato. In Devikulam Panchayath, the major land is occupied by KDH Company. The major land use in 1997 was the forest area which occupies about 41 % (472.01 km²) and is distributed mainly over the western and northern parts of the region. Area under scrub vegetation forms the next major land use and covers an area of 257.04km² which is about 22.54% of the total area. In 2004 the condition of the land use changed, the majority of area is covered by forest, scrub, tea and mixed crops.



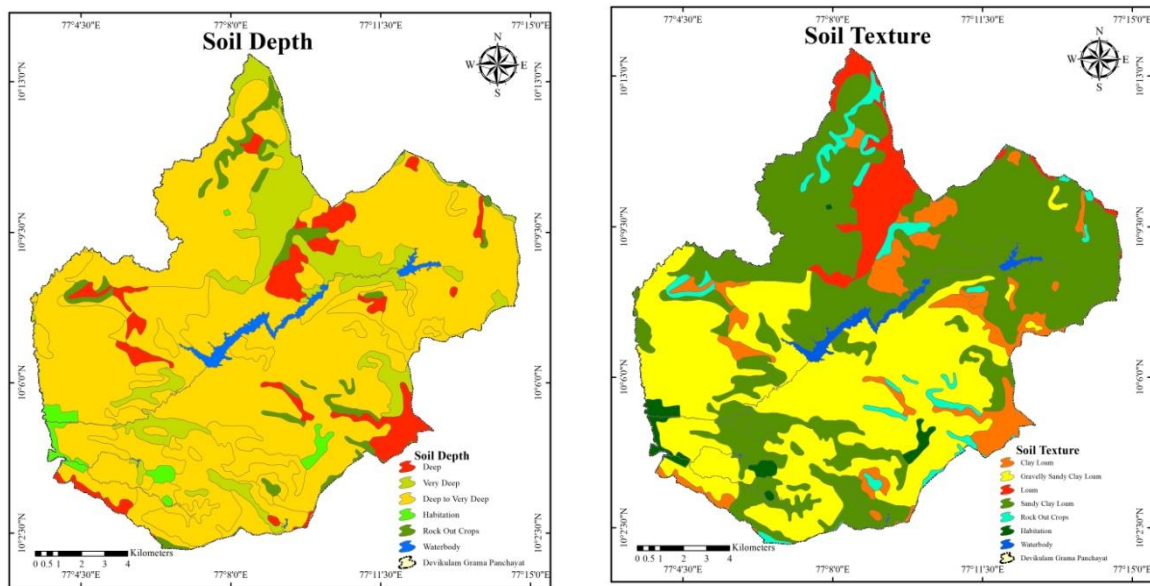


Fig.12 Devikulam

The dominant land use type of the area is forest and it covers about 38.9% (4433.95km²) of the total area. Its main concentration is along the northern and western margins, i.e. along the northern portion of Kannan Devan hills, portions of Mankulam, Mannankandam and Anaviraty villages. Scrub vegetation is the next largest land use type. Next important type of land use is tea plantations which cover 13.60% (155.09 km² of the total area tea estates are covered most of the area in Devikulam Taluk mainly in central and southern portions. Mixed crops form another major land use category in the region. (Land use and land cover changes detection using multi temporal satellite data Devikulam Taluk, Idukki district, Kerala).They are mainly distributed over the KDH Marayoor, Mankulam and Mannankandam villages of Taluk.

There are 10 tribal communities in Idukki district viz. Malayarayan, Muthuvan, Mannan, Urali, hill Pulaya, Ulladan, Paliyan, Malayan, Malavedan and Malam Pandaram. In the district, the highest percentage of ST. Population were reported in Devikulam Taluk (91%). The total population in Devikulam Taluk in 1875 is 2488. In 2001 it reached to 185103. The present population in Devikulam Taluk is 177621 (Census of India 2011).

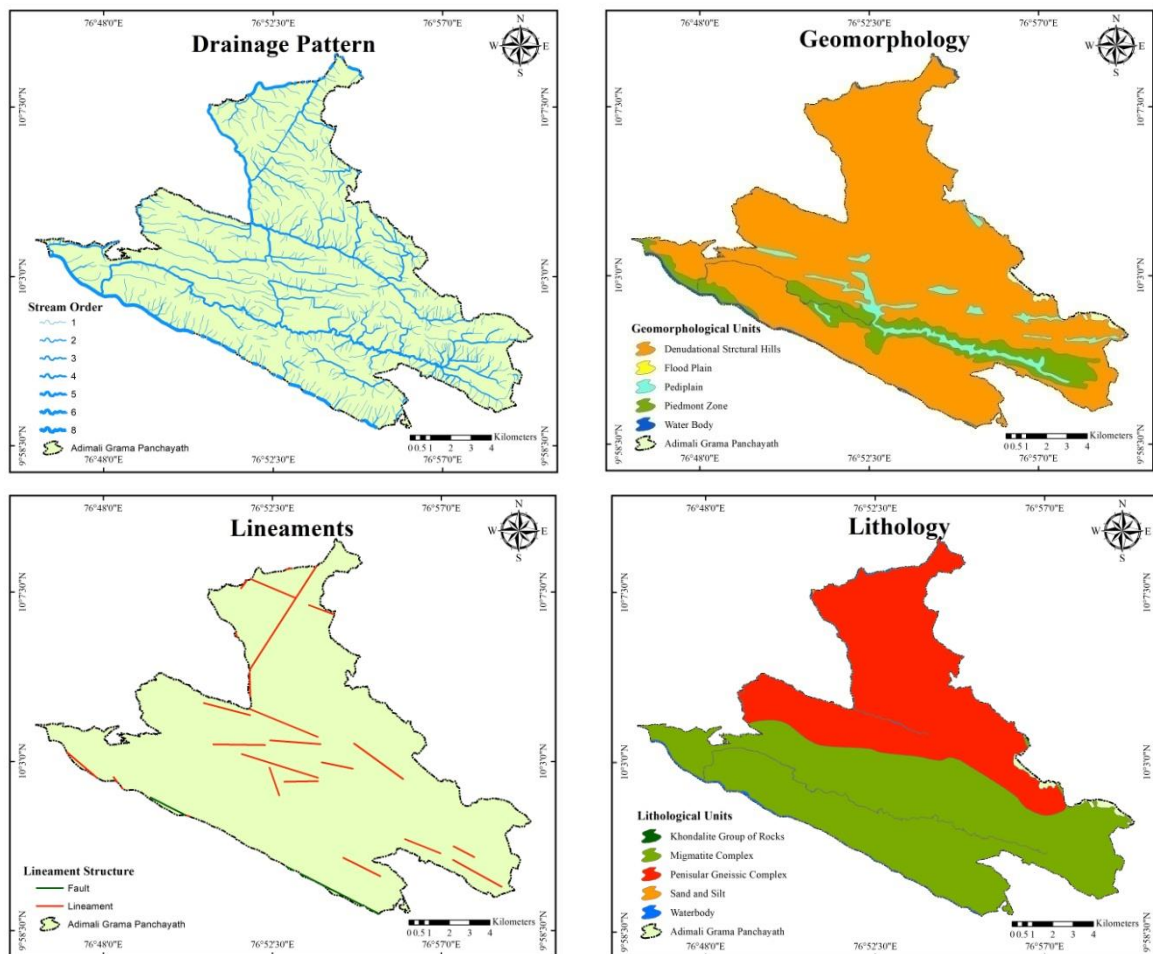
In Devikulam Panchayath the KDH Company have jasmine and rose plantation. They are using large area of land for this cultivation. The jasmine flowers were exported for processing the jasmine flower and taking the oil from the flower and this oil were exported. It's a big profitable business in foreign countries and there is a big demand for this. In Devikulam, there are 26 tribal settlements in which most of the people do farming in their own lands, MGNREGA works and other jobs outside the community. Most of the tribal settlement people are facing different problems. Most of the settlement is located in the hill top or inside the thick forest area. In Devikulam Panchayath our team visited KundalamKudi tribal settlement. The most faced problem in that settlement is water scarcity in summer season. There is only a spring from where they have to collect the water. It is inside the thick forest. They water is collected through a pipe which is connected to the water tank inside the settlement. But the most important problem is most of the time the animals like elephant and other wild animals destroy the water pipe. Therefore, in summer season they face the problem of water scarcity. Other problem faced by the people in this settlement is road and transportation. Most of the settlement is located in hill side or inside the thick forest. So transportation is very challenging. Another problem is lack of the availability of hospital facilities near the settlement.

The drainage pattern of the panchayat shows stream order from 1 to 6 of two river basins - Pampa and Periyar, Pampa to the north. Examining the geomorphological units, Denudational structural hills covers the entire region except for some small isolated regions in the center where Pediplain are found. The lineament structure shows two faults crossing in the central regions and two fold axes with one running all the way from east to west and other at the south. Lithological units of peninsular gneissic complex rock. Secondly, migmatite complex rock at the north & south, Migmatite complex in the central & north, acidic rocks to the south central and Khondalite rock in south can be found in the Panchayath. Devikulam Panchayath has a very good road network. It is also a good tourism spot and thus has a dense, mostly covered road network.

Soil depth analysis shows deep to very deep soil which is found in most of the areas of the panchayat. Deep, Very deep, Rock outcrops and Habitation soil are also found in many parts of the panchayat scattered. Sandy clay loam and Gravelly sandy clay loam are the most common soil types in the Panchayath that are found in the northern and southern regions respectively. Also, clay loam and loam are found in small quantities in many parts of the panchayat.

xi. Adimali

Adimali Grama Panchayat is located in the Devikulam Taluk of Idukki District. It has a total area of 271.5 sq km and the total population is 40484 with a density of 149.11. The drainage pattern of the panchayat shows stream orders from 1 to 8 of the Periyar river basin.



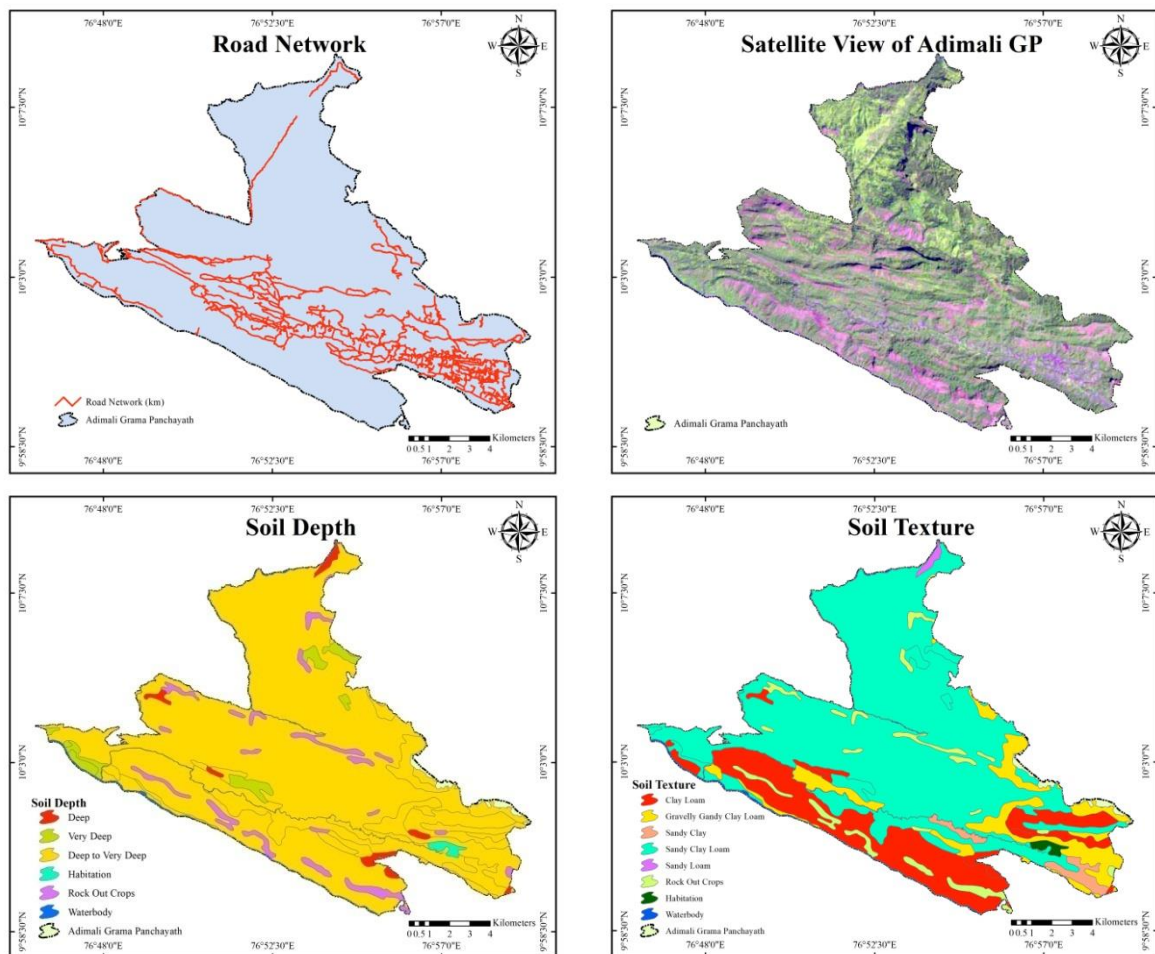


Fig.13 Adimali

More than 20 years before, 80% of the cultivated land was paddy but now the condition is totally changed. The Kurangatimala tribal settlement is only cultivating paddy. Most of the paddy cultivated areas are changed to cash crops and constructed buildings. Before 2017, more than 20 hectares of land was under paddy cultivation. But the condition has changed in 2017 -2018. The paddy cultivation was decreased from 20 to 13.5 hectares. The Padasekara Samithy and an NGO named Care India, worked together and 35 acres of fallow land were used now for paddy cultivation. Inspired by this, the agricultural department also takes an initiation for the cultivation paddy. More than 50 hectares of land is used for tapioca cultivation in Adimali Panchayat. The Kudumbrasree mission in Adimali also promotes Adukkalathottam for every household. They provide the seeds of vegetables to the households with the support of agriculture department. The households are cultivating organic vegetables for their own purpose. Eastern and

agro industries are the 2 major companies in this area. There are 28 tribal settlements under the TEO Adimali. They are Muthuvan, Mannan, Ulladan, Ooralan, and Malayarayan. Most of the tribal people are doing different works. Some of them are collecting NTFP and others are doing cultivation in their own land. Some people are collecting bamboos from the forest and sell them. Several people are doing MNREGA and kooli works from outside the community. Some people are collecting medicinal plants and honey from the forest and they sell them to Girijan society. In Adimali some of them are selling honey directly to public or other markets in Adimali.

The major geomorphological units are Denudational structural hills. Piedmont zone and Pediplain is also seen in the panchayat in central regions and southwestern regions. The lineament structure shows a short Fault line in the southwest border only, but many lineaments run through the northern, central, and eastern regions of the Panchayat. Lithological units of Peninsular Gneissic Complex cover the entire northland Migmatite complex cover southland. The Road network is dense in township areas but not present to the internal regions so can be seen to be poor.

Soil depth analysis shows Deep to Very Deep soil covering the entire panchayat except at some isolated patches where Rock Outcrops, Very Deep, Deep, and Habitation are present. Soil texture analysis shows Sandy clay loam majorly except at the southern and eastern regions where Clay loam and Gravelly Grandy clay loam are present. Sandy clay is also present in isolated regions towards the southeast.

4.3 Objective 2: Documenting various development activities, projects, drivers of change, agencies, and agents of development, institutions and their impacts in the indigenous and migrant settler communities in the HRML.

Activity: Identify the major drivers for biodiversity change such as developmental activities / institutions and its socio-economic, cultural and livelihood impacts on different groups of local (tribal) communities.

- 1) Secondary data regarding major developmental process in Production sectors such as Tourism, Quarrying, Plantations, Hydel projects that led to land use change was compiled from various sources for field level data collection.
- 2) 10 BMC meetings were conducted in 10 Grama Panchayath, except Edamalakudy which could not be done due to bad climate condition and inadequate transport facility.
- 3) Local perceptions regarding major drivers of change in the landscape were collected
- 4) Questionnaire format was developed for conducting PRA and RRA for local perceptions regarding land use change. For understanding the modification of various landscape and their consequent impacts on Biodiversity PRA and RRA were conducted in Mankulam

LAND USE AND LAND COVER CLASSIFICATION AND CHANGE DETECTION USING GEOGRAPHICAL INFORMATION SYSTEM

2.1 Introduction

Land use refers to the way in which land has been differently used by humans. Both the terms land use and land cover are closely related and are often used interchangeably. Land use / landcover pattern of a region is an outcome of natural and socio - economic factors. The immense agricultural and demographic pressures on land had made it a scarce resource. As such information on land use / land cover is essential for conservation, as well as planning and implementation of land use schemes. Though changes in land use / land cover do not necessarily imply degradation of the land however, LULC change is one of the most significant drivers of global changes and this affects many parts of geo-environmental and natural ecosystems such as biodiversity, water, and radiation budget. Changes in the condition and composition of land-cover affects climate, bio-geochemical cycles, energy fluxes and livelihoods of people.

2.2 Study Area

The study area consists of 11 selected Panchayaths from the three districts of Trissur, Ernakulam, and Idukki of Kerala state. The Panchayaths consists of Athirappilly of Trissur District, Kuttampuzha of Ernakulam District, Mankulam, Chinnakanal, Marayoor, Edamalakudy, Kanthalloor, Munnar, Vattavada, Devikulam, and Adimali, Grama Panchayaths of Idukki districts. The study area extends between 9° 59' North to 10° 23' North Latitudes and from 76° 26' 30" East to 77° 18' East Longitudes. The study region falls within the Anamalai hills of Western Ghats.

2.3 Objectives of the Project

The following are the specific objectives of the project.

- ✓ To identify a suitable land use land cover classification scheme for the study area.
- ✓ To determine nature, rate, location, and magnitude of land use/land cover change.
- ✓ To validate the data provided by means of Ground truth verification.

2.4 Data Classification

Almost all studies pertaining to Land use/Land cover derive their data from satellites imageries using image processing software. The satellite- and aerial photograph-based mapping of LULC are cost-effective, spatially extensive, multi-temporal, and timesaving. Earlier, the spatial resolution of satellite data was comparatively less than that of the maps prepared through terrestrial surveys. With the advancement of remote-sensing (RS) techniques and microwave sensors, satellites provide data at various spatial and temporal scales. Remote sensing provides the opportunity for rapid acquisition of information on land use / land cover at a much-reduced price compared to the other methods like ground surveys. In the present study the Land use/Land cover change is detected from vector layers of 2006 and 2016, prepared by Kerala State Land Use Board. The meta data of the two vector layers are not available and hence the authenticity of the data is not ascertained. The land use land cover classification scheme adopted for the year 2006 as per the given data is entirely different from that of the year 2016. It possesses difficulties in bringing both the data to a common land use land cover classification scheme. The scheme of classification of data pertaining to the year 2006 consists of five classes and four levels and is depicted below.

Table 1.1. Classification scheme adopted for the data set of 2006.

Sl. No.	Scheme of Classification			
	LevelII	LevelIII	LevelIII	LevelIV
1	Agricultural land	Crop land(Paddy)	Double crop	Double crop
			Reclaimed-Perennial	Mixed crop
			Reclaimed-Seasonal	Banana
		Fallow	Current fallow	Current fallow
		Plantation	Banana	Banana
			Cardamom	Cardamom
			Cashew	Cashew
			Coffee	Coffee
			Eucalyptus	Eucalyptus
			Mixed crop	Coconut dominant mixed crop
				Mixed crop
				Mixed trees
			Rubber	Rubber
		Tea	Tea	
Teak	Teak			
2	Built-upland	Town/cities(Urban)	Commercial	Commercial
		Villages(Rural)	Mixed built-up	Mixed built-up
			Residential	Residential
			Residential (Converted from paddy)	
3	Forest	Deciduous(dry/moist)	Dense	Dense mixed forest Mainly teak(R.F)
				Dense mixed forest bamboo and teak (R.F)
			Open	Open mixed forest (R.F)
				Open mixed forest
		Scrub forest	Scrub forest	
			Evergreen/semi evergreen	Dense mixed forest
				Dense mixed forest(R.F)
		Dense mixed forest mainly bamboo(R.F)		
		Dense mixed forest mainly bamboo		
		Forest plantation	Eucalyptus (R.F)	Eucalyptus(R.F)
			Eucalyptus and Softwood (R.F)	Eucalyptus and Softwood (R.F)
			Rubber (R.F)	Rubber (R.F)
			Tea (R.F)	Tea (R.F)
			Teak (R.F)	Teak (R.F)
Grassland	Degraded grassland	Degraded grassland		
	Dense grass land	Dense grassland		

4	Wastelands	Barren rocky/ Stony waste/Sheetrock	Barren rocky/ Stony waste/ Sheetrock	Barren rocky/ Stony waste/Sheetrock
		Degraded land under plantation crops	Eucalyptus	Eucalyptus
			Rubber	Rubber
		Land with or without scrub	Land with scrub	Land with scrub
			Land without scrub	Land with or without scrub
Mining/ industrial wastelands	Mining/ industrial wastelands	Mining/ industrial wastelands		
5	Waterbodies	Reservoir	Reservoir	Reservoir
			Reservoir bed	Reservoir bed
		River/stream	Perennial	Perennial
			River island	River island
			Sands/ riverine	Sands/ riverine
		Waterbodies	Waterbodies	Waterbodies

The scheme of classification followed for the data of the year 2016 is entirely different from the above-mentioned scheme of classification and is fuzzy in nature. It is a five-fold classification with three levels and does not follow any scientific scheme and is given in table 1.2.

Table 1.2: Scheme of classification adopted for the dataset of the year 2016.

Sl. No.	Scheme of Classification		
	Level I	Level II	Level III
1	Agricultural Land	Fallow	Current Fallow
		Mixed Crop	Mixed Crops
		Perennial Crop	Areca nut
			Coconut
			Others
		Perennial Plantation Crop	Cardamom
			Cashew
			Coffee
			Coffee & Tea
			Eucalyptus
			Gum Tree
			Oil Palm
			Others
			Pine
			Rubber
Sandal Wood			
Tea			
Teak			

			Others
		Seasonal Crops	Banana
2	Built upland	Builtups	Mixed Crops
			Commercial
			Dam Site
			Others
			Playground
			Public/Semi Public
			Residential
			Residential/Commercial
			Roads
			Religious
3	Forest	Barren Rock	
		Dense	
		Grass Land	
		Open	
		Plantation	Bamboo
			Cardamom
			Coffee
			Eucalyptus Softwood
			Eucalyptus
			Others
			Rubber
			Tea
			Teak
			RF-Eucalyptus+Softwood
		Settlement	
		Blanks	
		Current Fallow Land	
		Deciduous	Dense Evergreen/Semi Evergreen
			Dense mixed forest mainly teak
			Scrub forest
		Dense Evergreen	
		Evergreen/Semi evergreen	Dense Mixed mainly Bamboo
			Dense Mixed
			Fairly Dense
		Others	Bamboo
			Coconut dominant Mixed Crops
			Coconut
			Dense Mixed Forest
			Mixed Forest
			Arecanut
			Sandal Wood
		Paddy Converted to Built-up	Others
			Residential
		Paddy Converted to Mixed Crops	
			Builtups

		Paddy Converted to Perennial Crops	
		Paddy Converted to Seasonal Crops	
		Paddy Cultivating Land	Current Fallow
		Paddy Cultivating Land	
		Rock Outcrops	
		Scrub	
		Semi Evergreen	
		Settlement	
		Settlement with Mixed Crops	
		Swamps	
		Wasteland	Barren Rock
			Degraded Grasslands
			Degraded Plantation-Eucalyptus
			Land with Scrub
			Land with Scrub-Lateritic
			Land without Scrub
		Quarry	
		Wildlife Sanctuaries	
4	Wasteland	Barren Rocky Land	
		Degraded Plantation	Tea
		Land with Scrub	
		Land without Scrub	
		Mining	Granite
		Quarry	
5	Waterbody	Lake/Ponds	
		Reservoir	
		River	
		River Island	
		River/Stream	

The level 2 classification in this scheme seems to be more complicated and is not in tune with any standard classification schemes. This makes it difficult to compare the data both temporally and spatially. Comparison and change detection using these two data set in a GIS environment may yield erroneous results. So, both the data sets had to be brought to a standardized classification scheme. The Eight-Fold classification scheme proposed for 2nd cycle of LULC mapping by Natural Resource Census by NRSC and ISRO (2011) is selected for the present study since it is more convenient and meaningful to group the given land use data into the respective classes of the scheme. The classification scheme is given below in table 1.3.

Table.1.3: LULC mapping classes by Natural Resource Census by NRSC and ISRO (2011).

Sl No	LevelI	LevelII	LevelIII
1	Built-up	Urban	Built-up-Compact (Continuous)
			Built-up-Sparse (Discontinuous)
			Vegetated/Open Area
		Rural	Rural
		Industrial	Industrial area
		Mining/Quarry	Ash/Cooling Pond/effluent and other waste
			Mining-Active
	Mining-Abandoned		
	Quarry		
2	Agricultural land	Cropland	Kharif
			Rabi
			Zaid
			Cropped in 2 seasons
			Cropped in more than 2 seasons
		Fallow Land	Fallow Land
		Agricultural Plantation	Agricultural Plantation
	Aquaculture		
3	Forestland	Evergreen/Semi evergreen	Dense/Closed
			Open
		Deciduous (Dry/Moist/Thorn)	Open
		Forest Plantation	Forest Plantation
		Scrub Forest	Scrub Forest
		Swamp/Mangroves	Dense/Closed
			Open
Tree Clad Area	Dense/Closed		
	Open		
4	Grass/Grazing	Alpine/Sub-Alpine	Alpine/Sub-Alpine
		Temperate/Subtropical	Temperate/Subtropical
		Tropical/Deserted	Tropical/Deserted
5	Wastelands	Salt Affected Land	Salt Affected Land
		Gullied/Ravenous land	Gullied
			Ravenous land
		Scrubland	Dense/Closed
			Open
		Sandy area	Desertic
Coastal			
Riverine			
	Barren rocky	Barren rocky	
6	Wetlands	Inland	Natural (Ox-bow lake, cut-off meander, water logged etc.)
			Manmade (Water logged, salt pans)

			etc.)
		Coastal	Lagoon, creeks, mudflats etc. Salt pans
7	Waterbodies	River	Perennial Non-Perennial
		Canal/drain	Canal/drain
		Lake/Ponds	Permanent Seasonal
		Reservoir/Tank	Permanent
			Seasonal
8	Snow, Shifting Cultivation and Rann	Snow	Snow
		Shifting Cultivation	Current
			Abandoned
		Rann	Rann

The land use landcover data of 2006 and 2016 were reclassified to match with the level I of the Eight-Fold classification scheme proposed for LULC mapping by Natural Resource Census by NRSC and ISRO (2011).

Change Detection

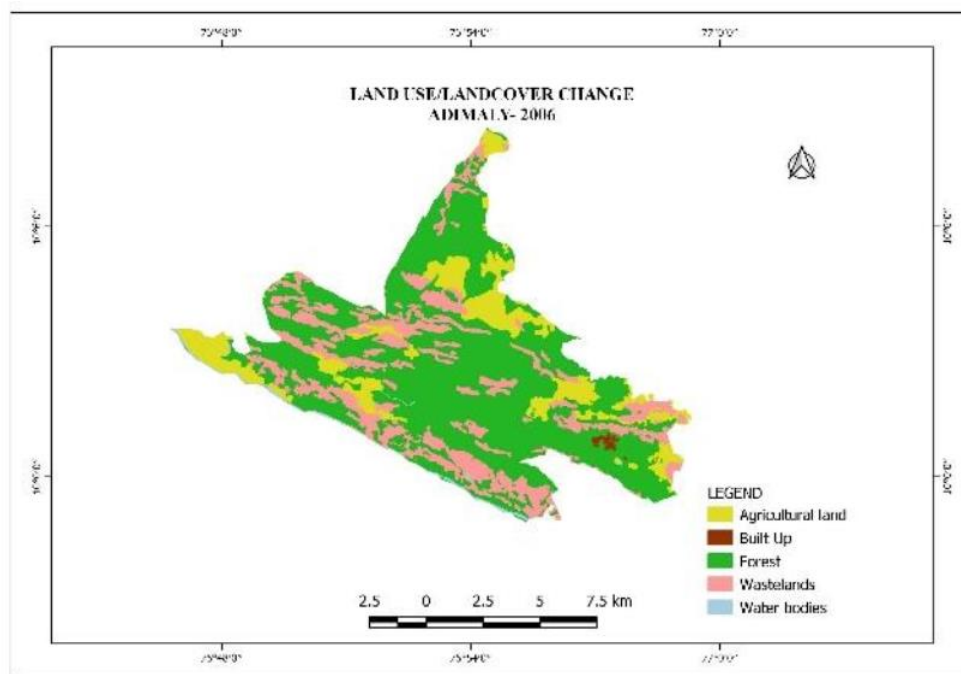
Change detection is a method of understanding how a given area has changed between two or more time periods. It can be used to identify change of a feature, as well as change of a feature's location size and shape over time. It usually involves comparing aerial photographs or satellite imagery of the area taken at different times. In this study vector layers of two different time periods are used to detect the change. These two vector layers are taken to a GIS environment and processed. The output from change detection is a difference between the data sets of 2006 and 2016. The change in land use/Landcover of each of the Panchayaths are detected and are presented below.

Adimali

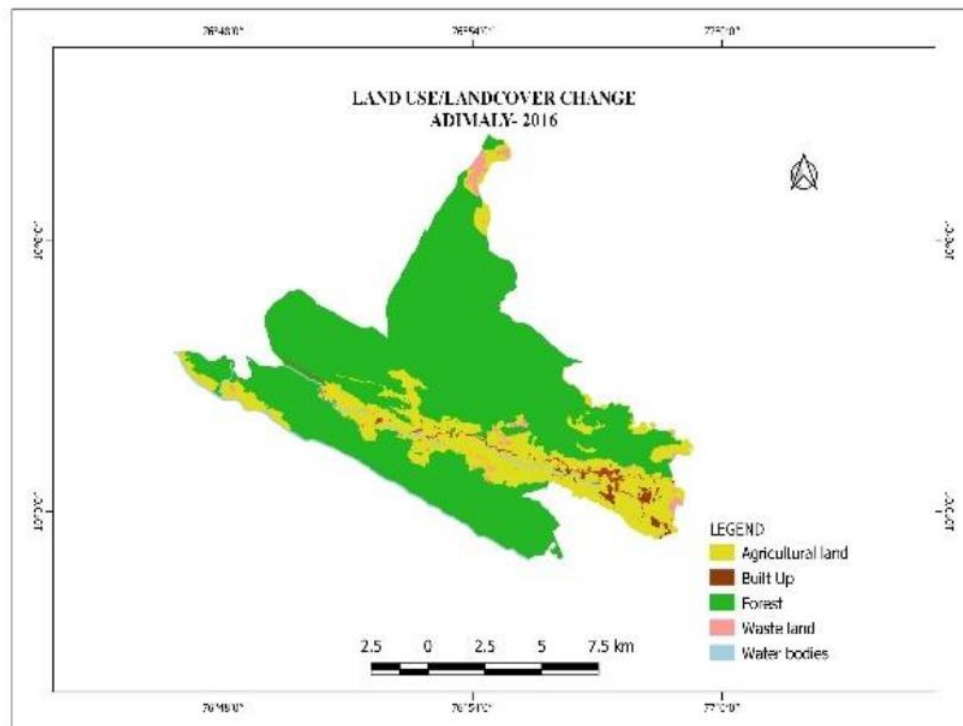
Adimali Grama Panchayat is located in Devikulam Taluk of Idukki District. The land use / landcover classification of Adimali Panchayath is in tune with the general trend of the study area as a whole. There is an increase in the area under agricultural land, built-up, and forest at the expense of wasteland in this Panchayath.

Table 1.4 Change in land use /landcover classes, Adimali Panchayath

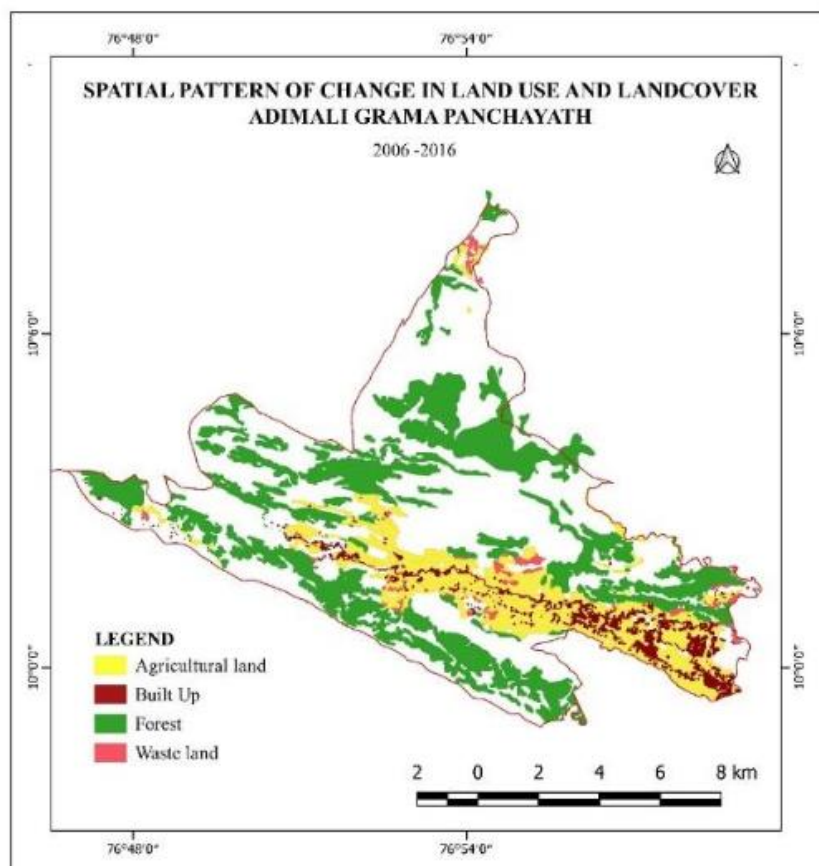
LU/LC classes	Area in Hectares		Change in Hectares	Percent
	2006	2016		
Agricultural land	2030.9	2930.43	899.53	17.44
Built-up	0	343.25	343.25	6.65
Forest	9053.01	10388.9	1335.89	25.90
Wastelands	2797.84	224.11	-2573.73	49.90
Waterbody	155.7	150.76	-4.94	0.09
Total	14037.45	14037.45		100



Map. 1.1. Land use map for the year 2006



Map. 1.2. Land use map for the year 2016



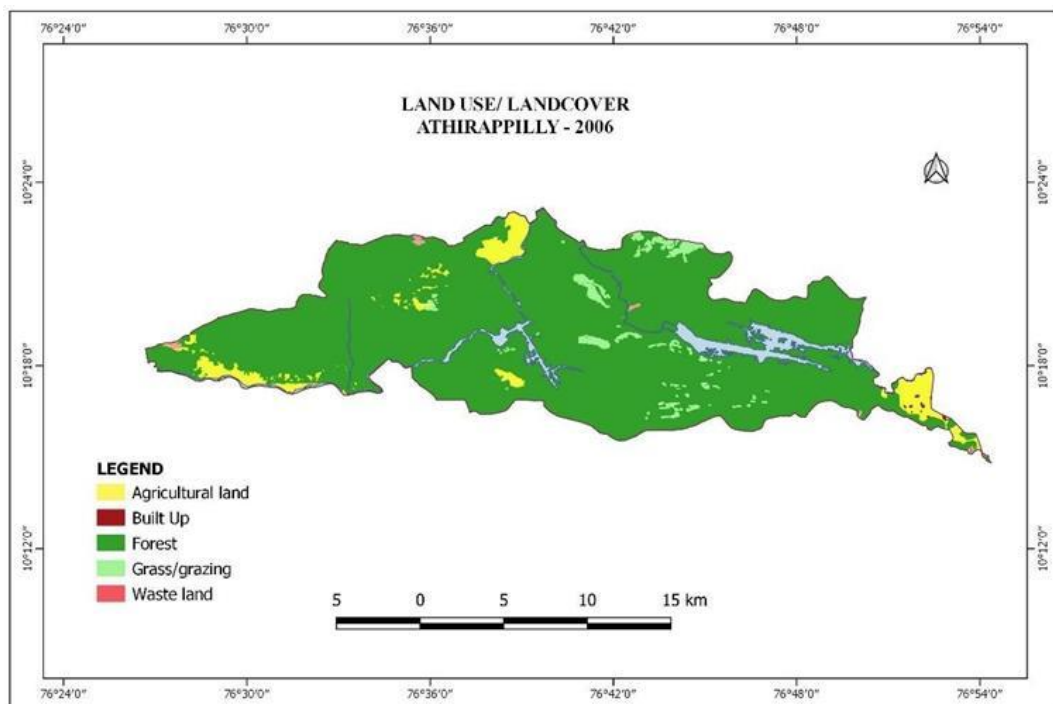
Map.1.3 Spatial Pattern of land use /landcover classes, Adimali Panchayath

Athirappilly

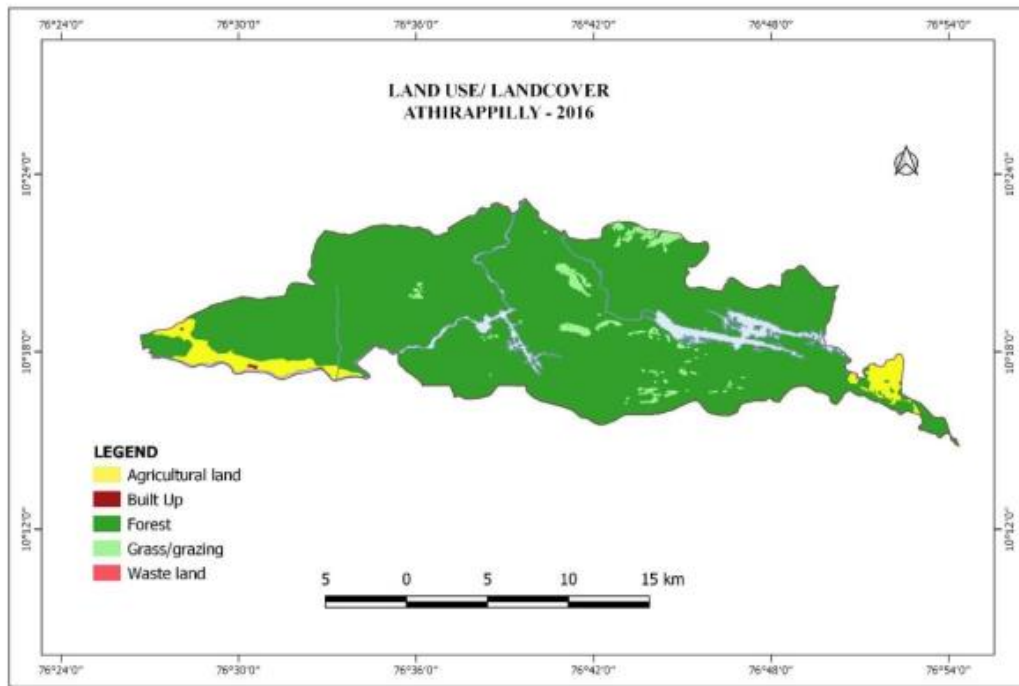
Athirappilly Grama Panchayat is located in Chalakkudy Taluk of Thrissur district. The area under forest in the Panchayath registered a steady increase during the period. There is complete absence of waste lands as of 2016. The pattern of spatial change has been depicted in the map 1.2.

Table 1.5 Change in land use /landcover classes, Athirappilly Panchayath

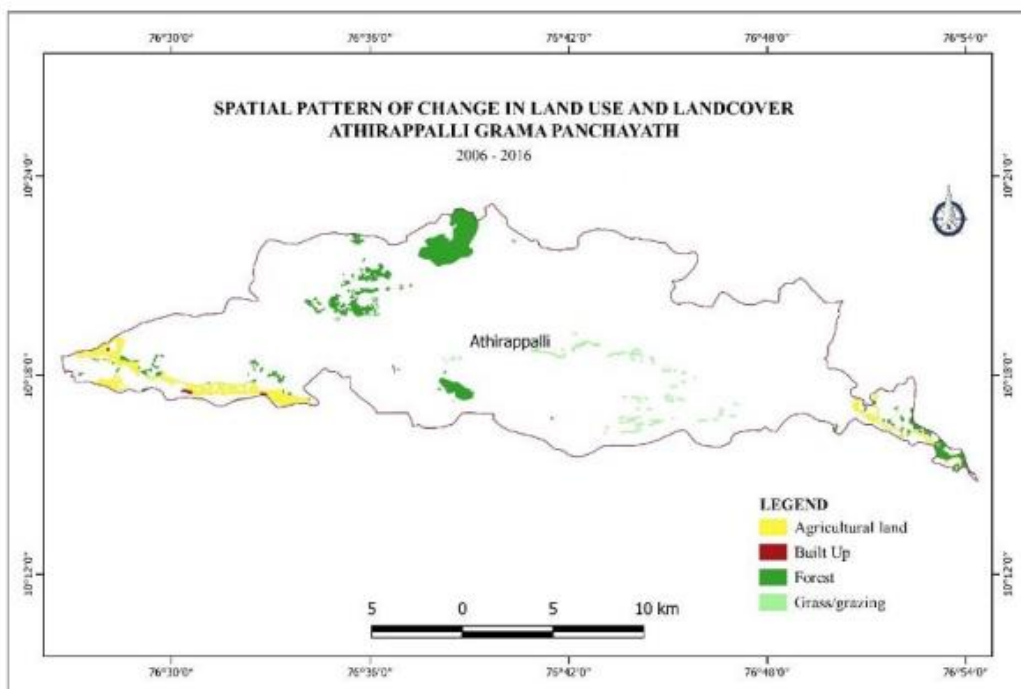
LU/LC classes	Area in Hectares		Change in Hectares	Percent
	2006	2016		
Agricultural land	2183.4	1701.91	-475.49	44.19
Built-up	12.32	10.4	-1.92	0.17
Forest	31785.38	32319.7	534.32	49.65
Grass/Grazing	519.46	519.14	-0.32	0.02
Wastelands	57.27	0	-57.27	5.32
Waterbody	1576.86	1583.54	6.68	0.62
Total	36134.69	36134.69		100



1.4. Land use map for the year 2006



Map. 1.5. Land use map for the year 2016



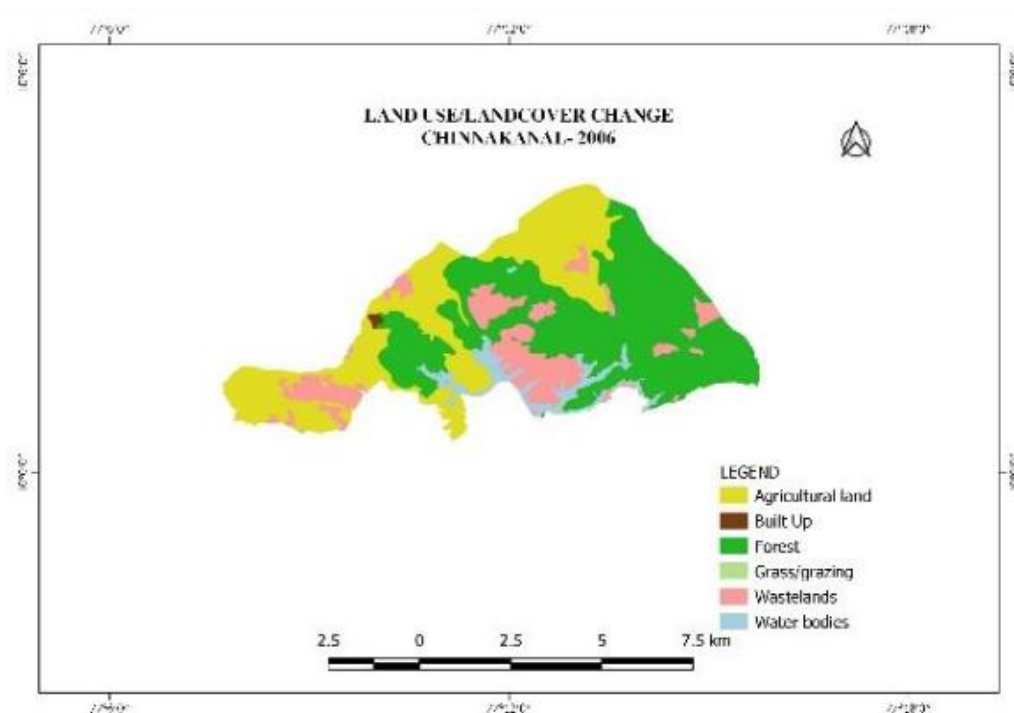
Map.1.6. Spatial Pattern of land use /landcover classes, Athirappilly Panchayath

Chinnakanal

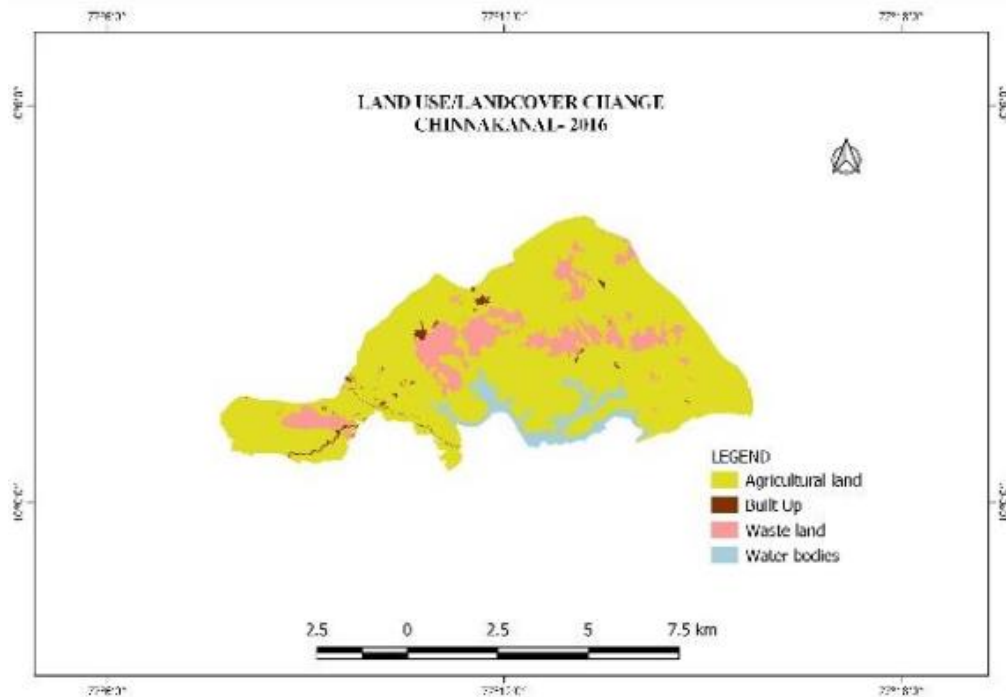
Chinnakanal Grama Panchayat is located in the Devikulam block of the Idukki district of Kerala. This is one of the panchayath in the study area where there is a considerable increase in area under agricultural land at the expense of area under forest.

Table 1.6 Change in land use /landcover classes, Chinnakanal Panchayath.

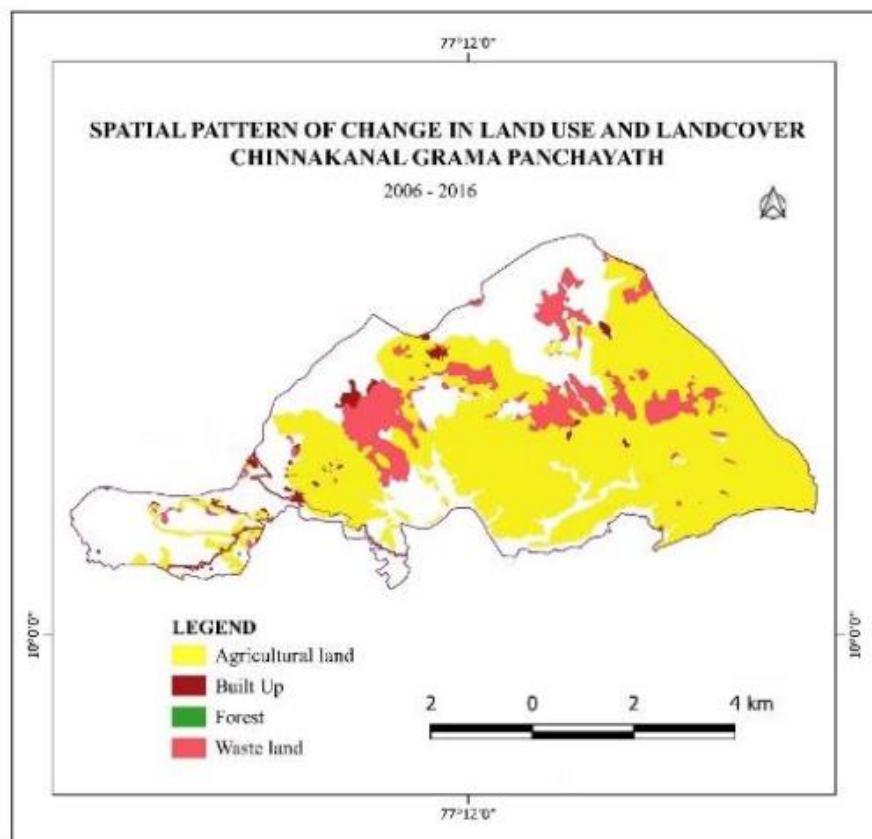
LU/LC classes	Area in Hectares		Change	Percent
	2006	2016		
Agricultural land	1712.44	3975.52	2263.08	48
Built-up	10.12	77.77	67.65	1.43
Forest	2342.3	0	-2342.3	49.68
Grass/Grazing	1.74	0	-1.74	0.36
Wastelands	679.88	706.4	26.52	0.56
Waterbody	246.02	232.9	-13.12	0.28
Total	4992.5	4992.5		100



Map. 1.7. Land use map for the year 2006



Map. 1.8. Land use map for the year 2016



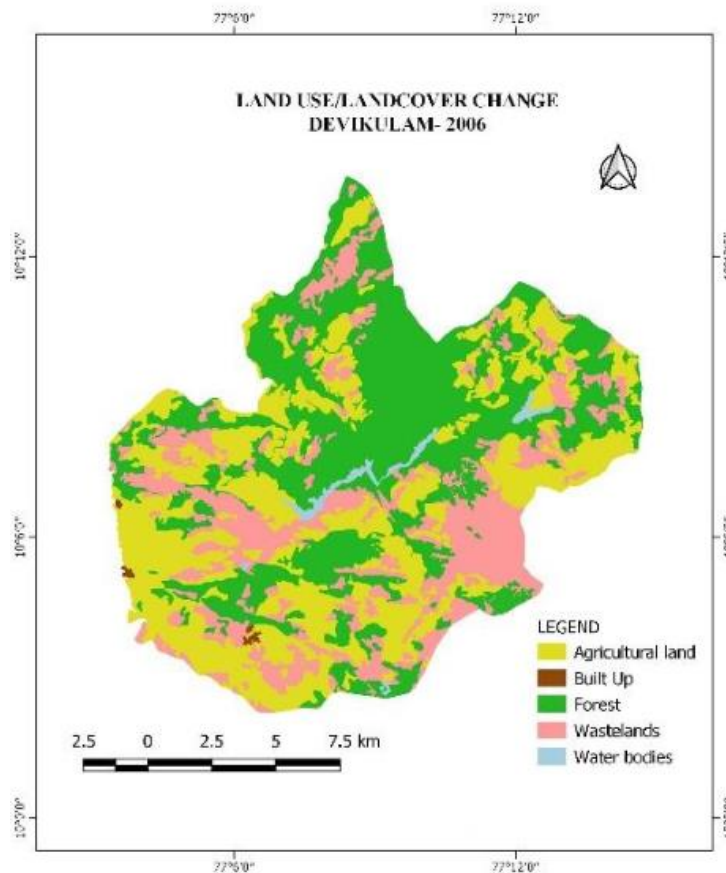
Map.1.9. Spatial Pattern of land use /landcover classes, Chinnakanal Panchayath

1.5.4. Devikulam

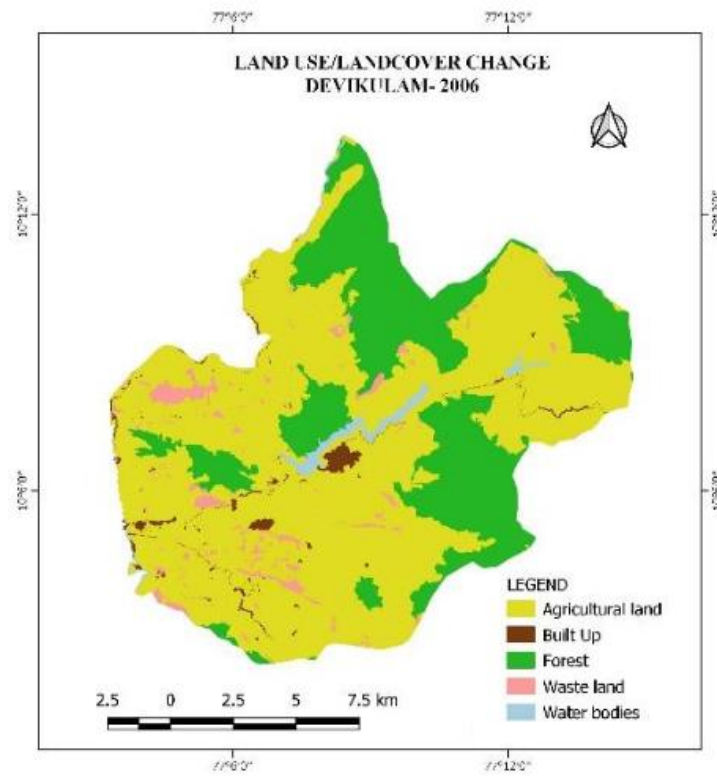
Devikulam Panchayat is located in the Devikulam block of the Idukki district in Kerala. There is a considerable decrease in area under forest and wastelands, whereas the area under agricultural land registered a sudden increase.

Table 1.7. Change in land use /landcover classes, Devikulam Panchayath

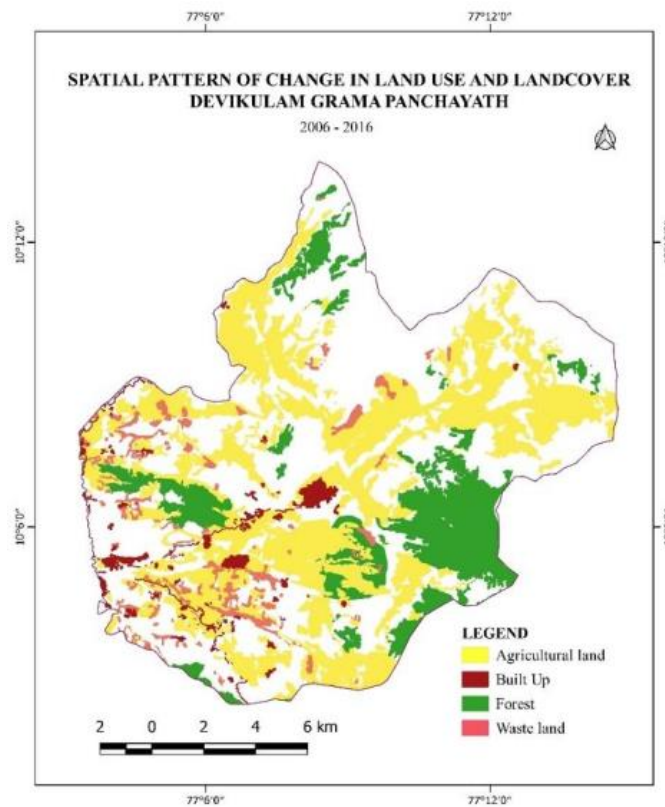
LU/LC classes	Area in Hectares		Change	Percent
	2006	2016		
Agricultural land	8326.56	15329.07	6002.51	42.88
Built-up	32.93	460.75	427.82	3.06
Forest	9114.51	5795.18	-3319.33	23.71
Waterbody	260.26	328.53	68.27	0.48
Wastelands	5186.31	1007.04	-4179.27	29.85
Total	22920.57	22920.57		100



Map. 1.10. Land use map for the year 2006.



Map. 1.11. Land use map for the year 2016



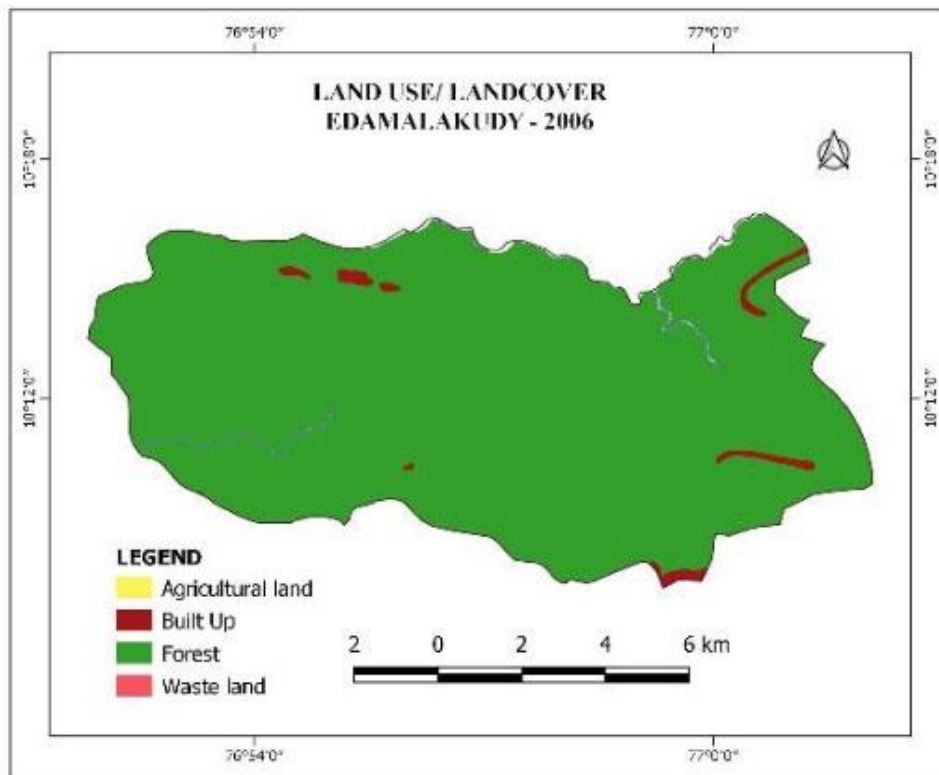
Map.1.12. Spatial Pattern of land use /landcover classes, Devikulam Panchayath

1.5.5. Edamalakudy

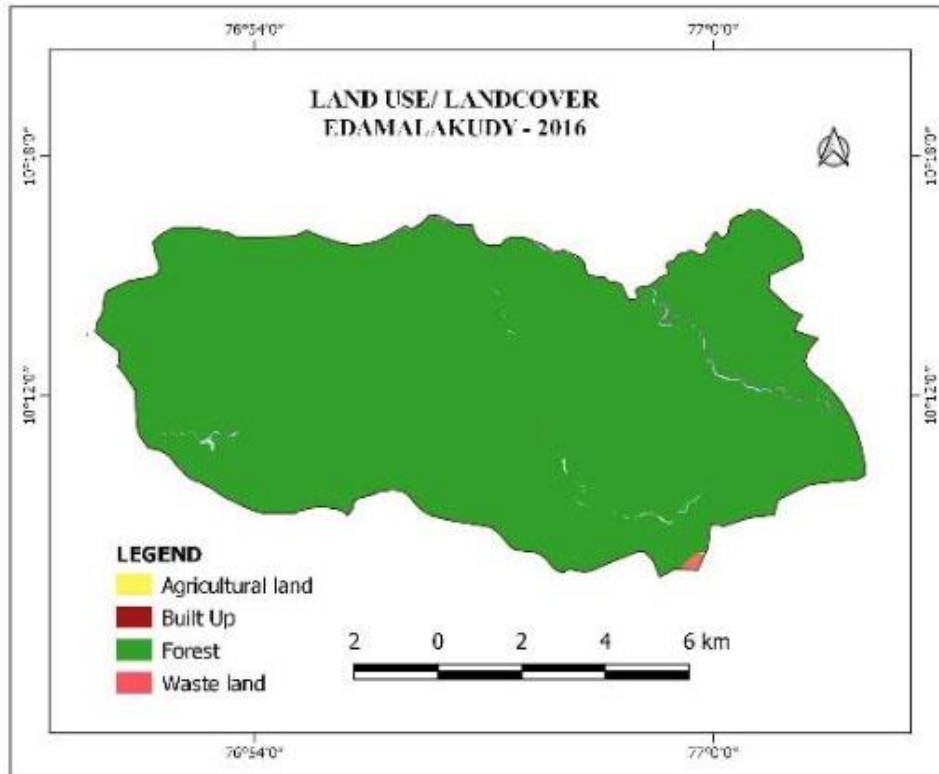
Edamalakudy is a small village in Devikulam Taluk, Idukki district. It is the only Panchayath in the study area where least change in land use /landcover is detected. The Panchayath is also famous for the Muthuvan tribes

Table 1.8 Change in land use /landcover classes, Edamalakudy Panchayath

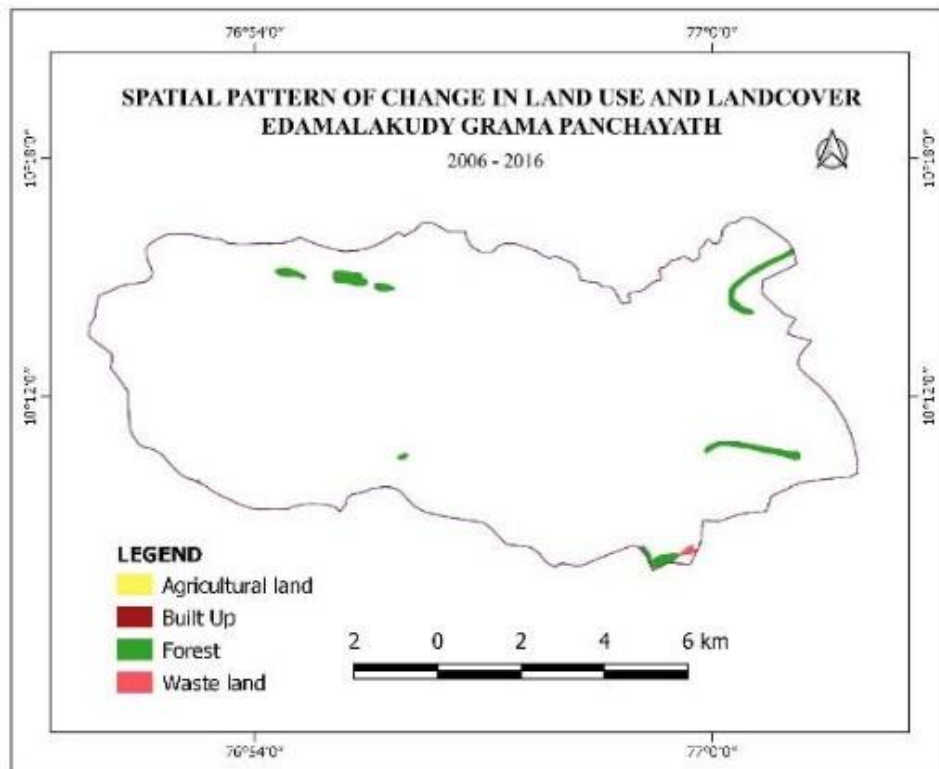
LU/LC classes	Area in Hectares		Change	Percent
	2006	2016		
Agricultural land	0	1.31	1.31	0.56
Forest	11236.3	11275.96	39.66	17.11
Waterbody	35.42	110.3	74.88	32.31
Wastelands	132.05	16.2	-115.85	50
Total	11403.77	11403.77		100



Map. 1.13. Land use map for the year 2006



Map. 1.14. Land use map for the year 2016



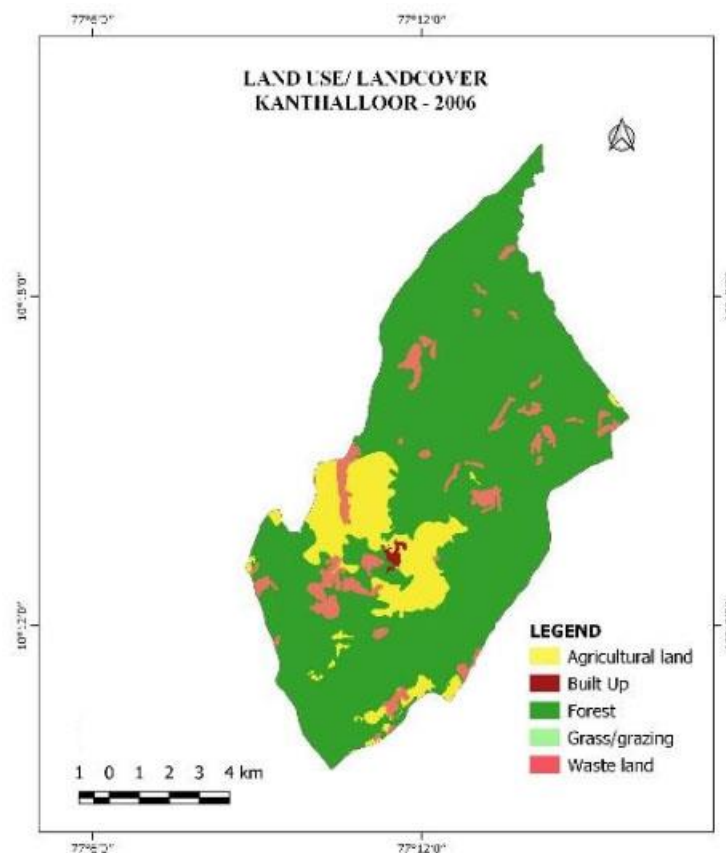
Map.1.15. Spatial Pattern of land use /landcover classes, Edamalakudy Panchayath

1.5.6. Kanthalloor

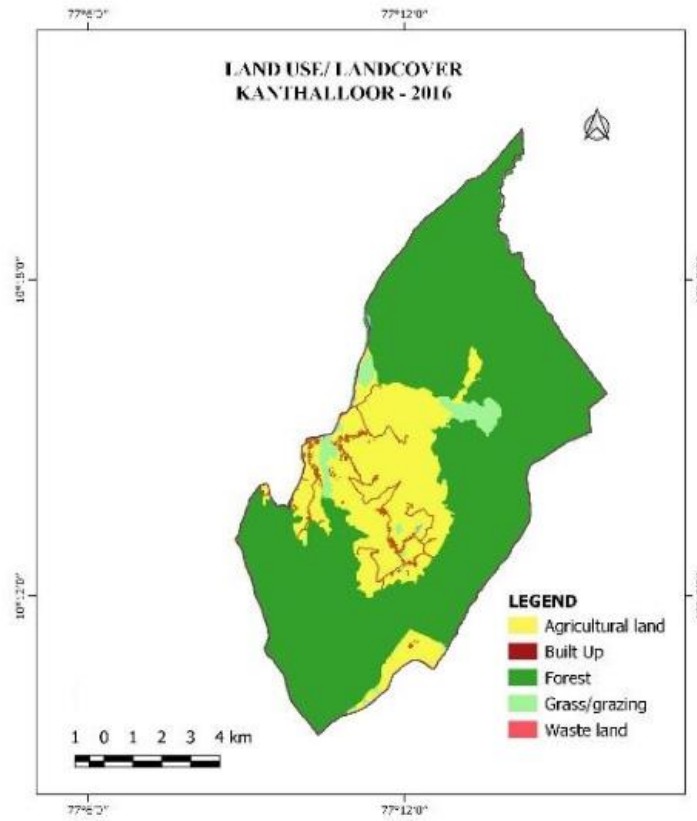
Kanthalloor Grama Panchayath is located in Devikulam block of Idukki district. The area under agricultural land and built-up had increased, while that of forest and waste lands decreased.

Table 1.9. Change in land use /landcover classes, Kanthalloor Panchayath

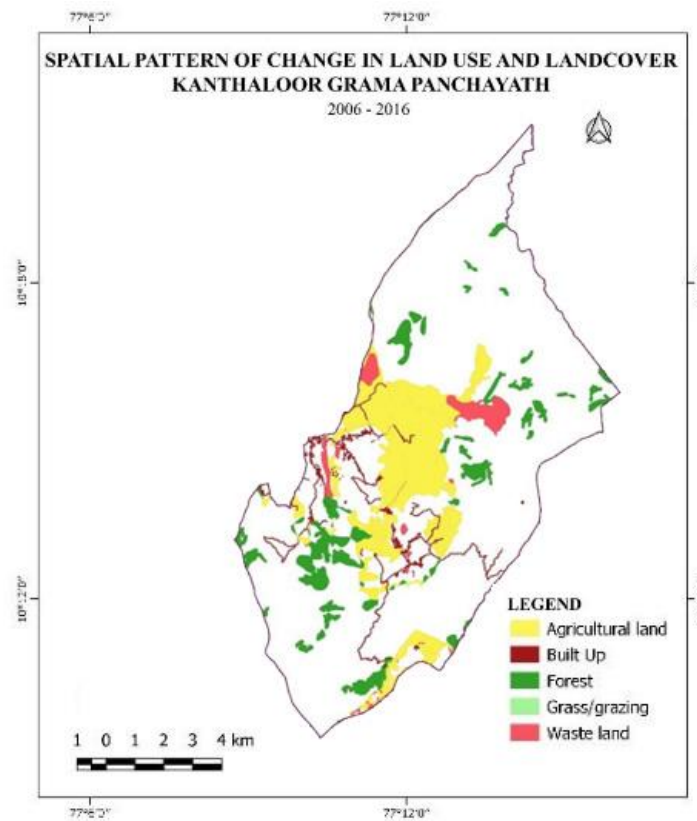
LU/LC classes	Area in Hectares		Change	Percent
	2006	2016		
Agricultural land	1512.91	2862.69	1349.78	49.01
Built-up	47.36	74.54	27.18	0.98
Forest	9930.25	8901.9	-1028.35	37.34
Wastelands	604.55	259.89	-344.66	12.51
Waterbody	10.23	6.28	-3.95	0.14
Total	12105.3	12105.3		100



Map. 1.16. Land use map for the year 2006



Map. 1.17. Land use map for the year 2016



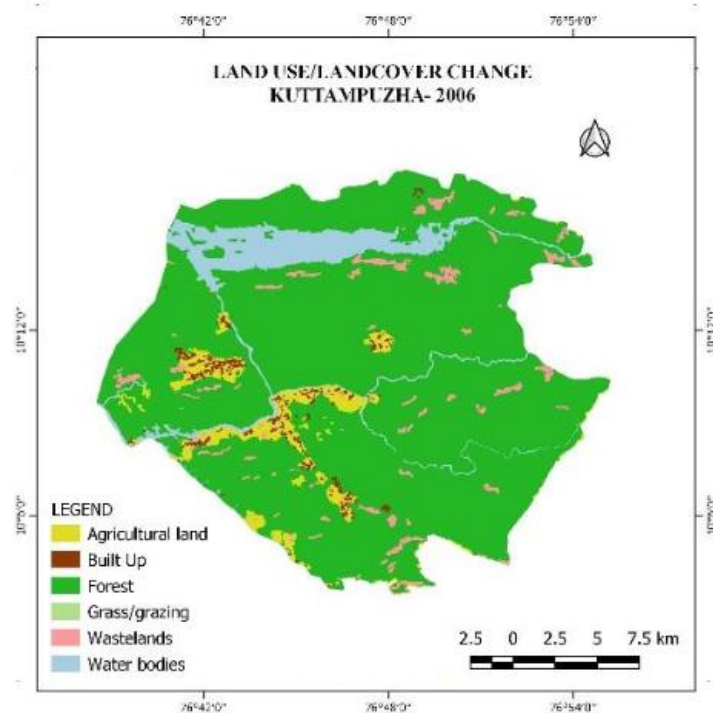
Map.1.18. Spatial Pattern of land use /landcover classes, Kanthalloor Panchayath

1.5.7. Kuttampuzha

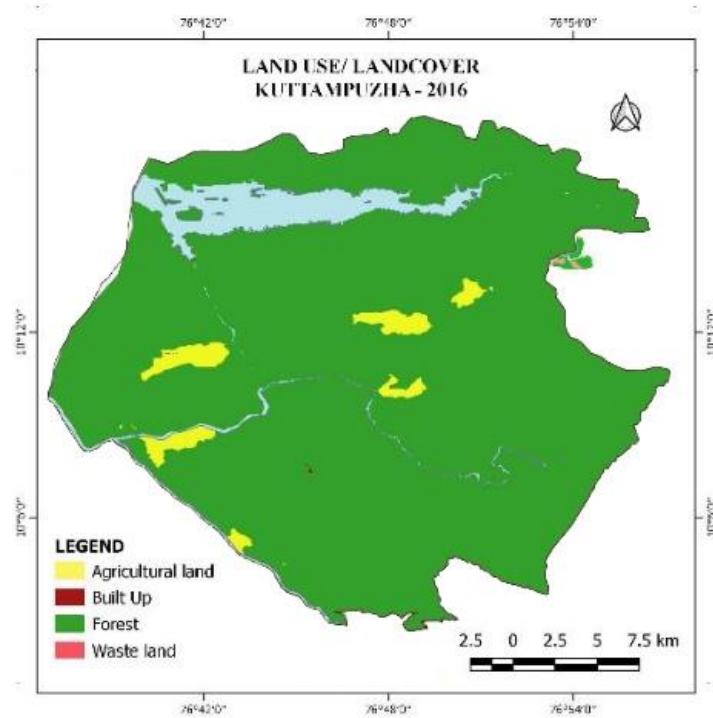
Kuttampuzha Panchayat is located in Kothamangalam Taluk of Ernakulam district. The Panchayath is marked by the loss of wastelands and an increase in area under forest.

Table 1.10 Change in land use /landcover classes, Kuttampuzha Panchayath.

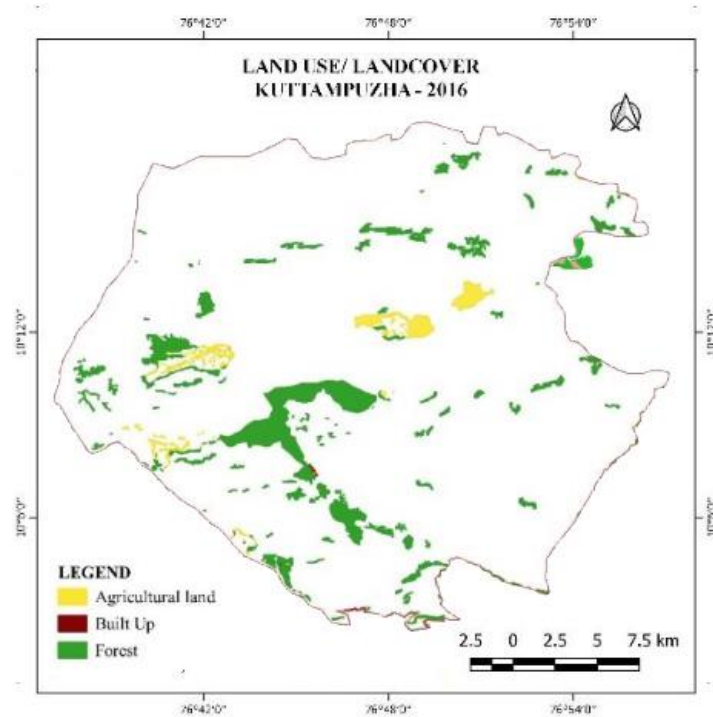
LU/LC classes	Area in Hectares		Change	Percent
	2006	2016		
Agricultural land	2260.5	1399.8	-860.7	17.78
Built-up	279.61	13.08	-266.53	5.50
Forest	41723.42	44143.1	2419.69	50
Wastelands	909.3	0	-909.3	18.78
Waterbody	3617.2	3234.05	-383.16	7.91
Total	48790.03	48790.03		100



Map. 1.19. Land use map for the year 2006



Map. 1.19. Land use map for the year 2016



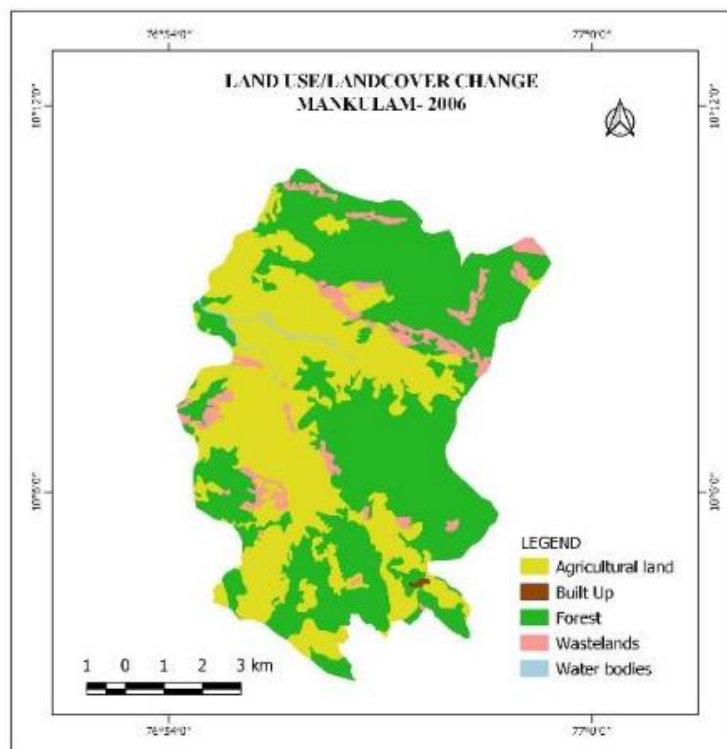
Map.1.21 Spatial Pattern of land use /landcover classes, Kuttampuzha Panchayath

1.5.8. Mankulam

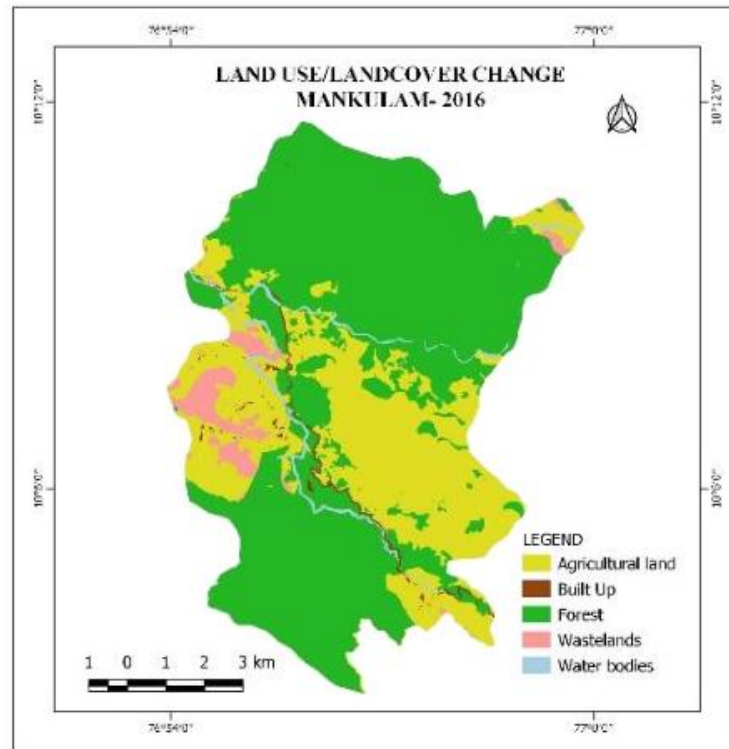
Mankulam Panchayath is located in Idukki district of Kerala. There is a considerable increase in the built-up area in the Panchayath. A marginal increase of area under forest is also registered at the expense of agricultural land.

Table 1.11 Change in land use /landcover classes, Mankulam Panchayath.

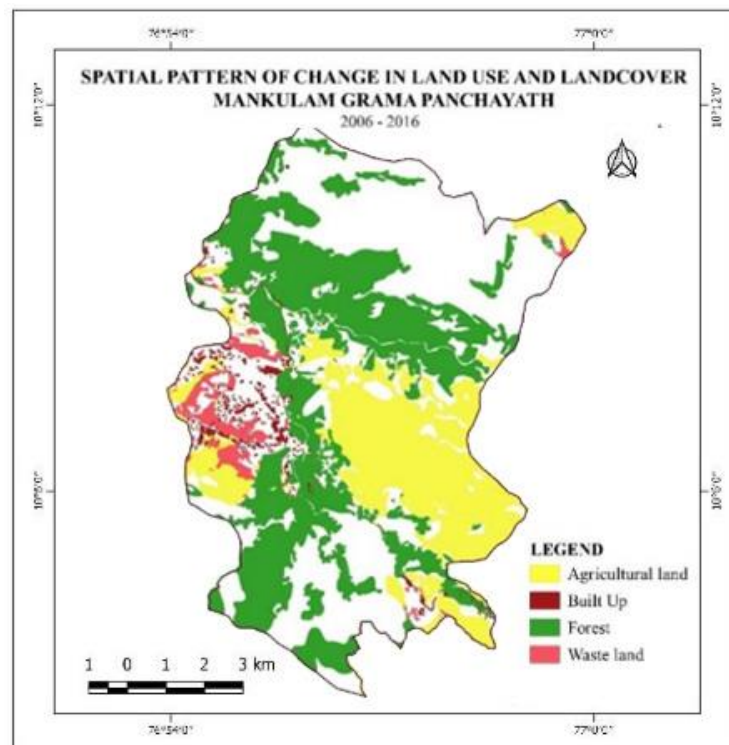
LU/LC classes	Area in Hectares		Change	Percent of change
	2006	2016		
Agricultural land	3070	2424.45	-645.55	40.55
Built-up	5.6	78.4	72.8	4.57
Forest	4216.42	4870.75	654.33	41.10
Wastelands	399	248.6	-150.4	9.49
Waterbody	42.3	111.12	68.82	4.32
Total	7733.32	7733.32		100



Map. 1.22. Land use map for the year 2006



Map. 1.23. Land use map for the year 2016



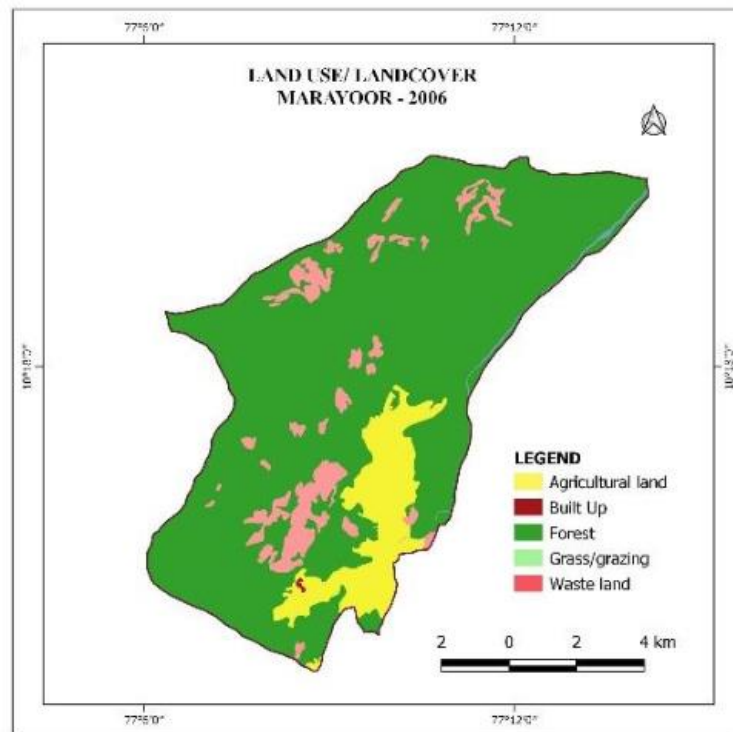
Map.1.24 Spatial Pattern of land use /landcover classes, Mankulam Panchayath

1.5.9. Marayoor

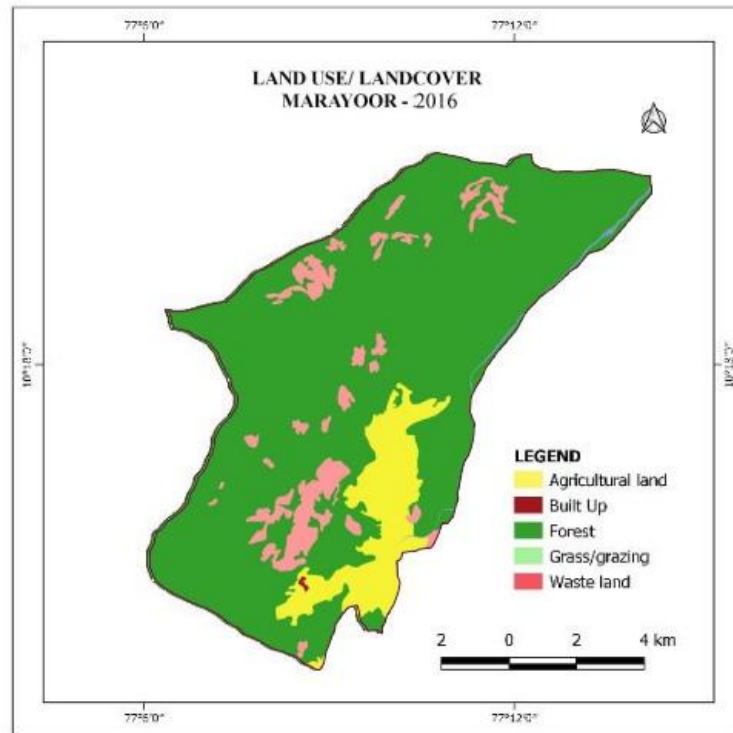
Marayoor Grama Panchayat is located in the Devikulam block of Idukki district. The Panchayath falls in the rain shadow regions of Western Ghats. There is a marginal increase in area under forest, built-up, and agriculture, while the area under wastelands shows a declining trend.

Table 1.12 Change in land use /landcover classes, Marayoor Panchayath.

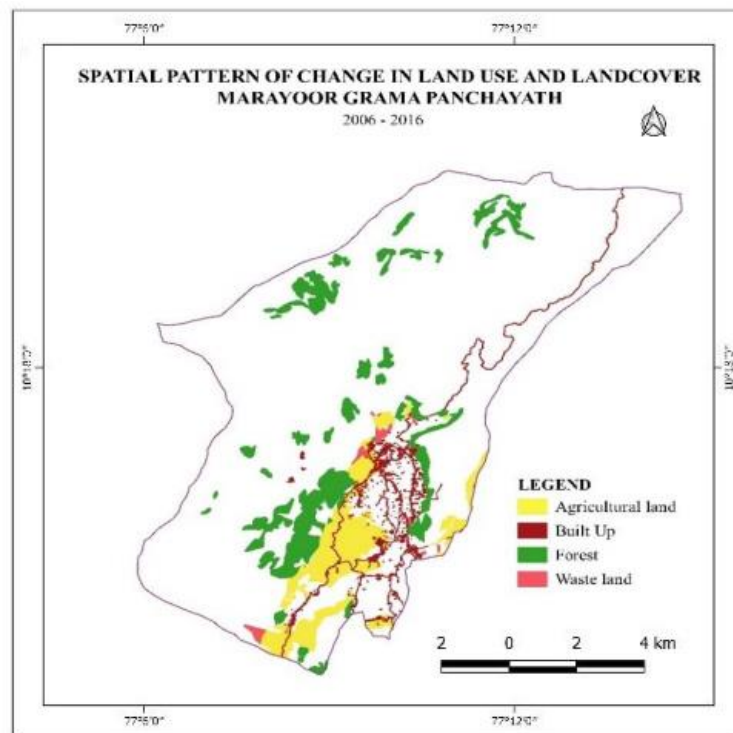
LU/LC classes	Area in Hectares		Change	Percent
	2006	2016		
Agricultural land	1127.35	1545.8	418.45	32.35
Built-up	4.2	129.6	125.4	9.69
Forest	9216.84	9319.7	102.86	7.95
Wastelands	684.72	44.7	-640.02	49.48
Waterbody	70.5	63.81	-6.69	0.51
Total	11103.61	11103.61		100



Map. 1.25. Land use map for the year 2006



Map. 1.25. Land use map for the year 2016



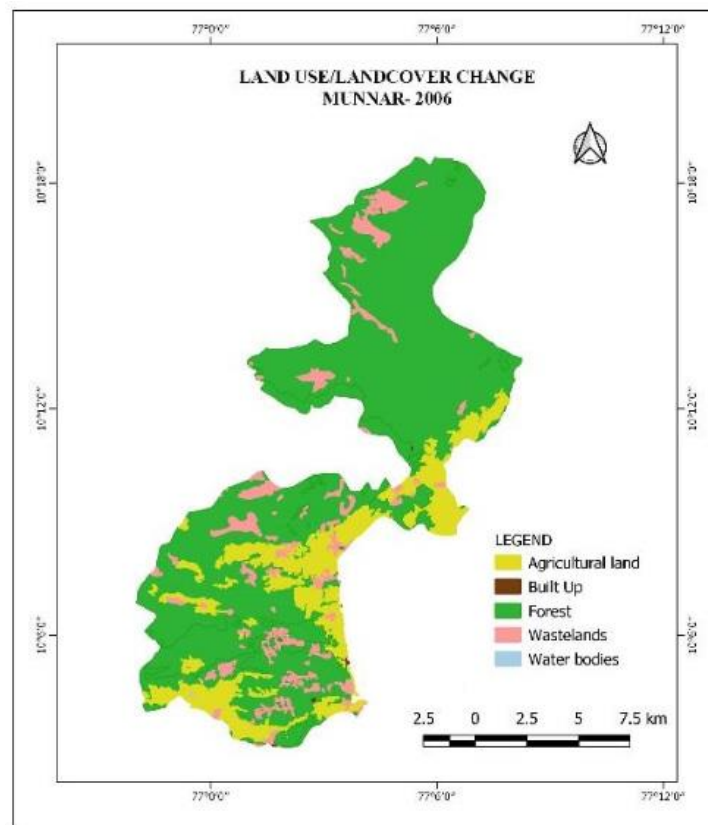
Map.1.27. Spatial Pattern of land use /landcover classes, Marayoor Panchayath.

1.5.10. Munnar

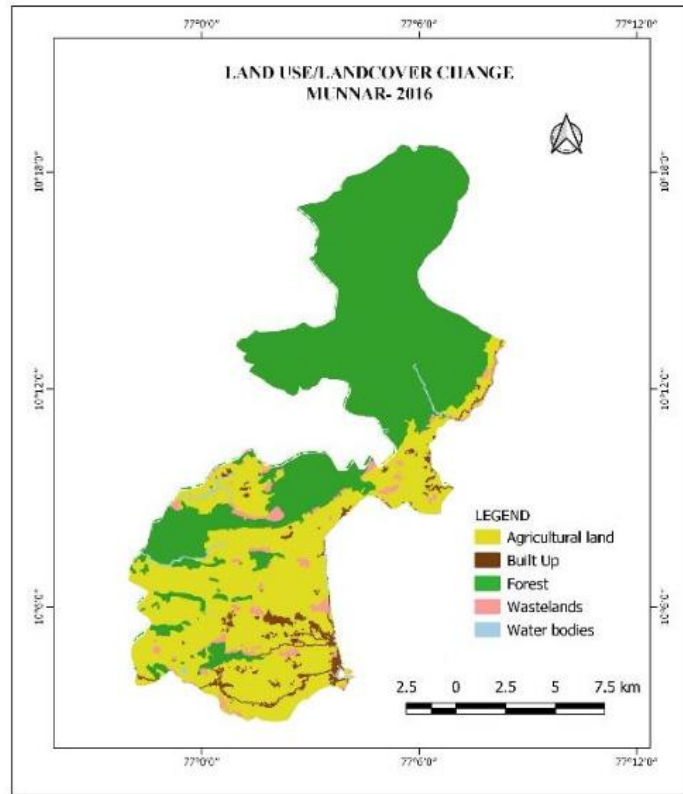
Munnar Grama Panchayat is also located in Devikulam Taluk, Idukki district. The Panchayath saw a drastic change in land use/landcover during the decade. The area under agricultural land and built-up registered an increase, while that of forest and agricultural land decreased.

Table 1.13 Change in land use /landcover classes, Munnar Panchayath.

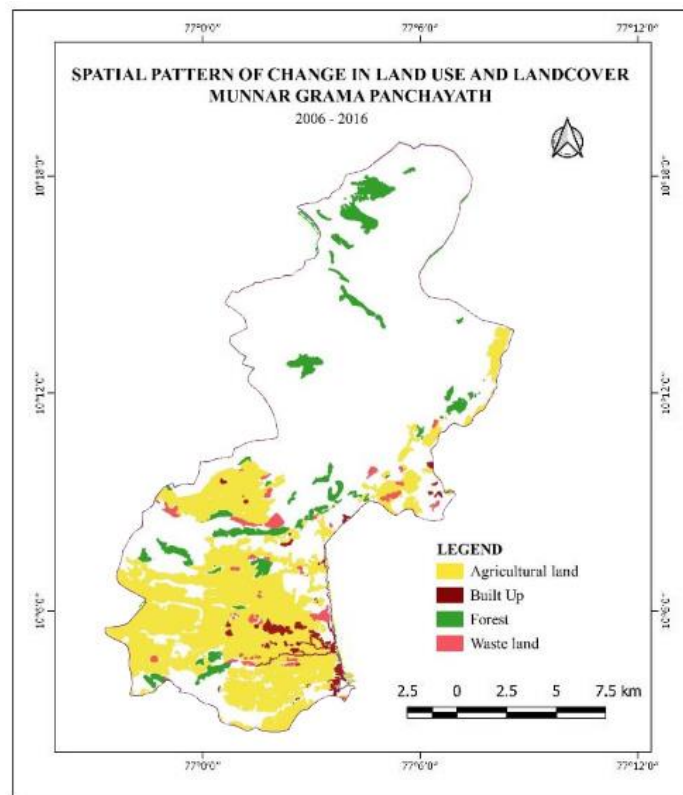
LU/LC classes	Area in Hectares		Change	Percent
	2006	2016		
Agricultural land	3481.8	9185.6	5703.8	46.87
Built-up	7.01	325.1	318.09	2.61
Forest	16871.7	11926.65	-4945.85	40.64
Wastelands	1526.15	386.91	-1139.24	9.36
Waterbody	2.2	64.6	62.4	0.51
Total	21888.86	21888.86		100



Map.1.28. Land use map for the year 2006



Map. 1.29. Land use map for the year 2016



Map.1.30 Spatial Pattern of land use /landcover classes, Munnar Panchayath

1.5.11. Vattavada

Vattavada panchayat is located in the Devikulam block of the Idukki district. There is an increase in the area under agricultural land, built-up, wastelands, and Grazing land in the Panchayath all at the expense of the area under forests.

Table 1.14 Change in land use /landcover classes, Vattavada Panchayath.

LU/LC classes	Area in Hectares		Change	Percent
	2006	2016		
Agricultural land	876.11	2354.26	1478.15	23.77
Built-up	0	71.28	71.28	1.14
Forest	5641.51	2532.64	-3108.87	50
Grass/Grazing	0	584	584	9.39
Wastelands	408.35	1383.52	975.17	15.68
Waterbody	0	0.27	0.27	0.004
Total	6925.97	6925.97		100

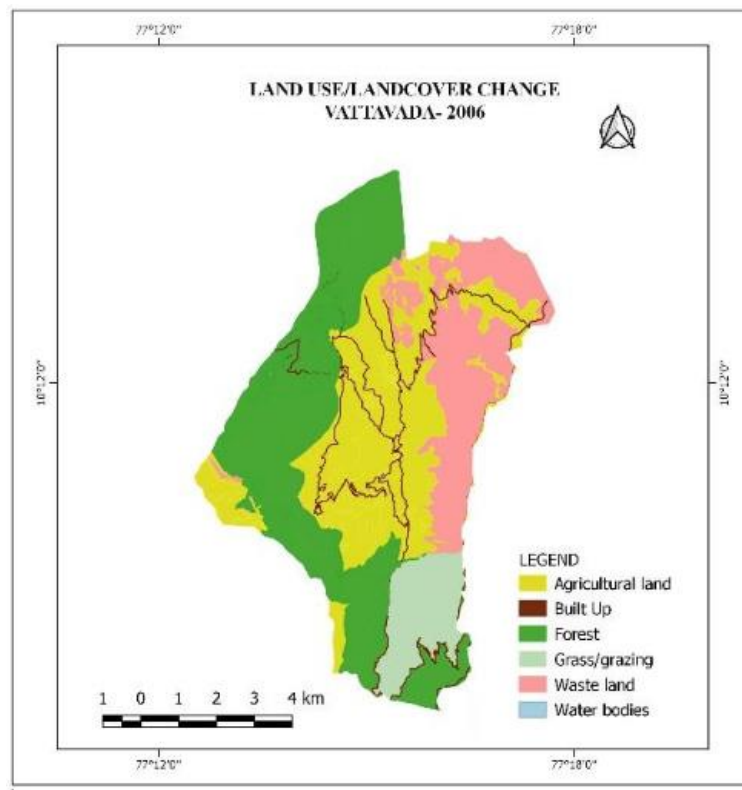
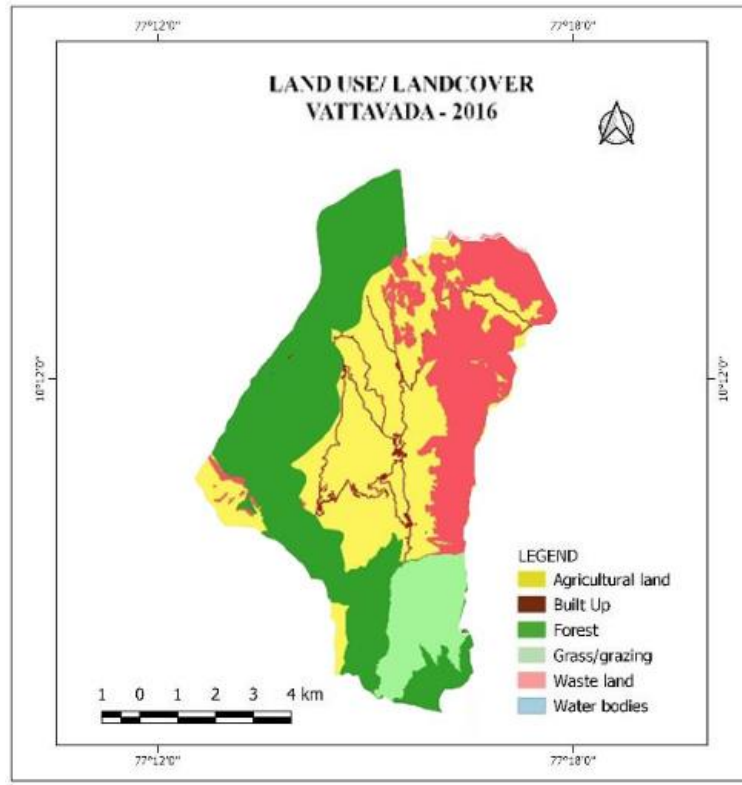
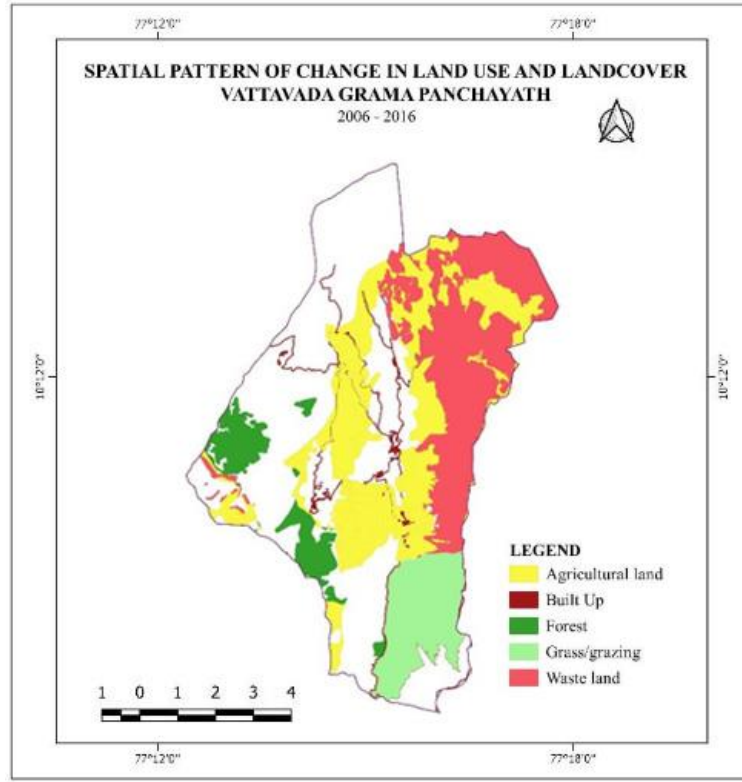


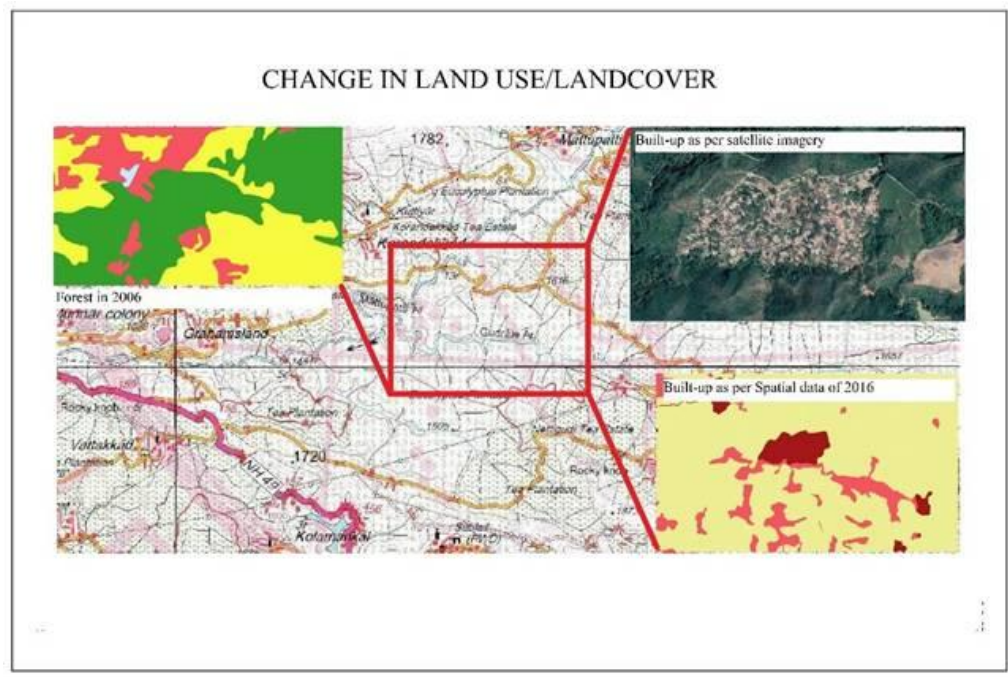
Fig. 1.31. Land use map for the year 2006.



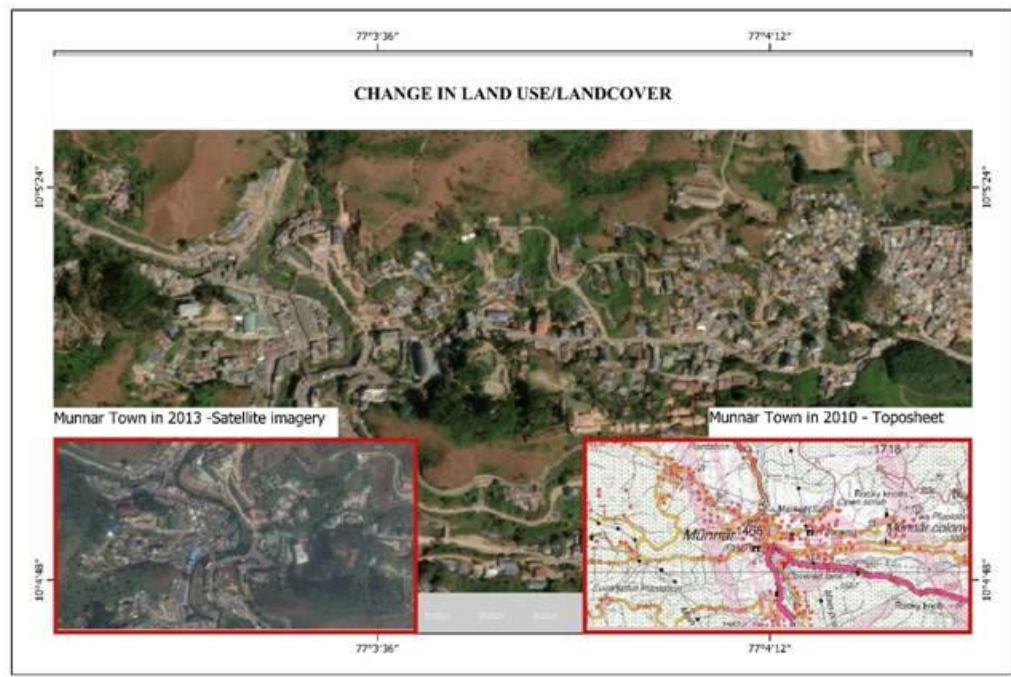
Map. 1.32. Land use map for the year 2016



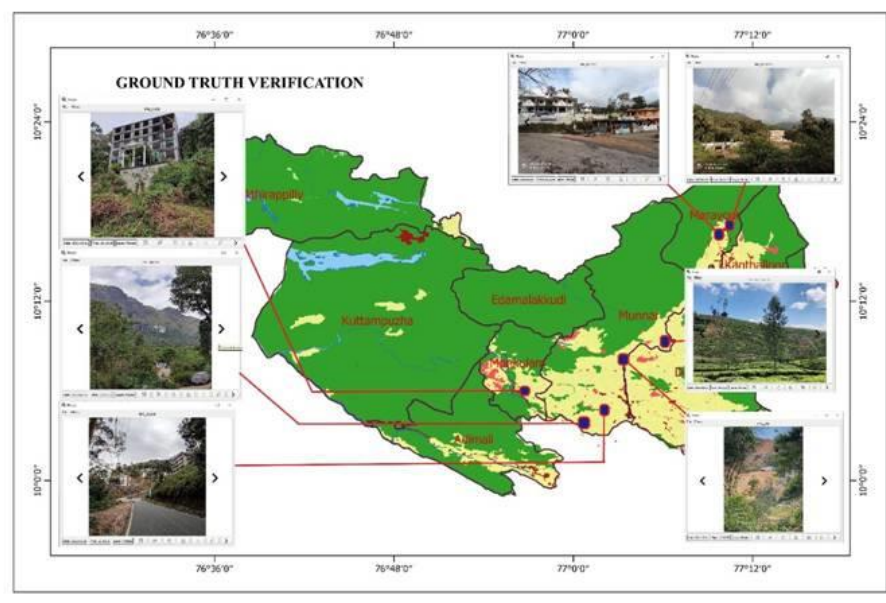
Map.1.33. Spatial Pattern of land use /landcover classes, Vattavada Panchayath



Map.1.34. Change in land use /land cover through the ages



Map.1.35. Change in land use /land cover through the ages



Map.1.36. Photographs of sample locations selected for ground truthing.

1.6. Change detection

From the analysis using the provided data, it is found that five Panchayaths within the study area registered a decline in forest area during the period. These are Chinnakal, Devikulam, Kanthalloor, Munnar, and Vattavada. Of these Panchayaths Chinnakal need special mention. As per the data, there is no area under forest in Chinnakal in 2016. The area under forest in Chinnakal in 2006 was about 2342 hectares. This immense change forced us to conduct ground truthing with special emphasis on that Panchayath. It was not a surprise to see during the site inspection that considerable area in this Panchayath had dense forest cover (Map. 1.26). Moreover, while classifying the data, agricultural perennial plantation crop in the Panchayath had been included in the class agriculture, and that of the forest with barren rock was included in the class waste lands. This is true for all the five Panchayaths which registered a decline in forest cover. The data pertaining to all the eleven Panchayaths had been consolidated in the following table.

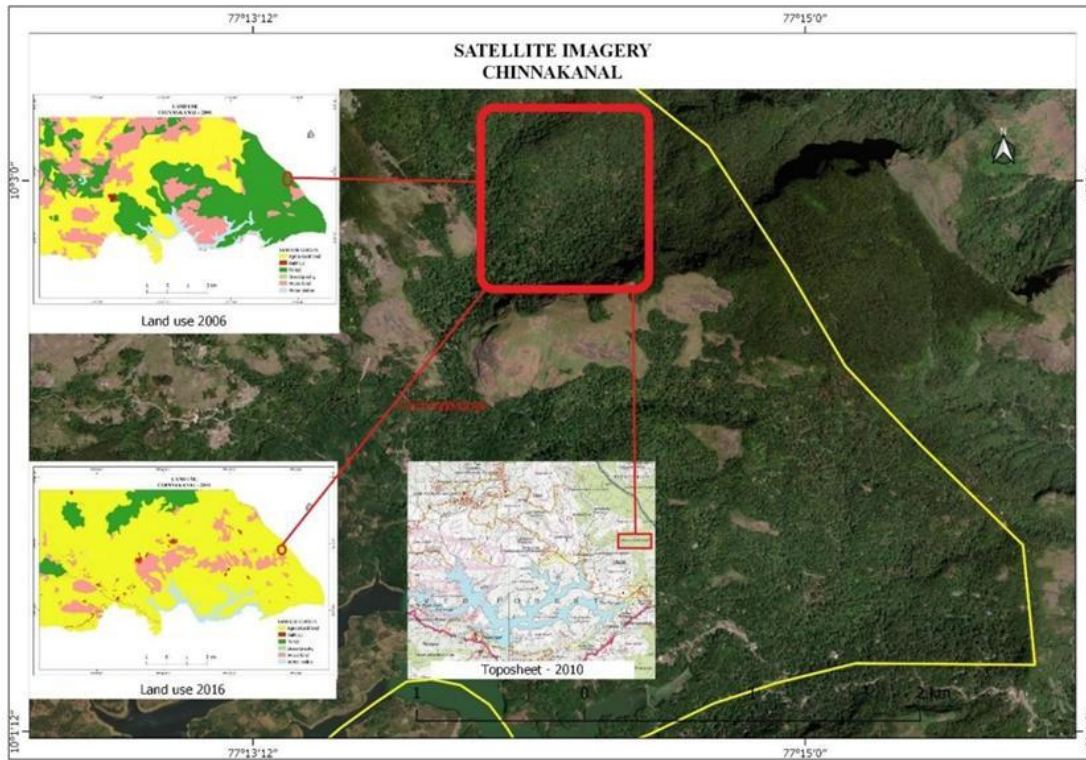


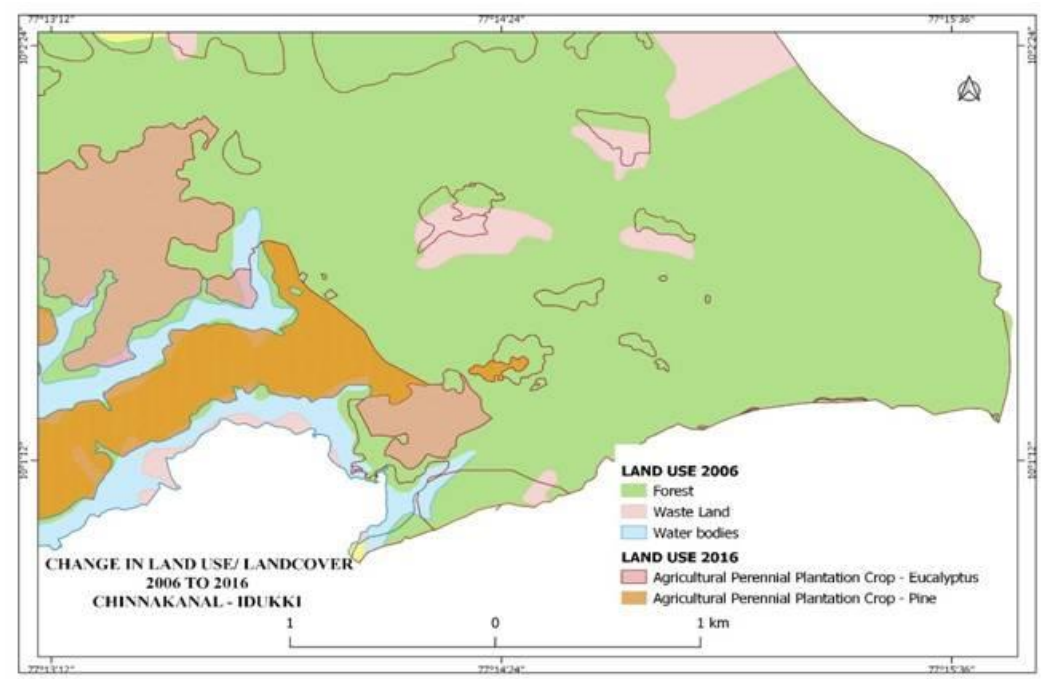
Table.1.15.Total area in each land use/landcover classes

SI No.	Name of Panchayath	Years	LU/LC classes						Total Area
			Agricultural Land	Built-up	Forest	Grass/Grazing	Wastelands	Waterbody	
1	Adimali	2006	2030.9	0	9053.01	0	2797.84	155.7	14037.45
		2016	2930.43	343.25	10388.9	0	224.11	150.76	
2	Athirappilly	2006	2183.4	12.32	31785.38	519.46	57.27	1576.86	36134.69
		2016	1701.91	10.4	32319.7	519.14	0	1583.54	
3	Chinnakanal	2006	1712.44	10.12	2342.3	1.74	679.88	246.02	4992.5
		2016	3975.5	77.7	0	0	706.4	232.9	

4	Devikulam	2006	8326.56	32.93	9114.51	0	5186.31	260.26	22920.57
		2016	15329.07	460.75	5795.18	0	1007.04	328.53	
5	Edamalakudy	2006	0	0	11236.3	0	132.05	35.42	11403.77
		2016	1.31	0	11275.96	0	16.2	110.3	
6	Kanthalloor	2006	1512.91	47.36	9930.25	0	604.55	10.23	12105.3
		2016	2862.69	74.54	8901.9	0	259.89	6.28	
7	Kuttampuzha	2006	2260.5	279.61	41723.42	0	909.3	3617.2	48790.03
		2016	1399.8	13.08	44143.1	0	0	3234.05	
8	Mankulam	2006	3070	5.6	4216.42	0	399	42.3	7733.32
		2016	2424.45	78.4	4870.75	0	248.6	111.12	
9	Marayoor	2006	1127.35	4.2	9216.84	0	684.72	70.5	11103.61
		2016	1545.8	129.6	9319.7	0	44.7	63.81	
10	Munnar	2006	3481.8	7.01	16871.7	0	1526.15	2.2	21888.86
		2016	9185.6	325.1	11926.65	0	386.91	64.6	
11	Vattavada	2006	876.11	0	5641.51	0	408.35	0	6925.97
		2016	2354.26	71.28	2532.64	584	1383.52	0.27	
Total	2006	26581.97	399.15	151131.2	521.2	13385.42	6016.69	198036.07	
	2016	43710.82	1584.1	141474.48	1103.14	4277.37	5886.16		

1.7. Conclusion

Area under agricultural land in the study area had registered a marked an increase from 26581 to 43710 hectares. The other land use / landcover classes that had registered an increase in area is built- up, which increased from 399 hectares to 1584 hectares. Area under forest, waterbody, wastelands, and grass/grazing had registered a decreasing trend. As per the given data the area under forest decreased from 151131 hectares to 141474 hectares. The total decrease of forest area within the stipulated years as per the data is 9657 hectares, which comes about 6.3 per cent of the total forest area. This loss of forest cover is mainly registered in the five Panchayaths of the study area, i.e., Chinnakanal, Devikulam, Kanthalloor, Munnar, and Vattavada. Further, it is to be noted that decline in forest cover in these five Panchayaths is more due to technical reason rather than an actual one. As per the adopted classification scheme of NRSC/ISRO (2011), certain classes in the provided data such as the area under "Agricultural perennial plantation crops" like tea, pine, and eucalyptus were included in the class "Agriculture". Grass lands within the forest had been included in the class "Grazing/grass lands". Similarly, area under barren rock which was considered as forest as per 2016 data had been put into the class of "wastelands" (Map.1.36). Thus, the adoption of a common scheme of classification have had considerable effect on reducing the area under forest with in these five Panchayaths.



Map.1.38. Change in land use in Chinnakanal from 2006 - 2016

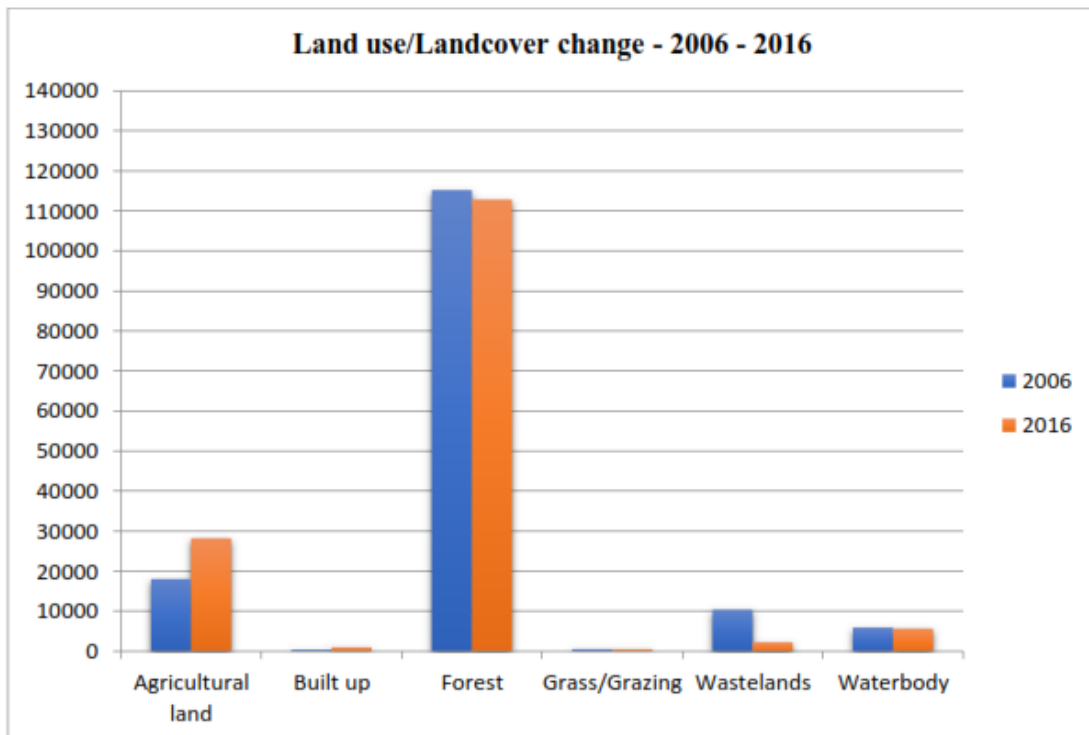


Fig.1.1 Land use /Landcover change - 2006 - 2016

1.8. Recommendations

Land is a scarce resource. The immense agricultural and demographic pressure had made the situation worse by inducing land use change. Land use / land cover change is one of the most significant factors that affect the geo-environmental and natural ecosystems such as biodiversity, water, and radiation budget. It is also causally related to the livelihoods of people. As part of the study, the following suggestions are proposed regarding the land use change in the study area.

- a) The driving force of land use change varies from one location to another. Hence further studies should be conducted in a local scale to identify the driving force behind the land use change in specific locations.
- b) A location specific action plan should be devised to prevent the degradation of forest and forest resources.
- c) The dense forests of the Western Ghats of Kerala are the real lifeline of the state. A community driven mapping programme of forest areas at small scale should be carried out in all Panchayaths which have considerable area under forest cover. The programme must ensure people's participation at all levels.
- d) A State level programme should be devised for the ecological restoration of degraded forest under the MGNREGS. This would ensure not only employment for the people who depend on forest products for their livelihood but at the same time prevent the degradation of the environment.

1.9. Data Issues and Other Limitations

Land use /landcover change detection is usually accomplished by using remotely sensed satellite data or aerial photographs. Very few studies used vector data for the detection of land use/Land cover changes. The data set on which the study

was based belongs to two years, ie, 2006 and 2016. The various issues faced with the data set can be classed into three. They are,

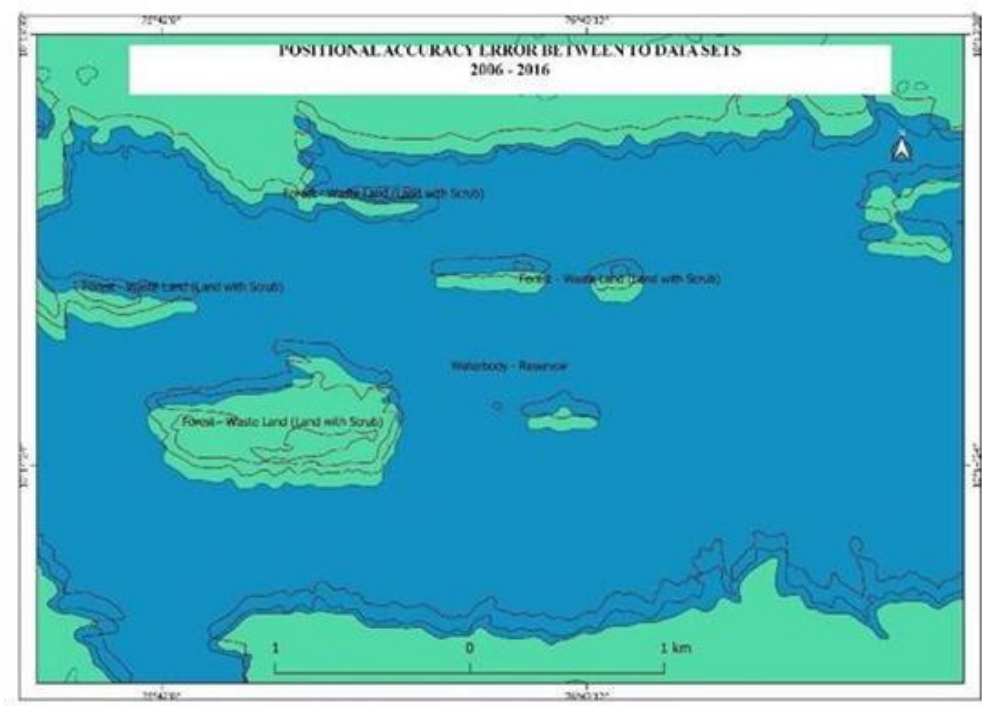
- a. Issues related to the geometry and topology of the spatial dataset, and
- b. Positional error in the spatial data.
- c. Issues related to the reliability of the spatial data itself.

The issues related to the geometry and topology of the spatial dataset is of serious concern in a GIS environment. Spatial data is the main component of any GIS based study, and geometric errors in spatial data are of great concern since it renders the data unusable in GIS. Spatial data with geometric errors are unable to process in a GIS environment. Few geometric and topological errors with the data set of 2006 and quite immense errors with the data set of 2016 had been rectified before processing.

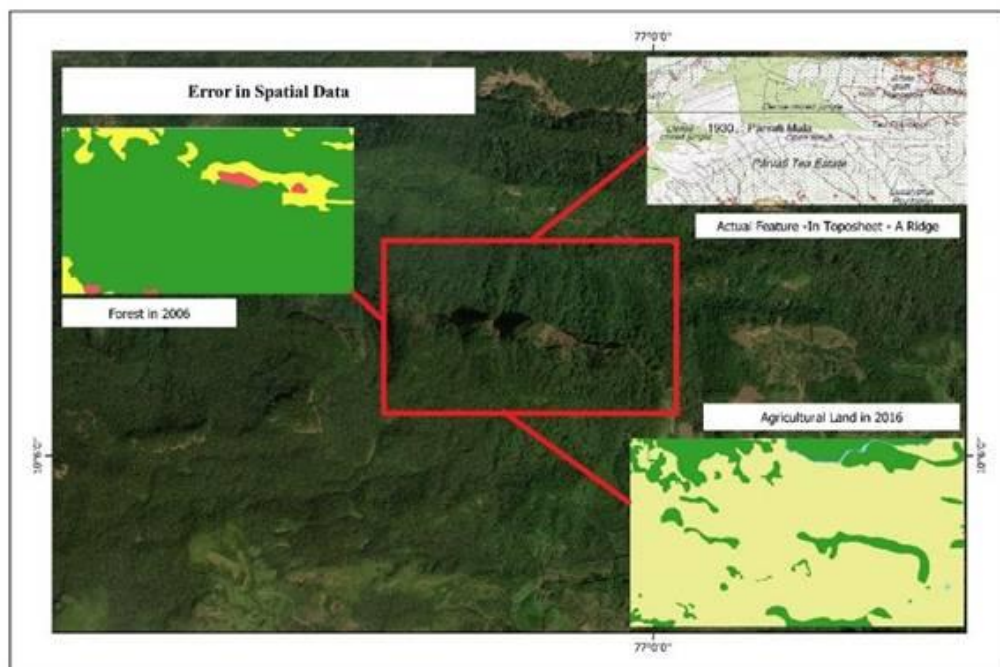
Positional accuracy is the probability of a feature being within units of either its true location on earth (absolute positional accuracy) or its location in relation to other mapped features (relative positional accuracy). The data sets provided for the year 2006 differ in position with reference to the data set of 2016. Vector data sets with such issues in positional accuracy yielded faulty results while executing the "Difference" command. The image below depicts the issue in relation to the positional accuracy of spatial data.

The issue related to the reliability of spatial data is of great importance. Site inspection as well as comparison with satellite data brought to light the errors in spatial data sets. Few such errors had been given below for the reference. The following map (map -1.12) shows how a ridge in satellite image has been misinterpreted as agricultural land as per the data set of 2016.

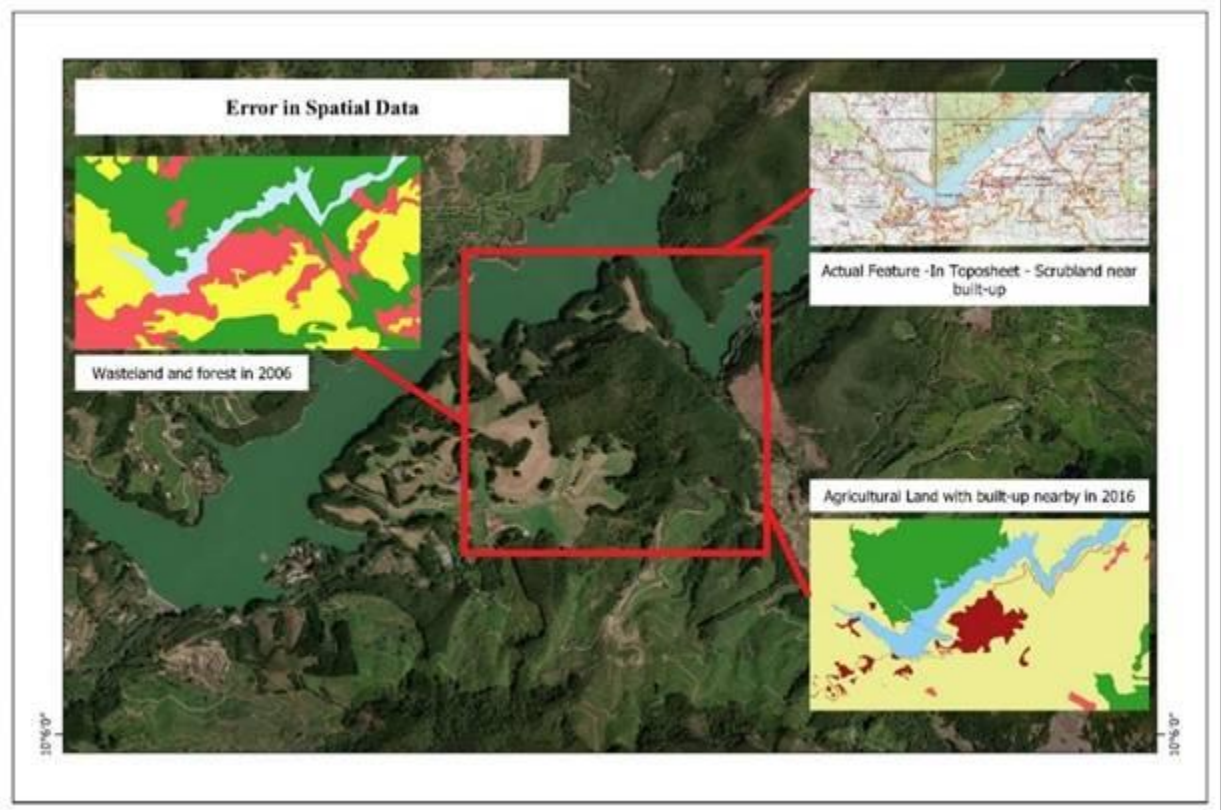
Yet another case is of a scrubland near to the Indo-Swiss Project at Mattupetty (map - 1.13). In fact, the project started at 1963, but in the 2006 spatial data set it has been recorded as wasteland and agriculture land. The same area as per the 2016 spatial data comes under agricultural land.



Map.1.40. Positional inaccuracy in the data sets – the opaque one is the data set pertaining to the year 2006, and the transparent one is the data set of the year 2016.



Map.1.41. Error in spatial data (sample I)



Map.1.42. Error in spatial data (sample II)

Such errors in vector data set cannot be corrected since a change in geometry and topology of the spatial feature affects the adjacent feature and will make the data set useless. Since spatial planning is purely based on data, accuracy of data is especially important. Care must be taken while using spatial data prepared by others for some other purpose in our studies. A better way to ensure spatial data accuracy is to make meta data standards obligatory for data being used in future studies.

4.2.1 Developmental activities, drivers of change and agents of development

1. Tourism

The hill stations, dams, mountains, spices, plantations, elephant rides, wild life sanctuaries etc. adds to the beauty of Idukki and it is the third largest tourist destination of the state. The modern tourism era emerged and developed in 2000. Since then, there is a vast change in the development of tourism sector. The 21st

century has witnessed a tremendous change in tea industry, development in educational sector, increase in the literacy rate, infrastructure facilities and so on. This helps in the economic development in local and state level. Tourism has brought development as well as impacted the biodiversity. The protected area includes Thattekkad Bird's Sanctuary in the West Kurinjimala Sanctuary to the east, Eravikulam National Park Chinnar Wildlife Sanctuary to the north east, Anamudi Shola National Park to the north, Pampadum Shola National Park to the south and Periyar Tiger Reserve in the south.

Table: Number of commercial buildings in 6 Panchayath in Idukki district

Sl. No.	Name of the Panchayath	No of commercial buildings
1	Adimali	481
2	Munnar	238
3	Marayoor	44
4	Kanthalloor	28
5	Devikulam	42
6	Chinnakanal	25

(Source: District industries Centre, Cheruthoni)

Above table shows that the number of commercial building in different Panchayath, most of the commercial buildings are located in Adimali Panchayath and the second top commercial building is located in Munnar are. And day by day the number of buildings is increasing.

The major tourist destinations in the study area are:

- Munnar- Munnar- Mattupetty Dam
- Pothamedu view point
- Rajamala
- Devikulam
- Munnar - Pothamedu
- Blossom international park
- Chithirapuram
- Pallivasal

- Attukkad water falls
- Cheeyappara waterfalls
- Munnar- Rajamala- Marayoor, Chinnar
- Tea museum
- Naimakkadu waterfalls
- Eravikulam national park
- Luckam waterfalls
- Vagavari
- Marayoor
- Muniyara the dwing caves of the ancient tribes
- Chinnar wild life sanctuary
- Munnar –Devikulam Range
- Devikulam lake
- Lock heart gap
- Power house waterfalls
- Anayirankal dam

Road is the only means of transportation to this beautiful place. Day by day there is a tremendous increase in the number of foreign and domestic tourists visiting the place. Tourism has brought ecological and geographical changes to the area.

The accommodation facilities in Munnar area are very large in number. Most of them are resorts, residencies, hotels and service villas. More than 115 licensed residencies and resorts are available in Munnar, Adimali and Devikulam area. More than 30 food production units, lots of bakery and street foods (Thattukada) are available in Adimali and Munnar area.

Table: Tourist visitor's data Munnar

year	Munnar		Athirapally		Chalakkudy	
	Foreign	Domestic	Foreign	Domestic	Foreign	Domestic
2012	29326	307595	3260	365397	786	44838
2013	32733	308816	4984	395975	449	47421
2014	35393	349881	5177	361725	436	35349
2015	39303	364493	3746	153267	NA	NA
2016	27576	407881	2225	168547	22	12670
2017	24003	628427	1978	181941	29	13296
2018	24293	782681	2119	187812	116	14846

Source :(Research, Kerala tourism department)



Tourist arrival in Munnar

The above figure shows that the arrival of foreign tourists in Munnar; there is a rapid increase till 2012 to 2015 and then a less decrease happened in the flow of visitors till 2018 but the domestic tourist visits were increasing day by day. In Athirappilly, the foreign tourist arrival was in an increased rate till 2015 after that a small decrease happened in the foreign visits. But the table shows that the domestic tourist arrival is increasing every year. The unstructured development of tourism has brought out adverse impacts on the natural environment which is the

foundation for the tourism industry in Munnar. Over construction on the rolling grass land ecosystem, lack of waste management techniques, deforestation, maximum utilization of resources, the profit motive, absence of holistic approach of tourism infrastructure development and land use pattern, lack of awareness among the tourism promoters, lack of visitor management technique, exceeding carrying capacity and disappearance of species diversity etc. adversely affect the biodiversity of the area

Impact of Plantation

Idukki is characterized by large area under Plantations. Landuse changes in Western Ghats over the last century caused by agriculture expansion, conversion to plantations and infrastructural projects have resulted in loss of forest and grassland (Kumar1993, Jhaetal2000, Khanetal., 1997). Considerable areas of forest have been converted to plantations in the Western Ghats, particularly of tea, coffee and Eucalyptus and different species of Acacia. The area under plantations is large and growing. Tea plantations in the south Indian states increased by 17.7% in the period 1987-1998 from 74,765ha to 87,993ha (Tea Board 2002). Large areas of Eucalyptus and Acacia plantations also occur with tea as it is used as fuel wood for tea curing in the factories. Extensive eucalyptus plantations have also been established by large tea companies and private farmers. Although tea gardens (14,000ha) occupy one of the major cash crops in the project landscape it retain several interspersed forest fragments (largely shola) in varying size that act as corridor or sheltered habitat for many flora as well as faunal components of the biological diversity.

In 1877, Kerala Varma, the Raja of Poonjar, sold 227 sq. miles of Kannan Devan Hills to John Daniel Munroe, a British planter. This has led to the birth of Kennan Devan Hill Produce Company. Kannan Thevan is an adivasi who showed the hills to Planters and today Kannan Devan Hills is internationally known. In 1878, the Maharaja of Travancore confirmed the sale. J.D Munroe formed the North Travancore Land Planting and Agricultural Society. The members of the society

developed their own estates in various parts of High Ranges. Tea was first planted by A.H. Sharpat Parvathi by clearing 50 acres on a dense forest. Later it was purchased by James Finlay and Company Limited. The Kannan Devan Hills Produce Company Limited and the Anglo-American Direct Tea trading Company Ltd owned 28 estates in these areas. There remaining 7 estates were owned by other British and Indian Companies. The present condition of the Munnar landscape most of the area is covered by tea plantation. The ownership of this plantation is mainly under the control of KDH Company and Tata Company. Some of the small and large plantations are also owned by some other individuals most of the owners are from Tamil background. Annually the tea plantation area of the Idukki districts spread over Peermedu, Udumbanchola and Devikulam Taluks. There are 36 tea estates, owned by 16 companies, in Peermedu Taluk. Out of these, 30 estates run by 12 companies. These estates are spread over Peermedu, Vandiperiyar, Elappara and Upputhara panchayats.

3) Agriculture

Most of the areas showed changed agricultural cultivation methods and most people are cultivating cash crops rather than food products. Most of the paddy cultivations in each Panchayath in Idukki changed to different cash crops. Most of the areas in Idukki district are facing drought in summer season, at the same time in rainy season the people are facing flood land slide etc. due to the climate change, most of the paddy cultivation in Marayoor changed to sugarcane. The colder and higher areas of the landscape lying towards the east (Vattavada and Kanthalloor) have vegetable farming.

Comparing with 20 years back most of the area is under the process of changes. In Marayoor region, paddy was a major crop cultivated since the 18th century. But now the majority of the paddy lands were converted into sugarcane plantations. In Munnar most of the land is owned by KDH Company. They use this and for various purposes, like plantation, constructions, mining etc. every year they converting their own forestland to plantation, during the time of field work the

team identified the conversion of forest land to jasmine plantation and rose plantation etc.

People mainly cultivate cash crops like Rubber, Catbarry Coffee, Tea, Coconut, Nutmeg, Arecanut etc. In Idukki district the main cultivations are spices. It includes pepper, cardamom, nutmeg, catbarry etc. This type of spices cultivations are increasing day by day. Cardamom Hills is predominantly moist evergreen forests and endured small scale extraction of wild cardamom from long time ago. However, following the state monopolization of the cardamom trade in the early 19th century, major cardamom growing areas were notified as Cardamom Hill Reserve (CHR). In 2003, apportion of CHR was also gazette as a National park (Mathikettan). Cardamom cultivation requires both clearance of the understory growth and opening up of the canopy to enhance light penetration but such manipulation of the evergreen plant community results in the disintegration of the evergreen forest in a relatively short time.

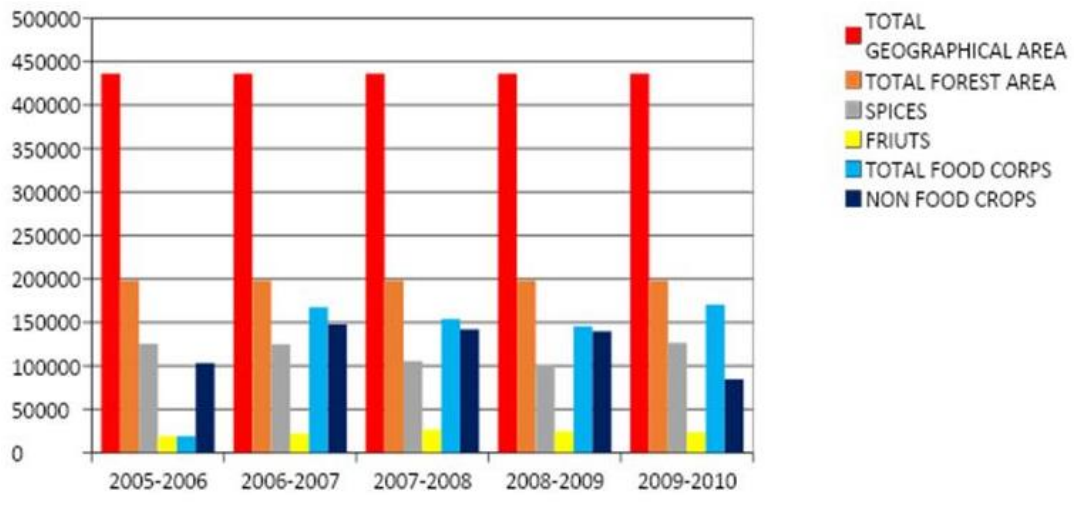


Fig -Agricultural and non-agricultural productions in Idukki

From 2005 to 2010 a major increase occurred in the field of total food crop cultivation, during this time the non-food crop production decreased. During this time the spices cultivation always maintain the same amount every year.

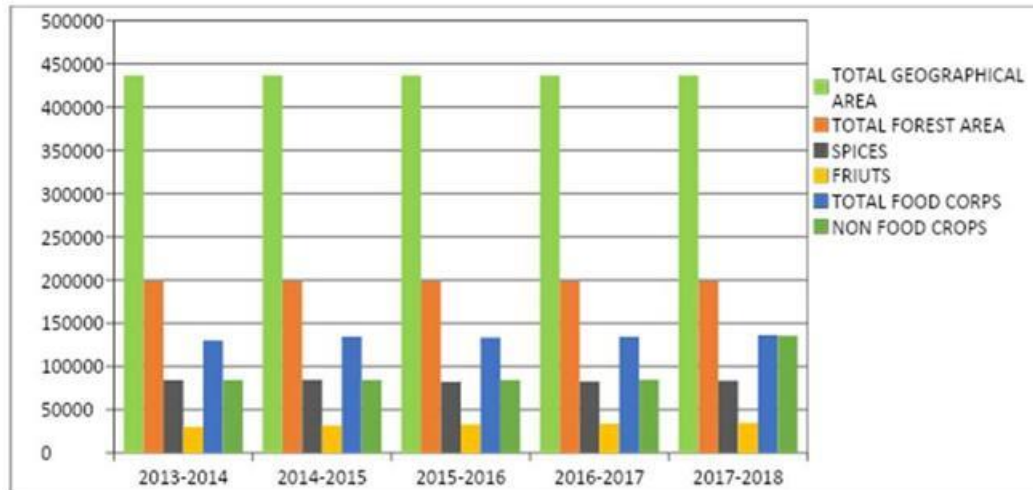


Fig - Cultivation in various sectors in Idukki

Graph No: 3 shows that cultivation in various sectors in Idukki district from 2013 to 2018. Comparing with graph no 2 and 3 shows that from 2013-2018 the production was totally changed. A rapid change occurred in the field of non food crops area. The spices cultivation and fruit production in this time maintained the same. This increase in non food crops will affect the food security of the local community.

d. IMPACTS OF HYDEL PROJECT

Small and giant Hydel projects dams in Idukki district are constructed in large number. The main focus of constructing dams is maintaining the electricity supply for different purposes. Most of the dams can store a huge amount of water and is also used for hydel tourism like boating, fishing and the stored water also provides habitat for flora and fauna. The water is also used by people who live nearside the dams for their daily needs. Dams raise the natural level of rivers, so flooding lands previously settled, farmed or periodically grazed. Dam construction results in the loss of productive land beneath the reservoir.

The hydel dams have all come up in the forested hill areas in Western Ghats and the irrigation dams are located amidst the foothills, both submerging large tracts of forests and fertile valleys. After the construction of large dams in many forested areas in Kerala, the adjacent catchment forests have been declared Wildlife

Sanctuaries. The Periyar Tiger Reserve, Neyyar, Peeppara, Chenduruny, Parambikulam, Peechi- Vazhani, Chimoni and Idukki Wildlife Sanctuaries are all protected areas in the catchments of river valley projects.

Most of the tribes meet their livelihood from the forest areas. Due to the real location and construction of dams they lost the freedom of fishing, hunting, and gathering in the previous settlement.

5.Quarries:- During the survey in 9 Panchayats it was observed reported that Panchayats in the study area is not giving license to quarries, but crushers are still working in most of the Panchayatse specially in Adimali, Kanthalloor, etc. The owners of these quarries collect stone from other district and use this stone for crushing.

4.2.2 Developmental activities and its socio-economic, cultural and livelihood impacts on different groups of local (tribal) communities.

The UNDP-HRML Project team of Kerala State Biodiversity Board conducted Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) exercises in Mankulam Grama Panchayat during Jan-Feb 2020 and other Grama Panchayats during the study period respectively. Native people from 6th Mile and tribal people from two settlements - VeliyamparaKudi, ThalumkandamKudi participated in the exercise regarding the documentation of traditional knowledge, agrobiodiversity, climate change anomalies. These two settlements of Mankulam Grama Panchayat selected for the pilot study are exclusive with tribal populations and 30 tribal people had actively participated.

The objectives of RRA are to learn about the lifestyle, agriculture, climate change, health, and education of the people in the area and also to raise awareness among the people and various authorities about the UNDP-HRML project. The team also tried to identify the major challenges faced by people, the problems in the agricultural sector, climate, as well as epidemics that had affected the people. As part of this project team conducted a transect walk in 1, 5, 7, 10, 11, wards, visited

various Government institutions, and conducted key interviews with the officers of Mankulam Grama Panchayat.

Public institutions like the Primary healthcare center, Anganwadi, Agriculture department, Panchayat office, and veterinary hospital are the first connected government institutions for people in any area. Secondary information is collected for the Rapid rural appraisal (RRA), discussion with Technical Support Groups (TSG), Biodiversity Management Committees (BMC), Tribes, Medical practitioners, and farmers.

Officers here are aware of the life of the people in their respective focus areas. Frequent surveys are also done by the departments for formulating and implementing policies that directly affect the lives of these people. Effective implementation of a government policy depends on these institutions and how effective each measure has been can be sought from these offices.

Table No.4.2: Tools applied for Socio- economic- climatic study

Tools	RRA	PRA	Division				
			Govt	Non Govt	BMC	Native s	Tribes
Social Resource Mapping		✓				✓	✓
Historical timeline		✓				✓	✓
Seasonal Calendar		✓				✓	✓
Interview	✓	✓	✓	✓	✓	✓	✓
Direct observation	✓					✓	✓
Indigenous knowledge	✓	✓				✓	✓
Transect Walk	✓					✓	✓
Group Discussions	✓	✓				✓	✓
Institutional Visits	✓		✓	✓	✓		

Mankulam Panchayat is on the path of development, as lots of tourist spots are located, including forest, waterfalls, elephant watching, trekking places, and spice farms. Mankulam Grama Panchayat is located in Devikulam Tehsil of Idukki in district in Kerala joining the heaps of Western Ghats. According to the census of 2011 the total population of the Panchayat is 9,595 people living in a total area of 10446 hectares. There are about 2,513 houses in Mankulam village. The census reports the scheduled tribal population in Mankulam is 2,099 and the scheduled caste is 490 people.

Within a short period of 10 years, this area will become the main tourist hub. The increased tourism has led to the development of several cottages and homestays. From our field visits, ninety percent of the people in Mankulam Grama Panchayat rely on agriculture for their livelihood. The Panchayat receives good rain in the monsoon season. The major crops that are cultivated are rubber, cocoa, pepper, nutmeg, banana, and tapioca. Recently cardamom cultivation became very popular in the Idukki district as a whole owing to the higher market prices.

The native people of this panchayat came from different places of adjacent districts in the 1950s and settled here for agriculture. The Panchayat has good natural sources of water in streams and rivers. Initially, food crops were cultivated by the people but have gradually shifted to all the above-mentioned cash crops. This place is also a biodiversity rich area.

Preliminary Works and Procedure- Team Building

The UNDP HRML Project team of KSBB sought help from the Biodiversity Management Committee(BMC) members for the organization of PRA. The team included consultants from MSSRF for the UNDP Project. To understand the outlook of the Panchayat and also to give an introduction to our project, the team conducted a meeting with BMC members highlighting the objective of the PRA and targeted communities. Notices were distributed and pasted at the public notice board at Panchayat and advised the members to make maximum publicity.



Fig. PRA introductory section with natives

Resource Mapping: Streams, thick forest, agriculture lands, government offices, roads, bridges, Forest fire-prone areas, flood-affected areas, public wells, ponds, market, religious institutions, and human-wildlife conflict areas are mapped with the help of PRA participants. Resource mapping can help communities identify valuable resources, ensure that everyone has access to the resources they need, avoid duplication of services and resources, enhance services, identify flexible funding strategies, use data to make informed decisions, cultivate new partnerships and relationships.



Fig.PRA process- resource mapping by tribes

The activity of mapping was organized at an open space for keeping a direction sense and also to make use of good spacing and lighting. The activity started at around 9:30 am where two elderly and two young participants were asked to join the mapping team voluntarily. Four of them enthusiastically joined a facilitator assigned for the mapping duty.

There was little confusion at the beginning among the participants but the facilitator started the mapping with a broad outline of the particular ward. Then it was a good continuous process where every participant contributes. The participants themselves corrected if there was a mistake made by one of the members. A list of legends was provided and advised to them to avoid confusion. The facilitator also involved in locating certain points after the consultation with participants

Mapping Process: Mapping started with drawing of ward outlines. The Road network was marked first with one of the participants starting from a corner of their ward. Once the road network is completed drainage network is then mapped to complete the linear features. Then bridges, major institutions, forest areas, major agriculture lands, disaster-prone areas, human-wildlife conflict areas were marked, Different color chalks were used for every landmark.



Fig. Resource Map-Veliyamparakudi

Benefits

Maps made by the villagers are more detailed than the already available online maps in Google or Open Street Map. This has also made people understand the area-specific areas that need conservation.

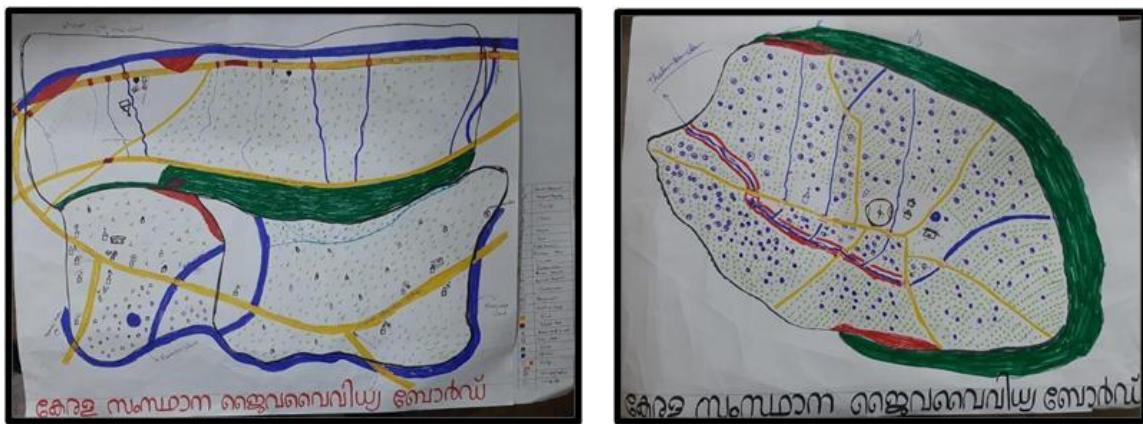


Fig. Resource Map- 6th Ward, MankulamGramapanchayath&Thalumkandamkudi

It was successful as a tool for understanding the spatial distribution of resources. Panchayat Resource Mapping highlights the Land/Resource Type, Current Status, Problems, Potential, and Activities. The mapping of the drainage system of the panchayat and agricultural lands gives information about potential water scarcity during summers. Agriculture and forest are mapped, which will help in further planning of HWC free models. Forest fire-prone areas are identified by villagers

itself and this will help in spreading awareness among the villagers. This map will also help to identify local land use information and finding patterns that are available on other internet-based maps. From the map, it is evident that almost every corner of the administrative unit is connected with roads. The panchayat has a large number of bridges that help connect the once remote areas.

4.2.2.1 Socio- ecological- climatic changes – Community perspective

a. Historical Timeline

Three decades are classified from 1990-2019 to understand the change in the factors in a holistic view. Change in agriculture patterns, change in climatic conditions, and natural calamities are analyzed with the help of decadal change. It helps to understand the accounts of native people from the past that have changed in their lifetime. Change in climate, cropping pattern, disaster frequency is recorded in this type. Although secondary data may be available for these sectors, this type of data collection can help in understanding local perspectives and design developmental frameworks. This information has been gathered by group discussion facilitated by a PRA team member that included open interviews and arguments. This has provided information on local events, how the communities have perceived it, and the changes that occurred in this livelihood that eventually made them overcome these issues. Thus the PRA team is more informed about the area, community, their problems, and progress.

b. Climate - Seasonal changes

Mankulam Grama Panchayat has a relatively favorable climate, both coldnesses during winter and hotness during summer are pleasant. The major crops are rubber, pepper, cocoa, and nutmeg which are generally grown in low water available areas. In recent monsoons, there has been relatively higher rainfall, so landslides and riverbanks destruction are common recently and rains start in June and last till September, so there is very little water shortage. Therefore, in recent times, more people have started cultivating cardamom in Mankulam Panchayat.

Like the natives, the tribal people have also started cardamom cultivation in their settlements.

1. Annual and Monthly Precipitation: Mankulam panchayat receives good rainfall in general. The months of June, July, and August receive very high rainfall for both tribes and natives. Medium amounts of rainfall are received in April and May. Occasional rainfall is received throughout the year which is very helpful for agriculture.
2. Drought Year: February, March, and April are the hottest months of the year in the Panchayat. The climate has changed a lot in recent times. Summers have become hotter and this has led to water scarcity in the hottest months of the year.
3. Landslide: The frequency of occurrence of landslides has increased in the last two years (2018, 2019) in July and August. Mankulam is a region that receives a lot of rainfall during this time. Tribal settlements also suffer from the consequences of landslides during these months.
4. Lightning: Lightning occurs during October and November and also during the emergence of monsoon season as reported by tribes and native people respectively. Lightning has not caused casualties in the panchayat at any time recently.
5. Flood: Rivers and streams overflow due to the heavy rain in the monsoon. The low land areas of the panchayat near the sides of the streams face flood and loss of their crops. This has happened in the last two years. Floods hit hard in the native land during July and August of 2018. Floods have not affected tribes due to their settlements in areas of higher ground levels.
6. Human-Wildlife Conflicts (HWC): Major contributors of HWC in Mankulam Grama Panchayat are elephant, wild boar, Malabar giant squirrel, monkey, sambar deer, and Porcupine, etc. Animal interference mostly happens in months January, February, and March in tribal land, where they destroy Pepper, cardamom, and Coffee. Food and water deficiency in the forest have driven these animals to cultivate lands.

7. Forest Fire: Forest fire is very common in the past in Mankulam Panchayat and has been reduced to a minimum due to the efficient intervention of the Forest Department and the making of fire lines before the summer season. The tribal people report forest fires in February and March when the climate is hot.
8. Water scarcity: Water scarcity is suffered by tribal people in February, March, and April months. Water availability is very low in the summer season in some parts of the panchayat. Native people face high water scarcity in March when natural water availability is at a bare minimum.

Table. Seasonal calendar of climate anomalies - Perspectives of people at tribal colonies ThalumkandamKudy and VeliyamparaKudy in MankulamGramapanchayath.

CLIMATE ANOMALIES													
Sl.No	Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Landslide								YL				
2	Lightning										Y	Y	
3	Rain				M	M	H	H	H				
4	Flood						Y	Y	YL				
5	Drought		Y	Y	Y								
6	HWC	Jan, Feb, Mar(on Pepper, Coffee, Cardamom)											
7	Forest Fire		Y	Y									
8	Water Scarcity		Y	Y	Y								
9	Mixture of snow and rain	H					Y	Y					H

HWC- Human Wildlife Conflict VH= Very High,; H= High, M= Medium, Y=Yes, YL=Yes in last 2 years

Table. Seasonal calendar of climate anomalies- Perspectives of people at 6th ward in Mankulam Grama Panchayath.

CLIMATIC ANOMALIES													
Sl. No	Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Landslide							H (VH for 2018, 2019)	H(VH for 2018, 2019)				
2	Lightning							H (for the last 2 years)					
3	Rain						H (VH on 2018, 2019)	H (VH on 2018, 2019)	H (for last 2 years)				
4	Flood							H	VH(for the last 2 years)				
5	Drought		H	H									
6	Human-Wildlife Conflict	H (Monkey, Porcupine, Kezha, Mlaavu, Wild Boar, Deer, Malabar Giant Squirrel, Squirrel)											
7	Forest Fire	VL, The forest fire was there in 2018 March.											
8	Water Scarcity			H									

VH= Very High, H= High, M= Medium, VL=Very Low

c. Climatic changes over the decades - Community perspective

The change in climatic condition over the decades are easily identifiable in the decadal calendar. People were able to tell events happened during a timeline rather than mentioning it in a particular year. The events, changes and its qualitative data given by both tribes and natives are similar but some differences account for their perceptions.

1. **Landslide:** Frequency of landslide in a span of decade has been increasing since the 1980s to 2019. Both natives and tribes testified very low frequency in the years between 1980 and 1990. It was gradually increasing but a boom in the number of landslides had happened in 2018 and 2019. During these years where there was heavy monsoon rain during July and August months, landslides were very frequent that caused significant number of casualties.
2. **Flood:** There was a flood in the year 1994 as briefed by Tribals. In general floods were not frequent until the third decade after 2010. Floods have devastated them in 2018 and 2019 particularly native people. Tribal people however are not greatly affected as they stay in higher altitude areas. But overflowing rivers that made gullies in the banks have affected the livelihood of all people. There was a decrease in stream resources after the floods. Large rocks rolled from upstream in forests to downstream of the rivers where people settled.
3. **Drought:** Instances of drought have been increasing lately. This is mainly attributed to inconsistent late arrival of monsoon.
4. **Rain:** Amount of rainfall has clearly varied over the years. Tribes have said that the amount of rainfall they had received decreased over the years towards the present. Native people though didn't apprise a decrease in rain, they have noticed a change in the rainfall pattern. There were phenomena like 'Noolmazha' in the 1990s which had consistent drizzling that pour down for 10-12 hours. The rain pattern lately has turned to very spills over a short period of time.
5. **Temperature:** Temperatures in summers have reported to be increasing over the years. Tribals say a gradual increase in temperature where there was higher temperature in the 2000s than in 1990s and temperature had increased further as the years progressed. Natives said to have experienced normal hotness till 2010 and there was also a boom in temperature since 2015. This is in correlation with increased instances of drought in the village.

Table. Historic calendar of climate anomalies as perceived by tribal people in ThalumkandamKudy and VeliyamparaKudy in Mankulam Grama Panchayath.

CHANGES IN CLIMATIC ANOMALIES OVER THE DECADES (Tribes)				
Sl No	Category Historical	Before 1990	1990-2010	2010-2020
1	Landslide			Increasing(from 2018)
2	Lightning	L	L	H
3	Flood		in 1994	
4	Drought			Increasing
5	HWC	M	M	M
6	Forest Fire	In February, March	In February, March	In February, March
7	Temperature	M	H	VH
8	Cold	H	H	H(very less in 2019)
9	Rain	M	M(less from 2007)	L (not able to harvest those which were harvested in Chingam)
10	Snow	In June, July	In June, July	In June, July
11	Wind	Wind and Rain during karkidakam	Wind and Rain during karkidakam	Wind and Rain during karkidakam

Table. Historic calendar of climate anomalies as perceived by people of 6th Ward in Mankulam Grama Panchayath.

CHANGES IN CLIMATIC ANOMALIES OVER THE DECADES (Natives)				
Sl No	Category Historical	Before 1990	1990-2010	2010-2020
1	Landslide	VL	L	H(VH in 2018,2019)
2	Lightning	L	L	H
3	Flood	VL	L	M(VH in 2018,2019)
4	Drought	VL	L	H
5	HWC	VL	L	VH
6	Forest Fire	VL	VL	L(1 in 2018)
7	Temperature	M	M	H since 2015.
8	Cold	H	M	VL
9	Rain	H, spread across the season	H	H, more spill in short

				duration
10	Snow	H	H	L
11	Wind	M. there was a 7-day continuous wind, pepper was destroyed, areca palm started to get manjiliprogam leading to the replacement of areca palm cultivation in Mankulam	L	L
12	Thunder	VL	M	M

6. **Snow and Coldness:** Degree of coldness has gradually decreased from the past as informed by the natives. For tribes the coldness felt unchanged till 2019, when there was a very significant reduction
7. **Lightning and Thunder:** Another climatic anomaly that has increased over the years is lighting and thunder. Native have experienced it but tribes haven't felt an increase in these factors.
8. **Human Wildlife Conflict (HWC):** Instances of HWC increased from the past. But the frequency was low until 2010s compared to present time, where there is a very high frequency of instances of HWC. The animals include elephants, boars, sambar deer. The incidents of crop raiding is informed by natives more than Tribals.
9. **Wind:** Wind wilderness has been decreasing from the past. High winds are experienced along with rains during *Karkidakam*. Natives reported a seven-day continuous heavy wind in the 1980s that resulted in various crop damages for pepper and areca palm. A major widespread disease in the palm - 'manjilip' was seen after this storm and consequently, this disease had replaced most of the areca in Mankulam.
10. **Forest Fire:** Forest fire occurs in February and March. Instances are rare in Mankulam, one had occurred in 2018.

4.2.2.2 Major causes for Agrobiodiversity change and its socio-economic, cultural and livelihood impacts on different groups of local (tribal) communities.

In Idukki district the main cultivations are spices. It includes pepper, cardamom, nutmeg, catbarry etc. This type of spices cultivations are increasing day by day. This type of non-food producing in Idukki district is one of the major cultivation of people.

I. Plantation crops

Cocoa, rubber coffee, coconut, and Arecanut are the major plantation crops grown in Mankulam. Agriculture is also the main source of livelihood for 90% of people in this Panchayat. Tribal people used to live by collecting forest resources. But their lifestyle has now changed and is similar to native people.

- Rubber cultivation in Mankulam Panchayat is continuing from the 1990s to 2020. However, native farmers have decreased in its cultivation due to negative climatic conditions. But the Tribals who started its cultivation from 1990s still depend on rubber for their livelihood.
- Coconut was widely cultivated in the area by the natives in the 1980s. But it has reduced very significantly due to various diseases like 'Mandari' in both areas inhabited by native and tribal people. The native people used to cultivate coffee even before the 1980s, but now they have withdrawn from it due to poor yields and price loss. Tribal people came to coffee later in the 1990s, but they still cultivated coffee very enthusiastically. It depends on climate and coffee flowers may dry off if rain is not on time.
- Arecanut was cultivated among both Tribals and natives from the 1980s but it has significantly reduced from the 1990s due to 'Mahali' disease which is a kind of fruit wilting.

II. Spices and continent

- Pepper is one of the popular crops cultivated in Mankulam from the past. There has been no decline in its production beyond the fact that diseases are now more prevalent than ever before. Tribals and native people cultivate this

crop actively. The main varieties are vella mundi, neela mundi, jeeraka mundi, panniyoor one. Quick wilt and stem borer are major diseases affected in pepper. Jackfruit, erythrina, and anjili are used as pepper stands.

- Cardamom was cultivated by natives before the 1080s. Tribals have started its cultivation from the 1990s after noting its profit from natives. Natives cultivate cardamom as an intercrop, so the production of cardamom among the natives has reduced compared to the 2000s for 30 years. But tribes are still cultivating cardamom.
- Nutmeg farming had started among natives from 1995. But tribals had been collecting wild nutmeg from the forest since long back. They had started cultivating it recently in the 2000s. It was cultivated in small quantities by the natives and tribes, but now many farmers are cultivating this
- Cloves were cultivated in good amounts even before 1980. Clove has high expenses for cultivating and soil erosion has led to its lower yields recently.
- Ginger too is cultivated from early decades very actively among natives and tribals. Boar attacks in tribal areas have reduced yields from the 2000s. Drip and sprinkler irrigation is used for ginger by natives. Even natives presently face lower yields and reduced prices.
- Turmeric was cultivated in good amounts and was profitable from earlier decades. It needed shady areas for growth. Its cultivation has reduced among natives but is still prevalent among tribals. Tribals process turmeric to powder for a better market recently.
- The aromatic ginger cultivation among natives and tribals in earlier decades. But it has now almost disappeared for cultivation.

III. Tubers

Tuber varieties like tapioca, colocasia, yam, Dioscorea, Chinese potato, sweet potato etc. are always cultivated by the natives but not for the market. All tuber

cultivation experiences document wild boar and porcupine attack from the early times. The yield has generally decreased due to HWC.

IV. Vegetable

Organic agriculture practice was prevalent among natives from early decades for vegetable cultivation. Mankulam Panchayat has a good number of organic farmers in vegetable cultivation even now. Very few people cultivate vegetables for the market but their livelihood. Popular vegetables that are cultivated by natives are Cauliflower, Cabbage, Beans, Pea, Tomato, Green Chilli, Koval, Bitter Gourd, Snake Gourd, Ash Gourd, Pumpkin. Their yield has also increased recently. Lower rainfall and higher temperatures with timely irrigation have favored the good yield in recent years. Tribals started cultivating vegetables from the 2010s. They cultivate Beans, Cucurbita, Tobacco, and soap mixture are used for pest control.

e) Fruits

Mankulam Panchayat produces high amounts of fruits owing to its good climate. From the 1980s natives mostly cultivated fruits like njaival, rambutan, jackfruit, mango ('naadan, moovandan'), lemon, giant granadilla, papaya, pot tamarind, guava, etc. Passion fruit and mangostein are introduced from the 1990s. The production of "Kari naranga" among the natives has increased recently but tamarind cultivation has reduced. Among the tribal people, the main cultivated fruits are Jackfruit (varikka), Mango, Guava, Babloos Naranga, Curry Naragam etc., all in their homestead recently they are also started cultivating imported varieties like rambutan, passion fruit.

f) Millets

Millets were the primary food crop of tribals in the earlier decades. Millet varieties of Ragi and Maize were cultivated by natives. Tribals cultivated millets vary widely in their lands. Between 2000 and 2010, there was a decline in millet cultivation. The tribes stopped cultivating millets and converted to cash crops like pepper and cardamom. The natives too stopped millet cultivation much earlier.

Table. Historic calendar of changes in Agrobiodiversity as perceived by local people of 6th Ward in Mankulam Grama Panchayath.

CHANGES IN AGRO BIODIVERSITY OVER THE DECADES				
Sl. No	Category Historical	1990-2000	2000-2010	2010-2020
1	Paddy	Good (Karanelu In Veliyampara, (Majaperuvazha, Vellaperuvazha, Poothakali)	Reduced	Not There
2	Coconut	Good	Reduced(Mandari)	Reduced
3	Arecanut	Good(Mahali Started)	Reduced	Reduced
4	Pepper	Good (No Irrigation, Organic) (Types-Neelamundi, Vattamundi, Jeeraka, Karimunda, Perumkodi) (Bordeaux Used For Cheeal)	Grown In Jackfruit Tree, Murikku, Anjili	305/Kg 2016-730/Kg
5	Cardamom	Good(Rs.600/Kg) Maximum In 1998	Reduced	Mixed Cropping Started(Pepper - >Cocoa->Pepper->Cardamom
6	Cocoa	3 Kg Seed / Harvest 45-70 Kg / Plant / Year Harvest From 6 Th Year Upto 20 Yr.	Increased	Most Cultivated
7	Nutmegs	Started in 1995.Good (Cowdung, Bonepowder, Caco3) (Soil Was Acidic)(Traditional Varieties Used)	Widely Cultivated, Good (Budded Nutmeg Become Popular)(1000kg From 70 Kandam)	(Rs.250/Kg, Less Price) (Fungus Attack In June-July) (Bud From Adimali)
8	Coffee (Robusta)	Good, Profitable(Cow Dung Used)	Reduced(Boar Problem)	Priceless(110/Kg), Rs 250/ Kg For Powder, 3kg Dried To 1kg
9	Rubber	Good, Aanakkulam Area	Reduced	Reduced(Negative Climate, Less Yield, Snowfall Affects Negatively)
10	Clove	Good	Reduced (Get's Dried, Used Bordeaux)(600-700/Kg)	High Expenses
11	Ginger	Good(Drip And Sprinkler Irrigation)	Reduced	Low Price And Low yield.

12	Turmeric	Good(Ash Used)(Need Shady Areas)	Good	Reduced
13	Aromatic Ginger	Good	Reduced	Not There Now
14	Arrowroot	70/Kg(Mixed Crop With Pepper And Turmeric)	120/Kg Powder 800/Kg	Subsidy Given By Krishi Bhavan
15	Vegetables: Cauliflower, Beans, Cabbage, Tomato, Pea, Green Chilli, Koval, Bitter Gourd, Snake Gourd, Ash Gourd, Pumpkin	Tomato Had Fungus. Pukayila Kashayam for Green Chilli, Garlic Used for Ivy Gourd. Kumbalanga and Mathanga- Good Yield But No Market.	Veppanna Used In Green Chilli	Yield Increased For Green chilli, Tomato, Koval. Good Conditions and High Yield for Kumbalangi and Mathanga The Low Rain And Increase In Temperature Favours.
16	Milletts	Kurumbuulu, Cholam Was There	Reduced	Not There Now
17	Banana	Nendrann Was Used	Pukayila, Bar soap, Uluvapodi Used As Pesticides	Boar Problem
18	Orange	Very Rare	Cultivated In Homes	Cultivated. With Kads Support. Send To Ekm Market.
19	Fruits	Njaval, Rambutan, Jackfruit, Mango(Naadan, Moovandan), Lemon, Giant Granadilla(Akashavellri), Papaya, Pot Tamarind, Guava	Rambutan, Passion Fruit, Mangosteen, Mango, Giant Granadilla(Akashavellri) Papaya, Guava	No Tamarind, Karinarakam Increased Giant Granadilla(Akashavellri) Papaya, Guava
20	Tubers: Tapioca, Colocasia, Yam, Dioscorea, Chinese Potato, Sweet Potato	Good	Good	Good Issue Of Crop Raiding
21	Medicinal Plants	Asparagus, Ipomoea,	Asparagus, Ipomoea,	Asparagus, Ipomoea,

Table. Historic calendar of changes as perceived by tribal people in ThalunkandamKudy and Veliyamparakudy in Mankulam Grama Panchayath.

CHANGES IN AGRO BIODIVERSITY OVER THE DECADES				
Sl. No	Category Historical	1990-2000	2000-2010	2010-2020
1	Paddy	Yes - Karanelu	No, (changed to pepper and cardamom)	No
2	Coconut	Yes	Yes, (mandari disease)	Yes, (mandari disease)
3	Arecanut	Yes	Yes, (mahaali-fruit wilting)	Yes
4	Pepper	Yes, (erythrina sp. As pepper stand)	Yes, Reduced by 1/10 Diseases - quickwilt, stem borer	Yes, Mainly karivunda, nelamundi and jeerakamunda. Temperature increased - dry soil. No fertilisers used
5	Cardamom	No	Yes	Yes
6	Cocoa	Yes	No	Yes, High yield- Rs.30 to rs.40
7	Nutmeg	Yes	Yes	Yes, Watering is less now and has led to less yield. Bone powder used.
8	Coffee	No	Yes	Yes, Most are not flowering. Will dry off if it is not rained
9	Rubber	No	Yes	Yes, Bark has got thinner Resin production good during cold climate
10	Clove	Y	Y	Yes, flower harvest during December and march. Soil erosion is the main problem
11	Ginger	Y	Y, reduced	Yes, boar attack is increasing
12	Turneric	Yes, profitable	Yes	Yes, Powdered for market
14	Arrowroot	No	No	Yes, Maturation time = 1-2 yrs. Yield = 10-50kg.Rs. 80/kg

15	Vegetables	No	No	Yes, Tomato, pea, cucumber, beans, cucurbita Tobacco and soap mixture against pests.
17	Banana	Njalipoovan, robusta, poojakadali, chorapoovan	Njalipoovan, robusta, poojakadali, chorapoovan	Njalipoovan, robusta, poojakadali, chorapoovan
19	Fruits	Jackfruit (varikka), mango, guava, babloos naranga, curry naragam(all in homestead)	Jackfruit (varikka), mango, guava, babloos naranga, curry naragam(all in homestead)	Jackfruit(varikka), mango, guava, babloos naranga, curry naragam (all in homestead)
20	Tapioca	Yes	Yes	Yes Boar and porcupine attack in all decades
21	Taro	Yes	Yes, reduced	Yes, reduced. Boar attack
22	Millets	Yes	Yes, Boar attack	No, no field
23	Akasha vellari	Yes	Yes	Yes, increased

g) Seasonal Calendar of changes in Agrobiodiversity as perceived by local people and tribes.

In the seasonal calendar, we considered agriculture, natural hazards, water availability, and other factors of climate. This activity was done using group discussion, open interviews, and FGDs. This can also help us understand seasonal patterns and help us understand how the resource availability of the locality over a year shapes the key activities like agriculture and animal husbandry. Understanding the seasonality helps in the aspects of assists in monitoring the change of calendar and baseline. It also helps to assist in making advice to make estimated projections for the future.

Table. Seasonal Calendar of agricultural crops among people of 6th ward in Mankulam Grama Panchayath.

Sl. No	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Vegetables	H	H									P	H
2	Cardamom					M	P	P	W	H&M		M	H
3	Cocoa	P		F		H	H	P		H		H	
4	Clove	Fl											
5	Nutmeg	I		M	I	I F	H	P H	W H	W H	W	w	
6	Ginger	W	H	H				P	P			M	W
7	Tapioca	W	H		P	P	H	W		P	P		
8	Koova		H	H	P	P			W				
9	Pepper			H	P	P				P		H	
10	Narakam				H	P						H	
11	Banana		I,M		H				P	P	M		
12	Orange	F		H	H	H							

P= Planting, W= Weeding, M=Manure Application, I=Irrigation, FL-Flowering F= Fruiting H=Harvesting, S=Sale

h) Seasonal crops and their characteristics

Scrutinizing these two tables, tribes follow a similar farming calendar as the natives. Tribes use very little or no fertilizers for their crops. But the natives employ both organic and chemical fertilizers. Cocoa and pepper are the most widely grown crops in both regions. Similarly, the natives have now started

cultivating more and more nutmeg. The most profitable and widely cultivated crops in the Panchayat are pepper, cardamom, nutmeg, cocoa, and ginger.

Table. Seasonal Calendar of agricultural crops at Veliyamapa Kudy and ThalumkandamKudy in Mankulam Grama Panchayath.

Sl. No	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Vegetables	M	H									P	
2	Cardamom						P. H	P.H					
3	Cocoa		H	F	F	P R	P	P	H	H		H	F
4	Coffee		F	P R			P	P					H
5	Nutmeg						F	F					
6	Ginger	H			P	P							
7	Tapioca				P.H	P.H		W		H	P		W
8	Koova		H	H	P	P			W				
9	Pepper		H	H		P R	P	P					H
10	Narakam						P	P	H	H			H

P= Planting, W= Weeding, M=Manure Application, I=Irrigation, FL-Flowering F= fruiting H=Harvesting, S=Sale, PR- pruning

i) Animal Husbandry practices

Direct observation combined with informal questioning yielded a substantial amount of general and specific information and should not be overlooked when conducting a PRA. They can give an indication of a number of important aspects of the local farming system including:

- The health and nutritional status of the livestock.
- Livestock housing system.
- Grazing/feeding strategy.
- Milking regime, etc.

Knowledge of local calendars and classification systems often provides important information about local farming systems. Disease incidence and nutritional management practices are strongly linked to this calendar. This knowledge was important in the subsequent planning of an appropriate primary animal health care programme.

Table. Animal Husbandry practices among people of 6th ward in Mankulam Grama Panchayath.

Sl. No	Animal	Diseases	Yield	Price of Yield	Food	Varieties	Current Status
1	Cow	Akidu Veekkam, Kulanburogam in Summer	8L/ one time Indigenous 2-3L/time	Rs.37/L	Kalitheeta(4-5kg), Paddy straw, Cocoa leaf, and Shell	Jersey, HF, Swiss, Indigenous	Less
2	Goat	Akidu Veekkam, Stomach problems, Kulamburogam. (Viramarunnu/6months)	1-1.5L/time	Rs50/ glass	Plaavila, Okka,	Jannapyari, Malabari, Indigenous	
3	Rabbit	Fever, Punnu			Grass, Kali Theeta, Pea, Jackfruit		Profitable
4	Pig	Kulammbu Rogam		Rs.250/kg	Hotel food, Jackfruit		
5	Hen	Vasantha Rogam	200eggs/yr. 4days/month with no eggs		Kozhi Theeta (60g/day)	Indigenous, Girirajan breed	Good
Table. Animal Husbandry practices among people of Veliyampara Kudy and Thalunkandam Kudy Mankulam Grama Panchayath.							
Sl. No	Animal	Diseases	Yield	Price of Yield	Food	Varieties	Current Status
1	Cow		10L-12L	Rs.42/L	Grass, Oil cake	HF	
2	Goat		1L		Jackfruit Leaf, grass, Indian coral		
3	Hen	Vasantham, cough(turmeric given)	250 eggs/ year			Girirajan,	

Almost all homes in the Panchayat have cattle or poultry from which people benefit from their livelihood. The marketing of animal husbandry products is done by few families. Among people, natives are more involved in animal husbandry than tribals. But tribals keep dogs in their settlement to sense the presence of leopards in case of an animal attack. Dairy farming was very widely done among the people but has now reduced because of disease proximity of cows. Poultry farming is very popular presently in the panchayat. Tribes generally raise only chickens, cows, and goats, unlike natives who are raising rabbits too.

j) Major Problems identified for loss of Agrodiversity -

1. Wild animal attack in the farmland.
2. Crop diseases and pest attack.
3. Low income from agriculture.
4. Lack of proper awareness about soil and water conservation.
5. Soil erosion Unfavorable and unexpected climate changes.

The transect walk has brought into picture the shift in agriculture pattern, the developmental changes, distribution of agriculture and wetlands, and the status of crop health. The shift of rice cultivation to cash crops like pepper, cardamom, cocoa was witnessed. The homesteads in the Panchayat are rich in diversity of crops and the majority is doing subsistence-level farming and excess produce to markets.

The experience from the PRA conducted in Mankulam Grama Panchayat helped to understand the changes that have taken place in the region in climate, climatic anomalies, agriculture and animal husbandry over the last 30 years. The main objective was to document these changes and understand the change in livelihood of people as a result of these.

The PRA has provided data on all the concerned sectors relating to the population which can be used as an integrated information and database for resource planning at local level. Interventions suggested by local people should be considered while framing the recommendations as they are the source of rich local knowledge.

4.2.2.3 Socio- ecological- Climate changes- Institutional level interventions

Kerala Agricultural Development Society (KADS)

Traditional rice cultivation in Mankulam needs special attention and promotion as the lack of availability of traditional varieties and the cost of cultivation force the farmers to give up. KADS collects the organic products and gives a little more amount for the products compared with other markets in Mankulam. KADS is a very supportive organization for poor farmers as they conduct seminars for organic farmers, provide fertilizers at a subsidized rate which the agricultural department fails to do.

The seed and planting materials are collected from the agriculture department and other government farms and the traditional varieties are lost. No support from the government or any other departments are given for traditional varieties as traditional varieties have some limitations in size and shape of the product compared to the high yielding varieties. The locally available varieties are more preferred as they need less maintenance. Regular soil testing is done by most of the farmers to ensure the fertility and productivity of soil.

The climate of Mankulam favours the growth of weeds in the farmland and need periodic weeding. Most of the laborers are working in estate areas due to availability of a variety of jobs and are not willing to work for the poor farmers. Increased wage for labour and the lack of availability of labour is a hurdle for the establishment and management of spice crops and are dependent of family labour. The farmers or small planters are not aware about the schemes and the avail of support from the line departments.

During the monsoon season, the riverbank of Nallathanniyar gets destroyed leading to the loss of native species of plants. Mankulam due to its peculiar climate is more prone to crop loss from the suddenly increased downpour. In the landslide, mainly rubber, cocoa, and pepper are destroyed and the great flood in

2018 altered the soil components. The decreased fertility in soil resulted in a decrease in yield.

In the last 2-3 years, Mankulam has lost the maximum percentage of its forest area as subsistence level agriculture shifted to a commercial one. Expanding cardamom cultivation has led to the degradation of the forest. Non-traditional cardamom cultivation outside the CHR area is a threat to degraded, fragmented, and protected forests. The expansion and increased yield of cardamom have forced the people to take more firewood for drying and led a shift from taking dead wood to selective felling and now towards clear felling. The change in the density and nature of the forest also resulted in increased human-wildlife conflict.

Primary Health Centre (PHC) - People in the Mankulam Panchayat very actively participate in all vaccination campaigns. The most common disease reported and treated in the PHC is fever. The cases reported in the PHC have increased from 148 in 2016 to 453 in 2019. This shows better health awareness among the communities to approach PHC in case of the disease. Dengue cases reported have reduced considerably from 20 cases in 2016 to just 1 case in 2019. Other infectious diseases like chickenpox, leptospirosis, dengue, hepatitis A, H1N1, TB have all been reduced to very low levels in the panchayat.

Veterinary Hospital- Most of the livestock farmers of cow, goat, poultry, and pig approach the veterinary hospital for its treatment. The major livestock varieties are H.F, jersey, and Swiss. The major diseases that affect livestock are foot diseases. Vaccination of cattle, especially cows, are being done by farmers when campaigns are organized by the department. Diseases affecting cattle are seen mostly during summer just before the advent of the rainy season.

Krishibhavan- Krishi Bhavan registers information of organic farmers who may have been already registered with KADS. Krishi Bhavan at times supplies planting materials like seeds to.

High range Organic Producers Company (HOPS)

HOPS is a registered society since 2006 and got upgraded to a Company later in 2014. Being a society, it was run as an open market, collecting and selling products especially vegetables from and to people or in the open market but as a company it only collects spices. The company is run by the 500 shareholders of which 80% are organic farmers. HOPS aims in promoting organic farming and in generating a sustainable income for organic farmers. In addition to the marketing services HOPS supports the member farmers giving free detailed classes regarding the types and the methods of farming. The company purchases cash crop products like cocoa, pepper prepared, both organic and inorganic from the farmers with higher price (organic) than the normal market price.

The spices like cloves, pepper have high demand and fetch high price if produced organically and the shortage and the existence as a marketing entity force them to purchase inorganic products too which fetch normal market price. The company due to legal issues does not export the products to foreign countries, instead sell the [products to other Indian based exporting companies and then they export these products. HOPS even produce products based on the interstate or international orders and market through the organic farmers trained by the officers from Agricultural University and experienced organic farmers from Krishi Vigyan Kendra.



Fig. Marketing products at HOPS

Horticulture products are also collected by HOPS along with main 9 types of products; pepper, cardamom, cocoa, coffee and nutmeg. This is to promote organic farming and to ensure a sustainable income. The registered organic farmers are cultivating the traditional varieties thereby ensuring conservation of such varieties. The first and fine quality product fetches maximum and the demand is highest for the stored product than the fresh one.

In Adimali Block, mainly 5 panchayats are engaged in organic farming and certain criteria are put forward to become a certified organic farmer and get registered. As a society the HOPS had supplied fertilizers under subsidized rate, being a company it is unable to take care issues related to farmers. The company now promotes cow dung and neem cake as fertilizer and are encouraged to use dried cow dung or as slurry. The supply of adulterated bone meal as fertilizer in the market, and the lack of facilities to test the soil to know the excess usage of fertilizers by the organic farmers are the hurdles in the way of HOPS. An Italian based company in Udumbannoor collects products of high grade and quality directly from farmers at various prices which is purely based on the product's quality and grade. Their weekly collection is almost 5 tons of cocoa and the registered farmers hoard or hold their products till they get a high market price.

4.2.3. Major drivers of change as perceived by different user groups

a) Farmers

In Mankulam Panchayat 90% of the people are doing agricultural works for meeting their livelihood. Most of them are dependent on organic farming. They generally use organic fertilizers for the cultivation of cash crops, vegetables, fruits, etc. Traditional rice cultivation in Mankulam needs special attention and promotion as the lack of availability of traditional varieties and the cost of cultivation force the farmers to give up. KADS collects the organic products and gives a little more amount for the products compared with other markets in Mankulam. KADS is a very supportive organization for poor farmers as they conduct seminars for organic farmers, provide fertilizers at a subsidized rate which the agricultural department fails to do.

A shift in a pattern has occurred, as food products cultivation was completely stopped and the cash crops were replaced in that area. People started doing cardamom cultivation. The cultivation of coffee is not profitable and people stopped coffee cultivation, increasing the cultivation of pepper and cardamom. Karimunda, Neelamundi, Vattamunda are the main varieties under cultivation. Karimunda and Neelamundi are the two varieties giving the good yield and disease resistance when compared with other varieties under cultivation. Karimunda pepper variety gives favorable yield yearly and is the most preferred among the farmers. Erythrina sps. is mainly used as the pepper stand. Quick wilt, root rot is the main diseases for pepper. The pepper needs to be a little dry to regrow into a new branch and is beneficial for both plants and farmers to get a better yield from these processes. Recently the regrowth of plant branches is sudden and the yield has decreased.



Fig. Cardamom and Cocoa cultivation in Mankulam

Cardamom cultivation has increased in the area and needs regular crop protection activities. Irrigation during summer and fertilizer application is very important and the cost of fertilizer depends on the rate of cardamom. Cocoa gives yield almost year-round and more yield in the monsoon season while it is the time of diseases. Most of the farmers use manures made from household materials using tea powder and cow dung. Fertilization of cocoa is done before the monsoon season to ensure the proper yield. The fungal diseases of the cash crops are

generally treated using Bordeaux mixture and Copper oxychloride as fertilizer. Tubers like Taro, varieties of Yam are cultivated but not sold in the market.

The seed and planting materials are collected from the agriculture department and other government farms and the traditional varieties are lost. No support from the government or any other departments is given for traditional varieties as traditional varieties have some limitations in the size and shape of the product compared to the high yielding varieties. The locally available varieties are more preferred as they need less maintenance. Regular soil testing is done by most of the farmers to ensure the fertility and productivity of the soil.

The people struggle to find a market for their organic product as the product does not fetch a decent price and makes people give up organic cultivation. The import of veggies and fruits from the markets of Tamil Nadu for cheaper price creates competition for organic products. The farmers are compelled to hoard their products. In previous years cattle rearing was an important livelihood activity but everything has changed and has become an unprofitable one because of the expense for feed and low prices for products.

The climate of Mankulam favors the growth of weeds in the farmland and need periodic weeding. Most of the laborers are working in estate areas due to the availability of a variety of jobs and are not willing to work for the poor farmers. The increased wage for labor and the lack of availability of labor is a hurdle for the establishment and management of spice crops and is dependent on family labor. The farmers or small planters are not aware of the schemes and the avail of support from the line departments.

Comparing the last ten years the cultivation in the Mankulam area has declined widely and the major reasons are low income to farmers, animal attack, and low price of their products. To adjust to the economic situation, the farmers are moving for mixed farming with the expectation of getting a fair price for one or other products to meet the expenses for the main crop rather than making an excess profit.

b) Lifestyle

The inhabitants mainly lead an agrarian livelihood. Though the old generation is continuing agriculture, the younger generations are not interested in farming. Most of the farmers have lost their mind for cultivation and will lead to loss of agrobiodiversity. Farmers also do not want their children to follow their path because of the instability in returns from agriculture. All the farmers try to give a better education for their children to take up better jobs.

c) Climate anomalies

Mankulam experiences landslides and floods during the monsoon and generally loses its crops and houses as part of the natural disasters. During the monsoon season, the riverbank of NallaThanniyar gets destroyed leading to the loss of native species of plants. Mankulam due to its peculiar climate is more prone to crop loss from the sudden increased downpour. In the landslide, mainly rubber, cocoa, and pepper are destroyed and the great flood in 2018 altered the soil components. The decreased fertility in soil resulted in a decrease in yield.

d) Man-animal conflict

In the last 2-3 years, Mankulam has lost the maximum percentage of its forest area as subsistence level agriculture shifted to the commercial one. Expanding cardamom cultivation has led to the degradation of the forest. Non-traditional cardamom cultivation outside the CHR area is a threat to degraded, fragmented, and protected forests. The expansion and increased yield of cardamom have forced the people to take more firewood for drying and led a shift from taking dead wood to selective felling and now towards clear felling. The change in the density and nature of the forest also resulted in increased human-wildlife conflict.

Rice cultivation in the area has been decreased to less than 5% due to the attack from wild animals and pests. Elephants, wild boar, monkeys are the main among crop raiders. The elephants from Marayoor and Munnar forest entering Mankulam in search of food to the forest after the complete

Destruction of plantain, Arecanut, and coconut plantation which are in the establishment phase due to its attractive taste. Tubers like tapioca, elephant foot yam, and taro root are raided by wild boars and the wide cultivation is stopped, limited to household needs. Fruit plants like plantain, jackfruit, mango, and cocoa are attacked by monkeys.



Fig. Crop raiding in Cocoa plantation in Mankulam

Farmers suffer wide crop damage every year and thus financial loss. The interest in cultivation is also lost among the farmers as the increase in crop-raiding incidences have increased in 10 years. Previous years the attack of animals towards crops was a very rare incident but now most of the wild animals are staying back in the farmland and not returning to the forest.

e) Major issues identified for loss of biodiversity

1. During the last 2 years, the area has been affected by extremely high rainfall and subsequent landslide.
2. Overflowing rivers have led to crop destruction. During summers, water scarcity is prevalent in many parts of the Panchayat. Rivers have become seasonal which were earlier almost perennial.
3. HWC is observed as an increasing trend which affects crops of natives as well as tribals. Despite some short-term measures done by forest departments, it has been increasing.
4. Although forest fires have reduced due to creation of a fire line buffer zone by the forest department, it still prevails as a major issue.

5. Food crop cultivation in the area has completely collapsed with ever increasing shifts to cash crops based on market dynamics.
6. Increased pest attack and diseases have made agriculture risky and income from the market is decreasing.
7. Crop irrigation has been reduced in the Panchayat over the years. Irrigation practice is not done now due to water shortage.
8. The livestock has decreased in the Panchayat.

4.2.4. Impact on Migrant and Tribal communities

Migration to Western Ghats-Idukki -Major land marks

- 1700s-Tamilians known as the Muthuvans migrated to Munnar.
- 1877 Advent of European Planters. In 1877 Kerala Varma, the Raja of Poonjar, sold 227 sq. miles of Kannan Devan Hills to John Daniel Munroe, a British planter.
- 1890-1920 migration of plantation workers
- 1920-50- Mass migration of farmers to different parts of Idukki- Aftermath of II World War.
- 1950 Colonies were established for Ex-servicemen

In order to withstand the severe shortage of food crops during the 2nd world war period, the government encouraged massive migration to the vast forested and fertile areas of the high lands, for the production of staple food crops, mainly paddy.

However, massive encroachments were reported only from the early fifties, and the process of encroachment continued during the sixties and the seventies 18. A major change notices in the expansion of settlement areas, which acted as catalyst for further changes in the form of infrastructure development with far reaching impact on the land use pattern and ecological balance of this region 19. In 1910, there was hardly 0.73% of the area under settlement that has increased to 30.57 with the combination of mixed crops. The narrow valley bottoms and marshy

areas were transformed as paddy fields mainly because of the strategy adopted in the early days of migration for the producing staple food crops. The settlement areas in Udumbanchola that occupied hardly 0.73% in 1910 were increased to 30.57% in 1990 by transferring forest lands, grasslands and cardamom plantations. The total area under plantation in this area had increased from 98, 123 acres in 1921 to 136,802 acres in 1931, an increase of more than 39%. (Census of Travancore 1931). During the 1951-1961 periods this area witnessed the phenomenal population increase of 675.75%.

Population of tribes in Idukki

The total population of tribes in Kerala is 484,839 and with this 238,203 represents the male population and the female population of tribes in Kerala is 246,636. In Idukki district the total population of tribes is 55,815 and with this the male population is 27,995 and females are 27,820. The main group of tribes in Idukki are Mannan, Muthuvan, Malayarayan and Ulladan,

Most of the tribal people do farm works. Men go for jobs outside the community. Women go for MNREGA works. Some people do agricultural works in their own lands. But most of the tribes do not have land because tribal people lost their lands as land was kept as a mortgage for money at times of need. They seasonally go to the deep forest areas for collecting forest resources like thelli, honey, pathri, medicinal plants, kattumanjal, kattukoova, Nooron, incha and food resources like tubers etc.

People say that the availability of honey and other products from the forest is also decreased. They meet their livelihood from their own cultivations and from "eettavettu" (reed work) for HNL Company and Bamboo Corporation also collects reed and bamboo. This is the main income generating works in most of the settlement. According to them there is no profit from agriculture.

90% of people live by wild resources. Now eetta is the only wild resource, collected and taken to home to make “paaya” and “kutta” and “murrām” which is sold for around Rs 100 in market or public.



Most of the settlements are more than 40 years old and they live there and cultivate different crops in their settlement. More than 20 years back, most of the settlements were cultivating rice and ragi but at present the paddy cultivation is completely vanished from most of the settlement in Idukki. Earlier they used to migrate after one year of agriculture and practice shifting cultivation. But now they are settled in a permanent land and have permission for cultivating only in this land.

More than 20 years back most of the settlement were completely covered by “Theruvappullu”. So the people extract oil from this and sell them to the market and this was the main livelihood of tribes. Recently this lemon grass has been replaced by rubber. Earlier most of the settlement were cultivating food items for their own need so they cultivated raggi, keppa rice, tubers like tapioca, Yam, Colocasia etc. But the transformation from this food crops cultivation to non-food crops is a major change in land use pattern. Previously the people cultivated traditional varieties of rice such as Peruvazha(Rice), silon (tapioca), Njalipoovan, Palenkodan, Chundilaakannan (Banana). In Komaly Kudi in bison valley most of the tribes were Muthuvan community and they previously cultivated 2 varieties of rice called “Manjapperuva and vellapperuva”. According to them, this varieties is now not available in their settlement. In their words, their main staple food was

raggi which gives healthy disease free body but these food items are completely vanished from the settlement. In Kurathy kudi under Adimali tribal office still a traditional variety of rice called peruvaya is cultivated by 2 to 3 families.

According to Kaani from Komalikudy; Raggi scarcity has affected their community a lot. Recently the tribal people are buying all items from the market. They get free ration and other items which they buy from the market. This gives a grim picture of food habit transition of tribal people. According to them, due to this transition, the life expectancy of Muthuvan and other tribes in Kerala reduced from 110-120 years to 60-75. Most of the tribes agreed that the food habit changes affected their life expectancy and health.

Crisis faced by the tribes

a) Wild animal attack

Most of the settlements are in thick forest area. So most of the colony face the attack of wild animals like elephant, wild pig etc. Recently most of the settlement face crisis of crop damage due to wild animals. Most reported cases are elephant attacks in all the settlement and general people who live near the side of the forest area are reporting that their crops are

destroyed by wild animal mainly by elephants. The elephants are getting attracted with some crops like banana and pineapple. Recently the people reported, the rubber plantations are also destroyed by elephants because the sweetness of rubber milk is attracting the elephants and they feed on the outer skin of rubber tree leading to serious health issues for the elephant in future. Other wild animals like wild pig, wild porcupine, monkey and squirrels also damage main crops.

b) Poor transportation facilities

Most of the settlements are located in the thick forests and are facing the problems of transportation. Most of the hospitals were located in town areas therefore their travel is time consuming. In some emergency medical situations the people die on

the way to hospital. Most of the roads are mud road where only 4x4 jeep can survive there. During the rainy season, the road will completely get damaged and they get isolated. Most of the settlement has more than 2 to 3 jeeps. But due to the maintenance cost people rarely use these vehicles

c) Water scarcity

Water scarcity is the most important problem faced by most of the settlements most of the water project from Panchayath and irrigation department failed due to wild animal attack damaging the water pipe connection. During the rainy season they faced land slide, because most of the settlement are located in the slopy areas. Due to heavy rain fall and water flow lots of tribal settlement area is facing landslides in rainy season.



Woman carrying drinking water

d) Cultural/Language erosion

Most of the settlements accepted that their new generations were on the way of transformation from their traditional culture to modern culture. They says that education and interaction with other community changed their styles, personality

and culture. The best example of their change can be identified from their dressing, hair cutting and talk. At the same time some tribes are still following their culture in a strict manner. The best example is the tribes of Edamalakudy. Most of the children go to school till 10th grade after that they stop their education. But some students go for higher studies. Earlier the Tribals marry within the cast but at present they marry from other groups especially the tribes marrying general people. The new generation do not much like to participate in their old traditions, so they keep a distance during the time of ceremonies. Previously they celebrated 4 to 5 festivals in a year and now it is decreased to 1 to 2 festivals in a year. Most of the educated tribal people beautifully speaks Malayalam,

English and some other languages, but at the same time they also can speak their language fluently. Previously the death ceremonies of the tribes were very complicated. They bury a person's body in a thick forest along with a Knife and Shovel. Using rifle they fire two times to the sky. They keep these tools like knife and shovel with buried person due to a belief that the dead person will reach a new place, and for meeting the livelihood in the new area he needs these items. At present, the concept changed and they bury the dead body in their own land.



Young tribal men during ceremonies

e) *Loss of traditional knowledge*

Tribes and other general people visit the traditional vydyhas for different type of diseases. The viydyas go to the thick forest and collect the medicinal plants and prepare medicine. Earlier they got medicine from nearby places of the settlement but now the availability of medicinal plants decreased. And the new generation did not have any idea nor any interest to learn



Medicinal herbs from forest

f) *Exploitation from others*

A study conducted in Kanthaloor showed that People get very less price for their produced vegetables. The BMC members of a tribal community say that they are cultivating kaatupadavalam and passion fruit in their land. They sell this to the market but they do not get enough money for their hard work. The shop owners will say that price is less because of rain. Profit is gained by intermediate agents. Previously the people cultivated cardamom organically but the demand of organic cardamom has decreased and the merchants advise to use pesticides and give good cardamom. Most of the houses are now converted from hut to concrete building but the quality of all building is very poor in every rainy season. Most of the buildings have leakage problem due to poor quality.

5.Objective 3: Review of developmental trajectories of various communities and social institutions

Activity

Review of Major developmental trajectories and drivers of change as perceived by different local level institutions as Technical Support Groups (TSG), Biodiversity Management Committees (BMC), Tribes, Medical practitioners, and Agricultures: Tool of RRA in different panchayats

1. Major drivers of change - Munnar

Overview/ information about Grama panchayat from BMC

Expansion of the tea plantations of Munnar had led to deforestation and related encroachment continues with the backup of lease agreements 'Chembolpattayam'. The plantation sector and the construction activities demand water and the overexploitation results in water withdrawal. The then raised plantations of eucalyptus have been maintained but a check has been imposed on the newly raised and upcoming plantation as it will affect the availability of water in this region. The area and number of Shola grasslands in Munnar have tremendously decreased and invasive species have occupied the place. The controlled forest fire has encouraged the growth of invasive species and has threatened the growth of Neelakurinji

The factories and the associated activities have also resulted in plastic and chemical pollution of water, air, and soil. Munnar panchayat maintains an effective waste management plan by collecting waste from different areas like households, restaurants, and other buildings of the region. The collected waste is stored in a yard, Kallar dumbing yard. The waste will be recycled using German Technology, once it gets granted from the Panchayat. The dumping of waste in the yard is a threat to the stream that flows to Mankulam during the rainy season.

Lifestyle

Most of the people residing in the panchayat are engaged in the Tea plantations and company (private sector) and the people with jobs in the company are secured in the company quarters. The company workers adjust in the small homes in lanes and most of them become homeless once they get retired. The MGNREGA and other schemes have encouraged the people to find alternate livelihood activities other than the plantation works. The lower primary education to the residents is given at the Company School and for the primary level, the students depend on the Kannimala Factory School. To pursue the next level, the students go to Marayoor, Adimaly, and Tamil Nadu. Tamil and Malayalam are the most commonly used language among the residents and Christmas is the main celebration. The population comprises the immigrant population from Thirunalveli and nearby Tamil Nadu areas. The tribes depend on NTFP Forest resources like Syzygium, Garcinia, Honey, and mushroom according to season. The herbal medicine and koovappodi which was taken by the society earlier have been stopped and are taken now only for household purposes. The practice of traditional medicines for diseases like jaundice even continues and for other diseases, they depend on the estate hospital or in emergencies in Munnar.

Climate change anomalies/hazards

The unscientific way of road construction has badly affected the environment and biodiversity in Munnar. The giant earth-moving machines like JCB, Hitachi, use explosives to break the rock nearside area have released dust and have generated tremors in geological structures which in turn resulted in landslides. The natural disasters have changed the scenarios and a check has been put by the officials against the illegal construction and the Revenue department is closely monitoring the same. The 2018 flood has taken away the Periyavarai bridge and has made it difficult to connect the Munnar town with remote areas in case of emergencies.



Fig. Landslide at Munnar Grama Panchayat

Man-animal conflict

Bison, Leopard, Elephant, and Boar are commonly found in and around the human inhabitations and the vegetable cultivation, in particular, the plantain has been frequently raided by the boar and elephant respectively.

2. Major drivers of change - Marayoor

Overview

Marayoor, a rain-shadow in the eastern slopes of the Western Ghats is the only place in Kerala that has natural sandalwood forests. Ancient dolmens and rock paintings in Marayoor date back to the Stone Age and maintain the remnants of the Megalithic period. As a known Sandal Reserve the mainland area resides with the Forest department.

Climate change anomalies/hazards

Lying between the Pamban mala and Karikomman mala Marayur faces the issue of water. Lack of rain makes their land very dry and the wildlife population is generally sparse. The people depend on Jalanidhi project and Canals for drinking and irrigation purposes. The groundwater exploitation has also resulted in the degradation of soil and forest and ended up in the alkalinity of the soil.

Man animal conflict

Rainshadow regions of Marayoor have their flora and fauna due to its special microclimate. The general fauna includes bison, elephant, gaur, wild boar, and monkeys. The moving population of NilgiriTahr and the arboreal mammals from Rajamala and Chinnar areas enhance the diversity. The vegetation similar to thorny scrub includes Acacia, Terminalia, Teak and Amla. Human-wildlife conflict is very serious in this area and the farmers are struggling to survive with elephants and monkeys. The area has vegetation with medicinal herbs and plants that caters the need of traditional vidyans.

3. Major drivers of change -Devikulam

Overview - The major chunk of Devikulam is with the Kannan Devan Hill Plantations and rests with the forest department. Along with the tea and eucalyptus plantation, patches of forest in particular the Shola forest also resides in between.

The tourism in Devikulam has resulted in waste management issues as the plastic and other wastes are dumped by the tourists and small vendors. The lack of waste management is a serious issue in the Eco point at Mattupetty and Kundala dam.

Climate change anomalies/hazards

Devikulam area faces the issue of water scarcity mainly in the summer season. The main water sources are through the land of KDHP and during summer the flow of the water from the estate decreases and start to face water scarcity, sometimes extreme. The groundwater withdrawal is aggravated by the construction and

exploitation through bore well in the name of tourism. The area is always under the shadow of landslides and few Panchayats is severely affected by the landslide. The flood of 2018 has made havoc in the rivers and riverbank vegetation.

MFP Collection

Reduction in the MFP collection has been observed as the tribes are more engaged with other jobs outside the forest. The Girijan society at Devikulam mainly collects Kattupadavalam, Chittarathy kizhangu, Cardamom, Pepper, *Acorus calamus*, *Curcuma aromatica*, Peenari wood, *Terminalia chebula*, *Myristica fragrans* (Mace). Most of the goods are from Marayoor, Gundala, Edamalakudy under the forest ranges of Marayoor, Kanthalloor, Munnar and Devikulam and collectors even give their MFP to other shops in Munnar. Kattupadavalam is collected at highest quantities and cultivated among tribes. The reduction in demand for the raw materials by pharma companies has affected the collection at grassroot level.



Fig. Nutmeg mace and Chitharathai kizhangu collected at Devikulam Girijan Society

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quantities and cultivated among tribes. The reduction in demand for the raw materials by pharma companies has affected the collection at grassroot level.

Man animal conflict

The major problem faced by the resident population of Devikulam is the human-wildlife conflict. The expanding plantations have reduced the forest area and thus the resources for animals. The elephant and wild boar frequently raid the crops like Red Carrot, Cabbage, etc. Most of the people in Devikulam are landless and the only ones with ownership are the tribes. The issue with land ownership hinders the affected people from claiming compensation for the crop loss. In previous years and in olden days to ensure the protection of the crops some plants were cultivated for elephants (Cheenivazhaikizhangu and Etta) and during that time the attack of wild animals decreased. The Biodiversity rich areas of Chenduvarai where animals come to drink water is now used for recreation purposes.

Agriculture - Ellappetty village – organic vegetable cultivation

Ellappetty village of Devikulam, inhabited by KDHP workers is a hub of vegetable cultivation. The area is mostly inhabited by E.grandis and a locally Chowka tree which comes under the KDHP company used for tea processing industries. Potato, Carrot, cabbage, coriander leaves, butter beans and muthira beans are the main veggies under cultivation. Intercropping and crop rotation is practised to ensure the fertility of soil where potatoes are done from January to March, followed by carrot from April to July and cabbage and beans during the remaining months. Butter beans and muthira Beans are mainly cultivated during the rainy season, coriander in the summer season and in windy seasons the fields are left fallow.

The organic farming/ agriculture is an additional income to the plantation workers to maintain their financial security. The products from Ellapetty have high demand in Ernakulam, Aluva and Angamaly markets. These markets keep away the farmers from direct entry to the markets forcing them to pay everything to intermediaries. The act of middle men and exploitation of the financial crisis of

farmers bring poor income or profit to the farmers for their produce. The middle men in the marketing field procure the expected yield at a very cheap price from the poor farmer's field on agreement and advance payment to the farmers even before sowing.



Fig. Ellappetty cabbage cultivation

Most of the Tamil descent farmers are regular employees of the KDHP company and cultivate in the 2000 to 2500 square feet of land given by the company temporarily. In addition, the company provides free medical support to them and their family because the company has its own hospital and therefore provides free medical support to them. Few of the farmers are engaged in cattle rearing and cow dung is mainly used as manure. The change in climatic conditions though resulted in heavy rain, more instances of flood and increased temperature during summer, on other side have supported agriculture by ensuring ample amounts of water throughout the year.

4. Major drivers of change Chinnakanal

Overview

Most of the inhabitants of Chinnakanal has been there for about 5 generations. They have been relocated from the places near Anayirankal dam. People own a landholding of the size of about 5- 10 cents to .5 acres -1 acres. Muthuvan, Panna, Ulladan are the main tribes of the area and occupied as part of revenue land granted to the landless by the government. The people reside in concrete homes built under the schemes for the homeless. Almost all the students have completed matriculation and a few take up higher studies as most of them are not willing to continue the studies. After studies, the majority have joined as forest watchers. Though the road network is good enough the medical facilities lack in the panchayat and have no clinic to take inpatients. The people generally depend on hospitals in TamilNadu but financial help is given if they consult hospitals in Kerala where the nearest one is in Adimaly and Kottayam. Estate hospitals of TATA also provide treatment facilities.

Being an area dominated by plantation giants, the resources are under-maintained under them and common people are restricted from free access. The tourism and related construction have brought changes in the area and the main threat. The scarcity of water is the main issue due to plantations and construction activity and in summer even the drinking water becomes scarce.

Lifestyle

The support of government schemes and advice on the practice of agriculture has brought overall improvement in life quality. All the tribal hamlets are now electrified and have the facility of television and mobile networks. The road network and vehicle facility are well established to meet the purpose of inhabitants. The inhabitants though have modernized are not ready to give up the life that they enjoyed once and are not ready to shift to the city nor permitted to move to the forest. The changing lifestyle has brought some diseases like diabetes.

The traditional languages are still in use in the hamlets and follow the traditional rituals. The sowing of yellow ragi by the head of the clan was there in practice once. Thaipongal is celebrated annually and the Vanapooja for the forest gods is done after the Pongal and for this, the adult male and children participate in the Pooja. Strict discrimination is followed in between the 'samuthayams' and among them, the Muthuvan occupies the top class. Traditional medicine practices are not in use now as have degraded without passing it from one generation to the next.

Agriculture

Wild honey, tubers, jackfruit are the MFP's collected, and earlier they used to go to a forest area and cultivate for 6 months. Ragi was mainly cultivated and the varieties cultivated include- cherukeppan, valiyakepa. Ragi cultivation is done in rotation with Ginger as the ginger improves the soil quality after the cultivation of ginger. Pattambi rice variety and wild mango were used once. Cardamom, pepper, ginger are the main species under cultivation. Organic farming was there once in practice and now the fertilizers are used.

Man-animal conflict

Chinnakanal area is an elephant corridor and the movement of wildlife is very high. Earlier they had cultivated paddy and ragi which become impossible due to elephants now and now shifted to tapioca, ginger, and pepper. Almost 29 elephants are stationed in and around Chinnakanal. The farmers use fires, crackers to flee the elephants. A type of bean locally called 'arakkodi' is the only crop not disturbed by elephants. The scarcity of natural resources pressures the elephants to move out of the forest in search of food and water and the attack has become unpredictable. The inhabitants established the colony in 2003 and from the beginning elephant was a problem in the area. The information regarding the movement of elephants is passed by volunteers staying near the dam and now tribal watchers are deployed for this purpose who roam inside the forest and pass the message through mobile SMS where the elephant is stationed at. The system has proved to be effective as the rate of attack decreased. Peacock was a problem

from earlier times and recently wild boar has become a threat. Rats are the main pest in Ragi cultivation.

5. Major drivers of change Edamalakkudy

Edamalakudy is the only tribal panchayats in Kerala and has around 22 hamlets in which most of them the livelihood activity is agriculture. The main species under cultivation include- orange, ragi, garlic, sugarcane, maize, tubers, and rear livestock. Edamalakudy, Kalathiyarkudi, Ooradikudi, maintains little cardamom cultivation which was established by deforestation. The areas in Edamalakkudy which are the upper areas to the Edamalayar valley are to be protected and should be addressed with an eye of agro-ecological zone-based approach as this productive system affects the rainforest.

6. Major drivers of change Vattavada

Overview

The people in this region are mostly landless or don't have land ownership certificates. Some tribal settlements have ownership certificates available only to very old farmers. The transportation facility is very poor that they depend mainly on shuttle jeeps. The number of homestays, lodge, hotels, and villas has increased recently as part of growing tourism industry. Proper waste disposal and management are running in the Panchayat and the sight of dumping is rare. The use and sales of hallucinogenic stuff have become a business in the Vattavada area and are working in connection with the tourism industry. Most of the buyers fall in the youth category and magic mushroom which is found in the Ellappetty area is of high demand.

Agriculture

Vattavada is the vegetable market of Kerala and are the leading producers of vegetables and an array of fruits including - apple, orange, strawberry, blackberry, and peach. Varieties of vegetables are cultivated and the garlic and

ragi which are famous due to their pungency and taste. Traditional varieties are used for cultivation and is the only Panchayat that continues ragi cultivation on a large scale where rice cultivation was ended more than 15 years before. Some of the farmers have shown interest in upland paddy cultivation but is constrained due to unavailability of quality seeds. Cardamom is another crop cultivated widely. Major tribal hamlets with cardamom cultivation are Samiyalarakudi, Kudalarkudi, Melvarisqappettykudi, Thazhevarisappettykudi, etc. The farmers generally get low prices for their cultivated products and the middlemen exploit the farmers and this continues in the case of medicinal plants too.

The people of Vattavada are the real natives of Madurai who have migrated in the fear of invasion of Tipu Sultan. Most of the people in Vattavada speak Tamil and Malayalam speaking people are very rare. The livelihood is generally dependent on agriculture since 400 years of inhabitation.

Vattavada, the vegetable capital of Idukki mainly hosts carrot, cabbage, butter beans, muthira beans, onion, green peas, garlic, passion fruit, radish, raggi, small onions and coriander cultivation. The minor crops include strawberry, kattu padavalam, taro, orange and tree tomato, where strawberry cultivation has now decreased. The Focal Group Discussion with farmers infer that the farming in Vattavada is mainly organic farming and their major markets are -Tamil Nadu, Ernakulam, Angamaly, Perumbavoor and Aluva.

The interference of the middlemen lowers the farmers profit as in the case of Ellappetty. The farmers of Vattavada cultivated paddy, 4 varieties of wheat and millets before 25-30 yrs, but the scarcity of water for agriculture pulled them back and is a major issue faced by the farmers of Vattavada for the last 10 years. A section of paddy called Matta still continues and is collected by the farmers from Tamil Nadu. E.grandis cultivation for high and speedy returns by the Forest department and the private parties is blamed by the farmers for their plight. Though the climate change has brought rainier days in monsoon and hotter days in summer the scarcity of water still exists.

Recently few tribes have started cultivating cardamom in between the border areas of Vattavada and Tamil Nadu. The climate here is a combination of the cold of Vattavada and the heat of Tamil Nadu and is conducive to cardamom cultivation.

Climate change anomalies/hazards

The occurrence of natural hazards is comparatively less in this area. The availability of poor rain due to its rain shadow region has led to water scarcity. The cultivation of eucalyptus has aggravated the decrease in the availability of water. The main source of water in the panchayats is originating from the Pampadum Shola National Park and recently the flow of water from this area has decreased limiting the water supply to Vattavada. The increased level of water due to monsoon from Pampadum Shola destroy the cultivation in the low land area of Vattavada. The unscientific bridge construction has increased the chance of flooding in nearby farmland.

Man-animal conflict

Though the instance of animal sighting has increased the rate of elephant encounters has decreased while the attack from wild boar, monkey, deer, bison has increased. The increased attack of the animals in the cultivation very close to the fringes have forced the people to stop the cultivation.

7. Major drivers of change Adimali

Overview

The first inhabitants of Adimali were the Mannan tribe and then the other tribal groups collectively called the Muthuvan migrated. At Kurathikkudi about 350 families of Muthuvan communities (500yrs) are there and they practice agriculture- Pepper, Cocoa, and Rubber. Traditional crops have been lost or reduced, Peruvazha, Ceylon Kappa, Njalipoovan, Palayankodan, Chundillakannan. Paddy cultivation has been here for 45 years. Before 1980, the

main crops under cultivation were rice as well as pepper and cardamom. Now almost 90 percent of the paddy fields have been modified for other purposes such as residential land, rubber plantations, banana fields, cocoa, pepper, and coffee.

According to BMC members in Adimaly, it's a suitable place for Biodiversity Park as it's near to the town area with the availability of water and rich flora and fauna. Before 1974 there were 4 dikes on which people depended on agriculture. In 1974 the dike was destroyed by a landslide. The solid and liquid waste management is ensured with proper recycling plants. In his opinion the scope for eco-tourism in Adimaly is yet to be explored as the wards 11, 21 are situated near the forest. There are two temples which are under devaswom board and a memorial at Ranickal in the name of SethuLakshmi Bai (who made a bridge for this tribe) which needs attention. Some wards (1) in the Adimali panchayat are facing issues due to lack of transportation because of bad roads or even no road in some areas and being remote the people are not able to reach the hospitals at Mankulam and Adimali traveling about 1hr.

Lifestyle

The Muthuvan colonies in Adimali have been there 100 years ago and now they have ownership of land. The availability of forest resources has increased. In some parts, the traditional language is almost dead as new generations are not interested in them. Changes have been seen in the rituals and death ceremonies that were once done in a particular area have been shifted to their own houses. The pattern of shifting cultivation once practice has been stopped and got settled.

Livelihood

The livelihood of tribes is mainly dependent on forest - honey, koova(yellow), thelli, maramanjil. They sell privately as there is no society. Samithi's working is not proper as similar to the VSS or Girijan society. They mainly cultivate Costus and Turmeric and are sold after drying. The Ethnic food KaattuKizhang, Koovanooru, purananooru are used by the tribes. Though the honey is collected from small and large bees, the harvest is low. For medicine and food, they

dependent on herbs and fishes in the streams. The primitive or the Muthuvan language is still in use but the traditional activities like Kaaduchopp are not practiced now. They still use gunshots to air when a tribe among them dies. Most of the tribal settlements have lost their culture, traditions, and customs and have adopted the modern style in their food habits, dress style, and language. Some tribes are employed by Adivasi Samrakshana Samithi. Some tribes still live inside the deep forest and in earlier times they had guns that were used to kill animals like monkeys if they enter human habitations. A change has been observed in food habits and has led to a decrease in life expectancy. Even ancestors used alcohol made inside the forest.

Through the Valara check post, the main resource moving out of the forest is the Bamboo and Rattan. The harvest of rattan has been decreased even from early times. In June - August months Eetta flowers, but are not harvested at that time. VSS was formed in 2000. All plantations established in degraded lands were successful - Kynna(Chooral), *Ailanthus excelsa*, *Cassia fistula*. The resources under harvesting are Dammar, Honey, *Hydnocarpus pentandra*, Neruvettika, Pulinchi, Edannapoo, Pathri, and Makkumkaa. The collected resources are sold at Neriamangalam and Kalady. A reduction in the harvest of honey has been observed. Small bee honey is taken during Kumbha month night (pollen grains mixed in honey is less this time) and fetch Rs.800/kilo. Honey collected from the large bee is cheap as fetch only Rs.300/kilo. The lack of proper storage and preservation mechanisms reduce the profit of collectors. Generally, the tribes and normal peoples are not in favor of specially conserved areas as it results in isolation from other people who might benefit from the forest.

Loss of agrobiodiversity

Adimali has a mixed cropping pattern with pepper, cocoa, clove, rubber, tea, cardamom, nutmeg, and vegetables. Through this mixed pattern, they maintain maximum agrobiodiversity within the field at the cost of increasing forest degradation. Most of the farmers practise organic farming and work with family

laborers due to the increased labor charge. Major cultivars include pepper, coffee, rubber, and banana. Karimunda is a popular variety in pepper. Agriculture seems to be an unprofitable business as the product does not fetch a fair price in the market and many farmers are compelled to hoard their product with the view of a better future. A reluctance has been observed in doing agriculture business due to high investment and low return from the market. The major cultivation is cocoa, pepper, and nutmeg, especially in mixed cropping methods. The main source of planting material is the traditional and local varieties from the neighborhood through barter system or from local farms and many among them conserve the traditional varieties and Cadbury variety of cocoa. The cocoa cultivation is affected by different fungal diseases, pepper with quick wilt, and the expense for multiple uses of Bordeaux mixture force the farmers to give up the cultivation for banana and tapioca.

The paddy cultivation that was a primary agriculture activity in the past has given up the way to vegetables, bananas, tapioca. Compared with the past 10 years' agriculture has become less profitable to meet livelihood needs. All the crops pepper to coconut is facing disease and pest problems that push the farmers into debt. A shift from plantain cultivation to tapioca has been observed to cope up with the market. Cattle rearing is also an add up for most of the farmers, as it reduces the procurement cost of fertilizer and manure. Farmers are mainly dependent on HOPS (High Range Organic Producer's Society Adimali) and Vipani (under vegetable and fruit promotion council Kerala, which was active for more than 4 years) than the markets at Adimali. Vipani is the main market for cocoa farmers to fetch double the price that usual market as they export the quality seed to other countries. They connect and conduct auctions and find markets for the nearby and far town Kayamkulam, Perumbavoor, Kottayam, Kothamangalam, and Muvattupuzha.

The traditional organic farmers opinionated that the new generation is not interested in agriculture work as expecting sudden returns and are engaged in skilled work and other sectors. The loss of interest in agriculture will affect agrobiodiversity. According to the farmers the only solution to the problems of farmers

and to save them from debt in the agriculture sector and to boost up them is support from the government irrespective of political backgrounds. The Agriculture Department, Forest, and the line departments must offer the support for farmers to bring back agriculture through providing compensation in an animal attack, subsidized programs for fertilizers, ensuring the quality of fertilizer in the market, ceasing the adulterant, quality planting material, and ensuring good market and storage facilities. Initiatives are also to be taken to preserve and conserve the traditional varieties as farmers replace the resistant traditional ones with high yielding varieties in search of profit. The subsistence level farming and cultivation of food crops has been decreased and have turned in to cash crops. The support and schemes from the government side could nurture the agri-dependent communities of Adimali to stay back in the food crop cultivation for sustaining the environment and food security.

Loss of Bio resources based livelihood

Traditional practitioners of Adimali collect herbs from the forest and the medicines are prepared by him alone to keep the secret. The treatment is given for heart block, piles, epilepsy, and other diseases. According to him the Wild Yam has high medicinal value but is not taken because of the complex process of cleaning and storing. The herbs are sold to agencies in bulk order or sometimes to middlemen and the diversity of herbs is very high. Chathaaveri, paalmookka, kurunthotti, naruneendi, etc are taken together rather than chathaveri alone for better profit. Sheevakka is used against dandruff and hair loss and the Sheevakka, honey- if dried can be stored and used for years

MFP Collection

The details of people from Girijan society who collect tribal medicinal plants were collected from Adimali and main biodiversity rich areas of the panchayat were located. Though resettlement and rehabilitation programs have been done, still people from four Kudi's Plamalakudi, Thattekkannamkudi, Kurathikudi and Chinnapparakudi reside in thick forests depending mainly on MFP and medicinal

plants for livelihood. Though a number of projects have been implemented, most of the projects was unsuccessful. The launched projects on hand loom cloth manufacturing units for the tribal women had been stopped due to lack of trained workers to function and the machineries used are still at the building which once provided jobs for many tribal women. The cement brick manufacturing unit initiated as part of MGNREGA scheme was also a failure due to the disputes related to the wages between the employers. Lack of support funding to the institution called Vipani which collects the organic agricultural crops from the farmer's at additional price rather than the actual market price was another issue flagged.

The lifestyle change, after the 19 th century in tribes have reflected in reduction in dependence of MFP's. Now they mainly collect cheevakka during December and January, sell through Girijan Society for a decent price. The two main companies that collect medicinal herbs are Oushadi and Kottakkal. Karimkurinji, Adalodakam, Koovalam, Pathirivettam and honey are also collected in limited quantities (10-12 cans of honey). The collection of root parts or whole plants as such raise a threat and these plants are at the verge of extinction. Most of the tribes cultivate Kattu padavalam and wild turmeric on their own land with fertilization, however the quality does not meet the one collected from the forest. The expertise of the tribes in identification of medicinal plants and associated knowledge has declined generation to generation and only a few traditional healers knew more about the medicines to be practiced just like earlier times. The medicinal plants collected by Adimali Girijan society, their uses, price and the season of its collection were given below.

Table. Details of medicinal plants collected by Adimali Girijan society				
S.L No	Name of the item	Collecting season	Use of the item	Price per kg
1	Urinchikkaya	January -April December -	Soap making For making	25/-
2	Pattincha	March December -	Scrubber Beauty cosmet-	80/-
3	Kasthoori manjal	April	ics	90/-
4	Kaattu kurumulakin val-ly	December - March	Medicinal prod- ucts	40/-
5	Makkum kaya	Always	Medicinal prod- ucts	35/-

6	Karim kurinji	Always	Kazhayam	18/-	
7	Kurimthotti	Always December -	Kazhayam		50
8	Pachotti tholi	March	Kazhayam	50/- Small honey - 1200/-	
9	Honey	February - March	Medicinal purpose	Large honey- 400/-	
10	Chittaratha kizhangu	December - April	Medicinal purpose	70/-	
11	Pulinchi kaya		Medicinal purpose	60/-	
12	Kattu padavalam	December - April	Medicinal purpose	200/-	

Climate change anomalies/hazards

Climate change – flood and drought has made an impact on the agriculture sustainability marketing and business sector of Adimali. In the past 10 years before Adimali was receiving proper rain and water availability that supported agriculture. The Panchayat depends mainly on the monsoon rain for water, some parts of the Panchayat get enough water during hot summer even to meet irrigation needs while the other face scarcity. The availability of water decreased because of the increased number of dig bore wells. Landslides are the major threats for their crops during the monsoon season. Adapting with the changing conditions, people have shifted to mixed crop patterns and multi-cropping to compensate for the loss from a single crop due to climate and market fluctuations. People have shifted from rubber to tapioca due to a decrease in rubber pricing. Farmers stopped cultivation and turned to other works like poultry farms and other businesses. Landslides are the main natural hazards faced in this area while floods make little disturbances.

Man-animal conflict

The attack of wild animals especially wild boar has increased very much and damage to pepper and tapioca. Sambar deer and Barking deer are also a threat to agriculture as they attack young plants and newly cultivated plants like bananas, tapioca, elephant foot yam, etc, and the area addressing this type of issue and

compensation from the Forest department is very rare. The attack from squirrels and rats have reduced the harvest of cocoa and arecanut. . Among the crops only tapioca is threatened by the wild boar. Water scarcity during the summer is an issue both for people and agriculture. The tribal hamlets are prone to HWC as Elephant, Bison, and Leopard, the issue with lack of network and range issues make it difficult to pass the information on time.

8. Major drivers of change Kanthalloor

Overview

Comparing the last 6 years the rain in Kanthalloor has decreased. The people in Kanthalloor are recently facing water scarcity as a result the cultivation has also decreased. The main source of water is from the Mannavan Shola. The flow of water has decreased gradually than earlier. The Mannavan Shola is the lifeline of Kanthalloor and the disturbance in the patch could result in a wipeout of cultivation and survival of Kanthalloor. The decreased flow of water from Mannavan Shola has made an impact on the Kezhanthaloore waterfalls, one of the main tourist spots. The sacred groves once existed in the area have been wiped out. The plantations of Eucalyptus once established have also contributed to water scarcity. The increased number of borewells is another issue in Kanthalloor Panchayat. Construction of small check dams in Mannaman Chola can only save the agriculture and sustenance in Kanthalloor. The tourism sector has shaped the economy of Kanthalloor but increased tourism raised waste management issues. The increased construction of resorts and homestays have disturbed the area with periodic population pressure and waste.

Agriculture

The inhabitants of Kanthalloor lead an agrarian livelihood. Keezhanthallore area has maintained paddy cultivation and a variety Komba is used. The poor availability of water hinders them from extensive cultivation of paddy. Recently the paddy cultivation has been replaced by other crops viz: sugarcane, vegetables,

fruits- apple as they flourish in the cold climate. Though their product has high market demand they fetch poor prices because of the intermediate agents. Chethalakizhang/ Chitharathi which grows like cardamom has now decreased.

The people are restricted from going inside to deep forest. The area has a few traditional practitioners. Aloe vera is used in household medicines. The resources collected from the forest include honey, honey wax, *Acorus calamus*, etc.

Man-animal conflict

The human-animal conflict in the area is very high and most of the farmers have lost their cultivation in the raid of elephants and boars.

9. Major drivers of change Kuttampuzha

Overview

Kuttampuzha is a panchayat with the main chunk of land under the forest. Most of the inhabitants are landless or without land ownership. The main inhabiting tribes are Muthuvans, Malayarayans, Ullandans, and Mannans and are the inhabitants for about 35-70 years. The people do not have any records of land ownership but records of documents of possession from the Forest Department. Resettlement has been done in most of the tribal settlements and the un-rehabilitated one lacks road network and electricity, but most of them have their vehicles like jeeps, auto, etc for their hamlets. Most of the houses are built up with concrete bricks, sheets and clay roof tiles.

The increased tourism activities have led to the change in the ecosystem and economy of the area and have made it to a concrete jungle. Government Ayurveda hospital, library, Government high school, pre metric tribal hostel, community hall, etc. are the major institutions and buildings in the Panchayat. Compared to the other panchayats of Idukki, Kuttampuzha has a sufficient network for smartphones and television. No hospital facility is in the vicinity of tribal settlements and they have to travel to the Kuttampuzha town to get medical advice. Kuttampuzha has 4 acres of revenue land located in the town with a rich

diversity of trees and medicinal plants. The natural system with the assistance and supervision can be turned up to a nature park in the midst of town.

Agricultural/agrobiodiversity

The people in this settlement cultivated rice and ragi varieties and their traditional rice varieties are Peruvazha, Aringodan, Choramoodan, Adamoodan, Jyothy, Aswathy, etc. They also cultivated Thina and Chama. After the introduction of forest rules and the restrictions for cultivation in forest areas, rice cultivation was given up. Earlier cultivation of rice and vegetables used to be there but now the main crops under cultivation are rubber, cocoa, coffee, and pepper. Irrespective of the crops the yield has decreased drastically. The domesticated animals include hen, dog, and goat. Before shifting to rubber cultivation they have been cultivating lemongrass which was stopped due to a shortage of firewood for distillation. They had been practicing organic farming for the past ten years and now have shifted to inorganic fertilizers for cultivation mainly but continue the use of organic fertilizers. Kunchippara settlement cultivates "kunjukunju" variety, with very small height that can be harvested within 90 days is cultivated. Recently they have stepped into Cardamom cultivation and pineapple cultivation taking land for lease. Banana and pineapple mixed cropping is done

Lifestyle

To cope-up with the changing economy, the inhabitants have also changed their lifestyle and are utilizing tourism as a tool. The cooperation of KFD (Kerala Forest Department) in expanding ecotourism could be a support to their livelihood and the cottage industries will also flourish due to this.

Among the tribes, the traditional language still exists and people are fluent in Tamil. The main festivals celebrated are Onam, Vishu, Ponkala, and Swamiyoot. The funeral is carried traditionally and changes are happening among the new generations. The customs and beliefs among the tribes have changed and even the marriage functions are now practiced as of common people. Once they used to

cultivate all required crops depending on the availability of water but now the cultivation has decreased, they are dependent on the ration shops and nearby shops for even rice and vegetables that they once cultivated.

The seasonality in the availability of materials from the forest has created financial instability and people has started to opt for jobs outside the forest and are engaged in daily wage jobs to get a monthly income for sustenance. The the older generation and the young ones are not interested to go with the MFP collection-based industries. Alcohol consumption, pan, and tobacco usage have increased in all tribal communities irrespective of male, female, and adolescents.

Livelihood

The inhabitants of Kuttampuzha are dependent on agriculture for meeting their livelihood needs, especially the tribes. The other means are cattle rearing and as coolly workers. The male is engaged in harvesting the rattans and bamboos from the forest and the females engage in carpet making or other cottage-based industries which are sold to Kerala State Bamboo Corporation. The harvested rattans are also sent directly to the Corporation without moving to value-added production. The people going outside the settlement for work return late and women are engaged with works of MGNREGA. They also participate in exhibitions and festivals outside the area to earn more price for their product. The milk and products are sold at the Cooperative Society and Milma.

Among the tribes, the Muthuvan community is more interested to live in the thick forest when compared with the Mannan community. The Mannan community is maintaining a financially stable lifestyle by getting themselves engaged in skilled work and agriculture and is not completely dependent on forest products like Muthuvans. . The relocation has made some disturbance in the livelihood of tribes. Honey and other MFP (dammar, arrowroot, pot tamarind, nutmeg) collection is a major job but the availability of honey and other MFP's has decreased when compared to the past years. The main honey harvest is small, large, and kuttipalli. Arrowroot is collected and made into powder for sale. Other forest products

include Sida, Asparagus, Hydnocarpus pentandra, Acacia incia, etc and are sold to Ayurvedic companies.

Loss of Traditional knowledge

Most of the traditional practitioners had died along with their knowledge as they refused to share the knowledge. Ten years before, some vidyans who chant mantras for healing disease were there. The large honey is extracted at night and mostly during the Malayalam month of 'Medam'. The bitter-resinous substance oozing from the arrowroot is used as a fish poison. Most of people know some medicines for small diseases like fever or medicine for wounds. The medicinal plants and herbs are not collected on a large scale due to lack of knowledge on them. A wild tuber called Nuronkizhangu was once collected from the forest and nowadays the availability of this product has decreased

Climate change anomalies/hazards

Kuttampuzha is badly affected by landslides and associated hazards during the monsoon. The flood of 2018 has affected the banks of Kuttampuzha river. Several native plants (Ama chedi) were lost from the riverbank which was one of the best plants for riverbank protection. Water scarcity is faced in all parts of the panchayats and is mainly due to the changes in cultivation and introduction of other plantations and construction of new buildings. No working quarries are under the panchayat.

Man-animal conflict

The instances of attacks have been increased compared to the past. The dry-up of water and other food sources in the forest results in the movement of animals in and around the fringe and enter to the farmland in search of food. The man-animal conflict is a routine in this area as the wild elephants, pigs, squirrels, and monkeys roam around the cultivated patch breaking the fence and other defensive mechanisms. Most of the people shifted to the cultivation of rubber to reduce the attack of elephants. The pineapple cultivation is mainly attacked by elephants.

Though several attempts have been made to establish water supply projects to various settlements all ended up in failure due to animal attack. Rubber plantations are threatened by the elephants as they eat the bark of the matured plants which will lead to the destruction of trees. The intake of these also creates health issues in animals. In the initial stages of establishment, the inhabitants used an instrument built by a piece of bamboo for preventing the disturbance of wild animals but now the animals have no fear and have adapted.

10. Major drivers of change Mankulam

Climate

There has been significant change in climatic conditions in the last decade from the 2010s. The observable changes in nature have increased in these years when compared with the previous decades. Landslides have become a major threat to the Idukki district as a whole in the last two years of 2018 and 2019. Landslides happen mainly during the peak of rainy days in the months of August. This situation has been no different in the case of Mankulam Panchayat. This has been correlated with the change in the rainfall pattern in the last decade. The rain spills out in its full strength within a short span of time and this usually leads to landslides in prone areas. Even though the quantity of rain has not decreased over the years, the nature of rain has transformed and this has resulted in another natural disaster drought. Instances of water scarcity can be seen as a result of the above mentioned and also due over exploitation of groundwater resources. Increasing temperatures also contribute to water scarcity which is on a steep rise in recent years. Global warming thus can be clearly seen as having an effect on this serene landscape of Munnar too. This has also affected the winter season of December and January where there has been a significant decrease in coldness. The changes in climatic conditions as a whole can be seen as an effect of global warming, but increase in frequency of landslides, drought instances and floods have caused due to drastic change in land cover and land use pattern.

Forest fires are natural phenomena that are a necessary evil. The rate of forest destruction due to natural fires and forest regeneration would hit a balance in natural conditions. Global warming had recently resulted in increased instances of forest fires. Forest fires in Mankulam in summers are common instances for tribals, these instances were always controllable. But a forest fire incident in 2018 experienced by natives shows the increased frequency and distribution of burning areas. Resource depletion in forest areas due to all these reasons had resulted in increased human wildlife conflicts. Instances of human wildlife conflicts have been steadily increasing from the past. This can be attributed to forest encroachment which is also very steadily increasing. Areas of forests have been increasing as per reports but the extent of dense virgin forests and rich resources inside forest is decreasing. The reduction of resources from forests also affects humans in a way where traditional forest dwellers no longer get their livelihood materials from the forest.

Agrobiodiversity

Agriculture sector had enormous changes in the last 3 decades or so with practical changes that had great market implications. These changes include a shift from food crops to cash crop cultivation, changed agriculture practices in the use of fertilizers, mixed farming methods and crop rotation. In earlier times of the 1980s, people cultivated food crops like traditional varieties of paddy, millets and tubers. Many varieties of them are cultivated among both tribals and native peoples. There was a severe shortage of food grains for people in those days when the public distribution system was not prevalent. Indigenous varieties of rice include peruvazha, Neelakkanny, Kunju kunju, vayal chanbal, and swarna valan which were popular among all sections of people in Mankulam. Ragi varieties were Talawari Sena, Meen Kanni and Sample Mudiyan. The paddy cultivation had vanished from this panchayat and millet cultivation came down very significantly with a reduction of more than ninety percent.

Traditional varieties of coconut, arecanut, aromatic ginger has reduced from being the major cultivating crops to mere minor crops. Similarly, the cultivation of rubber, turmeric and ginger have reduced when compared to the 2000s. The reduction in the above mentioned crops have given away to cash crop varieties like pepper, cardamom and cocoa. Cardamom which was not a popular crop among tribals in the 1990s has now become one of the most cultivated crop among them. Practice of mixed cropping which includes cardamom, pepper and cocoa has become the popular way of dodging market risks of any one of the crops.

Horticulture is prevalent in rural areas of Mankulam Grama Panchayat from early decades. There was an advent of excess usage of chemical fertilizers during the 2000s, but this practice was short lived in Mankulam where presently majority of farmers practice organic farming with limited use pesticides and chemical fertilizers. Presently tribal people too do active vegetable and fruit cultivation which mainly serve for their livelihood. However tribal people who mainly relied on forest resources for their livelihood had shifted to these cash crops for incomes. Forest resource depletion and lack of market for quality market for their Minor Forest Produces had paved the way for this shift.

Loss of Biodiversity

The effects of unscientific management in the highland area have created problems and the increasing population and need for resources force people to move towards the fringe areas. Devikulam, Kanthalloor, Vattavada faces water scarcity due to the low rainfall and rocky nature of the land. The plantations of eucalyptus and wattles are also a cause. Long term sustainability of this montane high range landscape must be ensured. Need for implementation of Organic farming policy is the need of the day.

Table. Findings of RRA

Sl. No	Panchayath	Lifestyle	Livelihood	Agriculture	Traditional Knowledge	Climate change anomalies	HWC
1	Munnar	Plantations Food habit: Syzygium, Garcinia, Honey, and mushroom	Tea plantations and Agriculture	Tea plantations	Herbal medicine and Koovappody	Landslide and flood 2018. chemical pollution of water, air, and soil due to factories	Bison, Leopard, Elephant, and Boar loss of agro bio diversity
2	Marayoor		Tourism	Sandal reserve	Herbal medicines- Vaidyans	Rain shadow region Water scarcity Groundwater exploitation	Thorny scrub - Acacia Terminalia Teak and Amla. Sparse and unique vegetation. Elephants and monkeys.
3	Devikulam		Plantation-Tea, eucalyptus	Plantation and Forest. Agriculture- Red Carrot, cabbage		Water scarcity Groundwater withdrawal- construction activities. Landslide and flood 2018. Dumping waste.	Elephant and wild boar. No compensation. Cheenivazha as a protection crop.

4	Chinnakanal	Muthuvan, Mannan, Ulladan. Rehabilitated & relocated people. Loss of traditional food and language Lifestyle diseases	Daily workers Plantation workers. Agrarians MFP collectors	Past- rice, wild mango, ragi. Now- Ginger, Cardamom, Pepper Organic farming	Not in use and not passed to next generation	Illegal quarries	Elephant, Peacock, Wild boar, Rat Rotation of crops - adaptation to HWC.
5	Edamalakudy			Orange, ragi, garlic, sugarcane, maize, Tubers Cattle rearing.			
6	Vattavada			Rice-15 yrs ago. Apple, orange, strawberry, blackberry and peach. Garlic and ragi. Unavailability of quality seeds, Cardamom- started.	Medicinal plants	Illegal quarry Water scarcity Safe from landslides and floods.	Wild boar, monkey, deer, bison
7	Adimali	Mannan, Muthuvan Traditional culture and language are dead. Now got modernised. Change of food habits- decreased life expectancy. Ecotourism.	Collection -Forest products and Agriculture. Forest products- Dammar, Honey, Marotty, Neruvettika, Pulinchi, Edannapoo, Pathri and Makkumkaa. Bamboo and Rattan	Paddy 45 yrs before. Cultivation- Costus sps. & Turmeric, Shift from food to cash crops. Now-rubber plantain, coco, pepper, coffee, clove, cardamom, nutmeg and vegetables. Organic farming- work with family labours. Cattle rearing Initiatives to preserve and conserve	Loss of traditional crop varieties. Peruvazha, Ceylon Kappa Traditional practitioners- herbs from the forest- Chathaaveri, paalmookka,	Landslide, flood and drought. Tourism led-, construction of roads, encroachment and construction along the river and streams. No quarries and other types of	Wild boar - damage to pepper and tapioca. Sambar deer and Barking deer- newly cultivated plants like bananas, tapioca, elephant foot yam.

			harvested sold- KSBC. Cottage industry-rattan Afforestation plantations- Kynna (Chooral), <i>Ailanthus excelsa</i> , New generation not interested- agriculture work. Lack of proper storage.	traditional varieties. Subsistence level farming.	kurunthotti, naruneendi. Medicines are secret. Wild Yam- high medicinal value. Sheevakka against dandruff and hair loss. Sheevakk- honey- if dried can be stored and used for years	mining	Squirrels and rats -cocoa arecanut Tribal hamlets - HWC- Elephant, Bison Leopard
8	Kanthalloor		Agrarian & Forest department.	Decreased water shortage. Paddy cultivation- replaced by other crops viz: sugarcane, vegetables, fruits- apple in cold climate.	Aloe vera- household medicines. Forest-honey, honey wax, <i>Acorus calamus</i> .	Water scarcity Only Mannavan Shola Population pressure and waste, construction of resorts and homestays.	Elephants and boards.
9	Kuttampuzha	Muthuvans, Malayarayans, Ullandans and Mannans Resettled population.	Agriculture, Tourism & Forest department Engaged in daily wage jobs. Tourism as an	Rice and ragi varieties. Traditional rice varieties are: <i>Peruvazha</i> , <i>Aringodan</i> , <i>Choramoodan</i> , <i>Adamoodan</i> , Jyothy, Aswathy etc. Past- Thina and Chama,	Rice variety "kunjukunju" - harvested within 90 days. Traditional practitioners	Decrease in the fish diversity in. Landslides and associated hazards - monsoon	Elephants

		No sufficient medical care. Alcohol consumption, pan and tobacco usage-increased. Change in lifestyle-tourism. Traditional language exists	income. Cattle rearing. Rattans and bamboos from the forest - cottage industries- Kerala State Bamboo Corporation. MFP's- Honey, dammar, arrowroot, pot tamarind, nutmeg, MFP- <i>Sida</i> sps. <i>Asparagus</i> , <i>Hydnocarpus pentandra</i> , <i>Acacia incia</i> ,-sold to Ayurvedic companies. MFP's decreased - compared to the past.	Lemon grass- lack of firewood. Now main crops- rubber, cocoa, coffee and pepper. Livestock- hen, dog and goat. Shifted mainly to rubber. Stepped into Cardamom, pineapple cultivation in leased land. Banana and pineapple mixed cropping.	died along with T.K. Refused to share the knowledge. Bitter-resinous substance from arrowroot -fish poison. Wild tuber- Nuronkizhangu- once collected from the forest- availability decreased.		
10	Mankulam	Lack of transportation Old generation is still continuing agriculture- the younger generations are not interested.	Tourism industries. Cottage industries Agriculture Organic farming Cattle rearing KADS collects the organic products.	In 10 years' time- areas under cultivation have declined. Struggle to find a market for their organic products. Plantain, arecanut and coconut, Tubers-tapioca, elephant foot yam and	Loss of traditional varieties.	Landslides and floods during the monsoon. Cloudburst like downpour Decreased fertility of soil.	Rice cultivation decreased to less than 5%- Elephants, wild boar, monkeys. Loss of forest and shift of subsistence level

				<p>taro. Jackfruit, mango and cocoa are attacked by monkeys. Food products to cash crops. Cardamom, Cocoa, Pepper- Karimunda, Neelamundi, Vattamunda. Tubers-Taro, varieties of Yam Diseases- Quick wilt & root rot. Seed and planting materials-Agriculture department, Govt. farms. No support for traditional varieties - government or any other departments.</p>			<p>agriculture to commercial. Loss of interest in cultivation-increase in crop raiding. Increased incidences in 10 years. Fruit crops - monkey.</p>
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HWC- Human Wildlife Conflict; MFP- Minor Forest Product; KADS- Kerala Agricultural Development Society.

Role of KSBB

- Need for Capacity building and institutional development.
- The need for sustainable and climate-resilient practices

Role of BMC

- Ability to mobilize the community through a participatory process

6. Best practises

Protection and Plant Varieties and Farmers' Right Authority (PPV & FRA) is a Government of India organisation under the Ministry of Agriculture and Farmers Welfare, to establish an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants which has been considered necessary to recognize and protect the rights of the farmers and plant breeders. To recognize the contributions of the farming community, the PPV & FR Authority also confers the Plant Genome Savior Community Award, Plant Genome Saviour Farmer Rewards and & Plant Genome Saviour Farmer Recognitions every year. Plant Genome Savior Community Award is awarded to the community of farmer's/farming community based organizations who have a long track record for conserving plant agro-biodiversity which is open to all Indian group of farmers, community of farmers, particularly the tribal and rural communities engaged in conservation, improvement and preservation of genetic resources of economic plants and their wild relatives particularly in the areas identified as agro biodiversity hotspots.

Four spices have been notified by the PPV & FRA, viz., Black pepper, Small cardamom, Nutmeg, Ginger and Turmeric. Farmer's varieties registered with PPV&FRA include Pepper Thekkan, Kumbuckal Selection and Agali Pepper in black pepper and Panikulangara green bold no.1, Panikulangara green bold no.2, Ela (Elarajan), Wonder cardamom and Thiruthali in case of small cardamom.

a) *Pepper Thekkan:* Pepper thekkan is a novel breed of pepper developed by T T Thomas Thekkel of Kanchiyar, Idukki. Pepper Thekkan had grabbed PPV&FRA recognition because of its exclusive high yields of about 8600 kg (max) annually per acre, approximately 10 times higher than other varieties. The berries are comparatively larger, with good weight and greater pungency. The peculiarity of developing 3 branches is the reason for its high yield and grafting gives the same even in organic farming. Foliar fertilization gives better results in Pepper Thekkan than the rootziers. Disease resistance is also seen to be higher in Pepper Thekkan. Along with pepper, cardamom and fish farming is done. Nursery is maintained for the sale of Pepper Thekkan. He manages a nursery for Pepper Thekkan for its sales. T T Thomas Thekkel was honoured with awards from National Innovation Foundation, President Award for Pepper Thekkan, Plant Genome Saviour Award of KSBB and has received patent for the variety Pepper Thekkan.

b) *Kumbuckal Selection:*A pepper breed developed by Mr. K T Varghese from Cheruvallikulam, Murinjapuzha, Idukki. The variety is cultivated along with rubber, nutmeg, and arecanut. The variety gives year round production and is almost unaffected by climate change as even in 2019 summer which was a bad year for farmers in general. During the 1980s and 90s, a wide destruction of pepper due to the spread of root disease called 'quick wilt' happened where Kumbackal Selection survived exhibiting its high disease resistance. The variety gives an average yield of 400kg/ acre under organic farming and is sold at Peermade Development Society. The variety has the peculiarity of uniform ripening of berries in a single spike. Kumbackal selection is a drought resistant variety due to its better root circulation. Along with this other variety under cultivation are Panniyur, Karimunda, Chipilimundi, Neelamundi, Arayamundi. Mr. K T Varghese owns 3 patents for his breed, maintains a nursery and his contributions were honoured with National Award in 2007.

c) *Panikulangara Green Bold No. 1:* A novel breed of cardamom developed by Mr. Joy Peter from Panikulangara, Kallara-Vattar, Idukki. The variety is resistant to diseases like 'early capsule borer' and is appealing with its large size, good shape

and bright green colour. The peculiarity of the variety to grow even under low shade than the one need large canopy, the breeder has given up Malabar and Mysore varieties which have been under cultivation for the past 60 years and shifted to own developed Panikulangara Green Bold No. 1. The variety gives an average yield of 1.5 kg/ plant and varies to maximum 5 Kg under utmost care. Unlike other varieties, the number of new sprouts from the base increases after the first harvest. Fertilization done during summer and pesticides are used at an interval of 30-40 days which is less frequent compared to other varieties which need pesticide application at an interval of 20-25 days. Along with this variety, pepper (Karimunda, Chengannoot), nutmeg, cocoa, coffee and clove are also there under cultivation in 100 acres while lack of human resource becomes a hurdle.

d) Panikulangara Green Bold No. 2: Another variety developed by Mr. Joypeter with better qualities than No.1. The then developed one needs lesser shade, has more oil content, better polish and greenness. The Panikulangara Green Bold No. 2 grows straight and is more resistant to drought. Each koth has 30 fruits which are basically small. Kothaduppam is also higher in No.2 than in No.1.

e) Thiruthali: The novel cardamom variety developed by Mr. T.P. Joseph Thiruthali House, Pethotty, Santhanpara, Idukki. Cultivated in the low temperature, Thiruthali is resistant to diseases like shoot panicle and capsule borer and rhizome weevil. The pesticide application for borer is done at an interval of 40-50 days and for rhizome weevil 2 times per year. The yield from Thiruthali is site and climate specific as it gives results in Santhanpara Panchayat with low temperature climate. Good yields are also reported from Wayanad and Nelliambathy with similar climatic conditions. Though a variety Njellani, popular with its bolder looking fruit exists, the market for Thiruthali is climbing recently owing to its high oil content and better dry to wet weight ratio. The variety Thiruthali is drought resistant and needs no irrigation. Climate change has made a severe impact on the variety that the yield has reduced in the last two years (Earlier 4 major and 2 minor harvest, now reduced to 2 major and 4 minor harvests). Fertilisation is done in summer before the advent of rain in May.

Organic fertilisers are used along with Bodo mixture. Other varieties of cardamom under cultivation include Valga, Njallai, Paalakodi along with pepper, nutmeg, coffee.

f) Ela(Elarajan): The variety of cardamom developed by Mr. K J Benny, Kalarickal House, Puliyanmala, Idukki, suitable for cold climate. The yield of this variety is about 1000 kg/ acre in the first year and 500 kg in 2nd year maintaining an average of 500 kg/acre per year. The variety gives high yield owing to the extra bolt, and fetches Rs 100 per kilogram more than others due to its appearance and tough skin. Elarajan requires good shade and water. Pesticides are applied at an interval of 30 days, followed by cleaning and intense mulching done to avoid rhizome weevil. Chemical and organic fertilizers are used along with the pesticide application. In the first round harvest 1kg of dry cardamom is obtained from 6 kg of fresh pods, in the second round harvest 1 kg dry / 5 kg of fresh pods. Both Njallani, a popular variety, are cultivated along with Elarajan and the yield has decreased to 3-4 rounds compared to the 6 rounds in the past due to climate change.

g) Wonder Cardamom: A novel variety of cardamom developed by Mr. Sabu Varghese, Vanderkunnel House, Valiyathovala, Kattappana, Idukki. The peculiarity of Wonder Cardamom is the adaptation to hotter climate and as a successful intercrop along with rubber. The adaptability to high temperature makes promise to the future in the view of increasing climate change and rising temperature. The variety has good oil content, good dry weight and is resistant to root decay and cesarean disease. Pesticides are used at an interval of 40-60 days, but less frequent to other varieties. The efficiency and effectiveness of pesticide application is ensured using nano-spraying and the practice is devoid of chemical fertilisers to prevent root damage. Organic and poly R fertilisers are used along with microfood and Rajphos. The variety requires an average level of irrigation and mulching is maintained all year around except during floods in fear of rotting. Though resistant to hot climate, the recent changes in climate had an impact on the yield, maintaining the average. Approximately 400-600 kg per acre and in summer

3-4kg of fresh pods gives 1 kg of dry pod while in winter 5.5 kg is required to get 1 kg dry pods. The other varieties under cultivation are Njellani, Elarajan, White Flower, Thiruthali in cardamom and Panniyurman, Karimunda, Neelamundi in pepper.

Best practices identified from the study area in Idukki



Fig. Identified Best Practices in HRML study area of Idukki

Table Identified Best Practices in agriculture sector from the HRML study area-Idukki

Place	Rice variety	Quantity	Agriculture practice	Advantages	Outcome
Variyam Kudi - Kuttampuzha	Peruvazha	17 families	Stubble burning practiced, to compensate manuring (using <i>Ochlandra trauancorica</i>) Intercropping with Pigeon pea, Pearl millet, ragi, maize-harvest respectively after sowing them simultaneously. Rice is harvested at last Use of family labor. 4-6 months' cultivation cycle Only for domestic use.	Cultivation done twice a year ensuring better food security High disease resistant variety Low water requirement	Seed bank of rice and millets. Organic and safe produce Conservation of traditional rice variety
Kozhiyala kudi - Mankulam	Peruvazha	3 families (50 cents)	Fallowing is practiced. 4-6 months' cultivation cycle No marketing	Cultivation done twice a year ensuring better food security Tastier than new rice varieties & have an attractive smell. High disease resistant variety Low water requirement	Organic and safe produce Conservation of traditional rice variety

Table No. . Identified Best Practices from the HRML study area -Idukki

Place	Unit	Practices	Advantage	Outcome
Mangapara Kudi - Mankulam	Hydropower generating Station	Generation of electricity by tribal community. Constructed a small dam and a mini power station. Funds from the forest department & the tribal department. Maintenance by tribes itself.	6 KWh power, to accommodate 50 families. No extra meter charges or other expenses. Enough electricity to meet essentials. Help for kids in studies. Emergency lights, mobile and television.	Accessible to basic amenity. Reduced fossil fuel usage. Reduction in number of animal attacks
Adimali	Plastic recycling Unit	Association with Clean Kerala Company & Suchitwa mission. Sorted into two categories- low quality plastics for road tarring and high quality plastics are recycled into plastic pipes. Waste from ten other panchayats are also collected.	Reuse of plastic. Job opportunities for women. High quality plastic pellets are sold to companies at a rate of Rs.45/Kg.	Reduction in plastic waste. Women empowerment
Marayoor, Kanthalloor	Marayoor Jaggery	Cultivation of sugarcane. Sweetest jaggery made in traditional methods. Competition from low quality jaggery from Tamil Nadu. In traditional methods, processing works done with hand.	No use of chemicals during manufacturing. Highly sweet, dark brown color, high iron, with less sodium content and insoluble impurities.	In 2019 the product received the G.I tag.
Ozhuvathadam - Adimali	Handloom Manufacturing Unit (Currently inactive)	Handloom manufacturing unit run exclusively by tribals in Adimali - Muthuvans and Arayans. Made bed sheets, school uniforms, other garments	Income generation for tribals. Formation of self-help group	Lack of training to newer machines being outcompeted in market. Can take up activity if given training.

(Munnar)

Expert Consultant Meeting - Minutes

Date: 12/03/2019:

Time: 11:00 am to 3.30 PM Participants:

Dr. S.C. Joshi IFS (Retd.), Chairman, KSBB

Prof. E. Kunhikrishnan, Associate Professor (Retd.), Department of Zoology, University of Kerala, Thiruvananthapuram

Dr. Jomy Augustine, Associate Professor and H.O.D, Dept. of Botany, St. Thomas College, Palai, Kottayam

Dr. V. Balakrishnan, Member Secretary, KSBB

Dr. Preetha N, Technical Associate, KSBB

Dr. Pradeep C.G, Technical Associate, KSBB

Divin Murukesh, Research Associate

Bindya A, Project Assistant

The meeting was chaired by Dr. S.C. Joshi IFS (Retd.), Chairman, KSBB. Chairman gave a brief overview of the project and the objectives were discussed in details. A tentative work plan including draft questionnaire for conducting FDGs were circulated. It was explained that the main objective was to develop a methodology for PBR preparation and incorporation of the major gaps identified in the PBR (Annexure). It was also noted that the documentation of process of creating standard PBR is also necessary. It was suggested that the PBR formats may be modified to incorporate all the necessary information. Meaning thereby that these modified formats should be finally fitted in recently prepared ePBR by NIC, Thiruvananthapuram. Therefore it must that UNDP team may interact closely as many times as required with NIC officials, particularly Dr. Kasthuri so that the modifications suggested by UNDP experts are made within the boundaries on suggestions limitations suggested by Dr. Kasthuri in order to ensure that suggestions after field visit by UNDP consultants get adjusted in the e-PBR made by NIC. This is highly essential as KSBB has already developed an e-

PBR after working with NIC for more than one year and utilizing about 9.9 lakhs of rupees on the finalization of ePBR format to make it user friendly and more useful by rationalizing existing formats, simplifying some of them and adding certain new fields. Therefore, it is essential that UNDP expert team must discuss with NIC along with Dr. Preetha to understand how the new ePBR being suggested under the project (after standardising the methodology) could fit in the ePBR now being filled up by LSGs in coming months. This is essential to avoid any incompatibility issue with ePBR already made by NIC.

Member Secretary, suggested on focusing on supply chain and value chain of the tradable bio resource of the concerned panchayat. He pointed out that prioritizing the areas is necessary otherwise huge volumes of data will be generated which will be difficult to handle. Accordingly it was suggested that key areas shall be bioresources having commercial potential and IPR for medicinal, food and nutraceuticals, biocultural practices. It was agreed that since the methodology will be implemented across the state while updating PBR certain thumb rules has to be developed for collection of information, identification of knowledge providers, for conducting FDGs, PRAs etc. Kunhikrishnan pointed out several cases studies relating to the traditional knowledge practices relating to soil, resource use etc. It was suggested that a handbook will be brought out regarding incorporating the methodology and thumb rules. The work done during the 1st phase of the project was explained and it was decided to incorporate the data also in the present work and avoid duplication of work

Dr. S.C. Joshi concluded with opinion that as part of this project at least one model PBR will be developed and that data collection for PBR updation is a continuous process and suggested the experts to continue the discussion with the newly appointed team for field execution. The expert team suggested mapping of study area using GIS technique. It was also decided to conduct monthly meetings at Head office regarding the progress of the project.

As per the discussions the objectives were reworked as:

1. Systematic Group wise and Taxa wise documentation and compilation of available information.
2. Documentation of the economically important plants, animals, microbes, insects etc., and supply chain, value chain of tradable bioresources.
3. Identification of the research and management priorities and recommend policy and plan initiatives for long term conservation of Munnar landscape.

Initial Action Plan

- ✓ In the first phase of discussion Prof. E. Kunhikrishnan suggested to collect secondary data of Birds, Butterflies, Reptiles, Odonate, fishes and Amphibians from scientific journals to find their type locality, endemism, IUCN category, scheduled category, and comments on its population status.
- ✓ As a byproduct of this categorisation, he pointed out the possibilities of upgrading the species if data deficient and the possibilities of incorporating it as notified species under Section 38 of BD Act.
- ✓ Collection of existing data of flora and fauna using various resources such as E bird, forest department reports, surveys, ZSI, newspaper cuttings and photographs etc.
- ✓ Sampling sites are to be finalised with an objective of all representative locations of the study area. Altitude may also be considered while selecting the study location.
- ✓ Dr. Jomy Augustine provided various sources and references on flora of the study area.
- ✓ It was suggested to get required permissions for the KSBB team from Forest department.
- ✓ The team planned for incorporating external resource persons in the respective fields for the upcoming field study.

- ✓ The team planned for a preliminary field visit on 29th March to 31March2019 (tentative).

Expected outcome: Development of standard methodology of it for preparation and upgradation of ePBR and development of at least one PBR as model PBR and its seamless incorporation in the ePBR created by NIC which is now going to be filled up by LSGs.

The meeting concluded at 3:30PM

**MINUTES OF THE FIRST TECHNICAL AGENCIES MEETING FOR THE
GOI-UNDP- GEF INDIA HIGH RANGE MOUNTAIN LANDSCAPE PROJECT**

1. The meeting with the Technical Agencies for the GoI-UNDP-GEF India High Range Mountain Landscape Project was held at Hotel Hycinth, Thiruvananthapuram on June 18, 2019 at 10.30 a.m. under the chairmanship of Dr. S.K. Khanduri, Senior Technical advisor, UNDP and Smt. Padma Mahanti IFS, State Nodal Officer, as Co-Chair. The list of participants is attached as Annexure 1. At the onset, Shri. Jerin Thomas Abraham, Project Officer from the Project Management Unit (PMU) welcomed all the participants and facilitated a round of introduction. Thereafter, the context was set by Anusha Sharma, Project Officer, and NPMU. She gave an overview of the project and its deliverables.
 2. The chairman apprised the committee of the immediate need to kick-start the various programmes and called for a coordinated effort between the various Technical Agencies and the PMU to ensure successful realization of the project outcomes. He then invited the agencies to present their work updates and concerns, if any.
 3. The first presentation was made by Co-Investigator Dr. P. Balasubramanian, Senior Principal Scientist, Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore. He presented the updates on “Ecosystem requirements of Hornbills and assess the status and distribution of select mammals in Anchunad and adjoining landscape”.
- Dr. Balasubramanian reported that the Indian Grey Hornbill was not figured during the observation visits to Munnar landscape; other species figured include Great Hornbill, Malabar Grey Hornbill and Malabar Pied Hornbill; the species figured were categorized based on the forest types,

protected areas and tree species; ideal location for nesting is Evergreen forest areas; *Macaranga peltata* was observed to be the favoured food plant of Malabar Grey Hornbill; Vazhachal and Thattekkad areas are in the first and second positions, respectively regarding the number of species located and that the hornbill breeding season is from January-April. He also explained a format of literature survey sample sheet. Further, he explained that similar studies have already been conducted in Nilgiri and Anamalai, however in the Munnar landscape, studies have been conducted only in Vazhachal area. Hence the study is relevant to the project and the distribution map presented is relevant to the study since no such data is readily available. A list of mammals occurring in Anchunad landscape was also presented.

- In response to the presentation by SACON, the State Nodal Officer, Smt. Padma Mahanti, IFS, indicated that additional data on shifting of nests and changes in nest patterns will be helpful to have more insightful findings. She stressed on the need to understand the changes in breeding seasons, if any, in the post flood scenario. She also highlighted the need for detailed literature review and clarified that the field data should substantiate the purpose of the study. She also requested SACON to compare the change in hornbill population size, nesting pattern and nesting location with available literature.
- Shri Baiju Krishnan, Assistant Conservator of Forests, Department of Forest and Wildlife, suggested to analyse the regenerative status of associated species. He also suggested to undertake local migration analysis using invasive molecular tools, to which SACON replied that molecular aspect is not built in the project and may not be possible.
- The Chairman commented that there is a need for preparing a large mammals distribution map and specific data about the landscape. He further suggested SACON to focus on 1 or 2 species of mammals.

- The PMU clarified that the Project Results Framework mandates report on Nilgiri Tahr and Malabar Grizzled Squirrel. The PMU also requested SACON to map the threats intensity and device plans for threats and conservation management and effective monitoring of the protected areas.
- In response to the concern raised by SACON regarding clarity on project area, the State Nodal Officer clarified that more prominence is to be given to the landscape units rather than the administrative divisions.
- The constraints raised by SACON include the non-availability of adequate population data, limited literature review available for certain species and ambiguity regarding the Terms of Reference. They also committed that the distribution map would be prepared once the entire landscape is covered.
- The second presentation was made by Dr. Udaya S. Mishra, Professor, Centre for Development Studies and Consultant with the Kerala Institute of Local Administration (KILA) on the “Creation of benchmark for socio-economic database”.
- The data presented was primarily descriptive in nature based on the previous studies. Creation of benchmark for socio-economic database for concurrent evaluation and understanding the effectiveness of sustainable resource governance in the landscape is the major focus of the study. A comparison of 11 Grama Panchayats in terms of work participation rate, gender composition in Agri and Non-Agriculture Livelihoods and SC/ST demographics was presented. Other important aspects discussed include migration and climate change in Munnar landscape based on the rainfall changes over a period of 6 years. Dr. Mishra added that the comparison of a period of 15-20 years of rainfall data is required to depict the significant changes.

- The Chairman stated that there could be variations in the Munnar landscape from Idukki district in general. Hence, there needs to be more focus on the economic activities in natural resource sector, livelihoods pattern and financial inclusion in the Munnar landscape specifically. Regarding access to markets, he suggested to include subsistence-based livelihood analysis.
- The State Nodal Officer suggested KILA to undertake impact study and alteration reasons for drift in female to male work participation. She also requested KILA to include temporal profile change of population characteristics and economic characteristics and record whether the profile change is in response to natural changes; prepare database on subsistence-based and commercial activities; document the history of landscape with respect to landuses, landscape and migration and record livelihood patterns of new generation, which is not dependent on tea industry. She indicated that gender composition in the work participation rate is an important aspect to be studied further.
- The PMU added that a stock assessment of contemporary issues at the panchayat level regarding the patterns of revenue, migration, tourism and unemployment over two decades could give a comprehensive picture of the socio-economic scenario in the project landscape. PMU also stressed the need to record the livelihood patterns of the new generation in the project landscape, not dependent on the tea industry.
- Proposed interventions by KILA intend to bring forth a comprehensive picture of livelihood patterns, indirect indicators of market dependence and history of the landscape.
- It was decided to convene a separate meeting of KILA with the PMU.
- Dr. Jibini V. Kurian from KILA further presented the updates on “Social change among Tribes - trajectory of development - focus on Edamalakudy”. They proposed the tools to be used for the study and

informed that 20% of the total households (874) would be considered for the sample survey.

- The Chairman suggested that there is a need for focusing on the cultural history and detailed review of literature is needed.
- The State Nodal Officer pointed out that effect of cardamom cultivation on the socio-economic framework needs to be included and that the newly introduced high yielding varieties of cardamom and its impact on the forest fragmentation is to be studied in detail, since there has been a shift from collectors and gatherers to agriculturists. She asked KILA to elucidate the impact of introduction of high- yielding variety of cardamom on the socio-economic fabric. She also stressed the need to focus on the trend of indigenous cardamom variety being taken over by high-yielding variety by proxy planters. She further requested to explore the possibilities of system reversion and restoration of gene pool; undertake specific review of literature as a prerequisite for the study; focus on migration of Muthuvans and its economic implications and also on fragmentation due to roads, total electrification, etc. and clarify on end-market for produce.
- Shri Baiju suggested to explore socio-economic effects of man-animal conflicts and assess the degree of change in forest dependence. ➤ The PMU suggested that higher focus may be placed on life and livelihoods; dependence on the forest-based livelihoods; change of food habits over the period; status on the use of traditional knowledge and the influence of proxy planters.
- The third presentation was made by Team Leader, Shri. C. Dinil Sony, Senior Principal Scientist, Centre for Water Resources Development and management (CWRDM) on “Hydrological Investigations in the High Range Mountain Landscape, Kerala.”

- The presentation was based on proposed outcomes such as hydrological investigations in high range landscape, water availability, estimation of water demand, preparation of water resource management plan and technical support to LSGIs. He explained that the Government water schemes are based on the spring/streams-based water sources and water availability is adversely affected during the summer season. Five water samples were reported to be collected from each location except Edamalakudy and three wards of Athirappilly, making a total of 597 samples. The highest pH value was reported to be obtained from ward 5 of Athirappilly (9.02) and the least value from ward 3 of Marayoor (4.52).
- State Nodal Officer specified that 20% increase in the water quality is one of the indicators to be achieved by the end of this project and hence, other relevant factors influencing the water quality needs to be focused in detail; post flood scenario is to be taken into consideration and the audit of available structures and the ones clogged post flood needs to be taken up. She reiterated that CWRDM is expected to come up with specific recommendations towards the achievement of the desired outcomes.
- The Chairman indicated that there is a need for checking the availability of watershed maps and the data regarding the ground water/other water resources.
- The PMU stressed on the requirement of GIS maps indicating the water sources and possible infrastructure that require renovation in the landscape at the earliest. PMU further explained that the project aims to develop one demonstration model in each panchayat and therefore, among the 11 Gram Panchayaths, at least one structure each requiring renovation needs to be identified scientifically within this year to initiate implementation. Also, the PMU requested support for determining the causes of pollution and devising remedial measures for the revival of Nallathanni River.

- The fourth presentation was made by Principle Investigator, Dr. R. Jayaraj, Scientist, Kerala Forest Research Institute (KFRI) on “The pattern of usage of pesticides and their impact on the ecosystem of plantations and adjacent areas in the GEF Munnar Landscape project area”. He explained that the study focuses on the major cropping systems in the project area and pattern of pesticide usage in the region, analysis of various potential pesticide residues in different matrices and effect on the environment and fauna. He further informed that the sample collection strategy would be random sampling method.
- The State Nodal Officer requested to specify the end results of the study. In response to this, the Principal Investigator indicated that there is extensive use of pesticides in tea estates in the landscape and recommendations for sustainable practices could be stated. However, the Principal Investigator opined that adoption of such practices by the tea estates may not be practicable due to various other factors.
- The Chairman suggested to include more data from the impact areas and stressed on the need to focus more on sustainability and conservation. He suggested to collect more samples from downstream and compare with forest near plantations and forest in upper reaches. With regard to studies on animals, The Chairman requested to strategize sample collection from road kills, natural death, etc. in coordination with forest officials.
- Shri Baiju suggested to focus on pesticides proposed to be banned or alternatives suggested for recommendation to government.
- The PMU suggested to formulate mitigation plans / best practices for pesticides across India.
- The Chairman requested KFRI to focus on sustainability of crops subjected to pesticide use and deduce means to mainstream conservation in production sectors.

- Dr. V.B. Sreekumar from KFRI further presented the updates on “Study on diversity and current status of fish and fisheries in GEF-Munnar landscape project area”. The presentation focused on the fish species and biodiversity pattern and reported that 53 fish samples were collected from 15 field surveys and 61 species of fishes were identified, including. Critically endangered (02), endangered (09), vulnerable (06) and near threatened (01). The need to study the adverse effects in the Chalakkudy region due to the floods were highlighted. It was also informed that pre-flood data is not available. The highest number of fish species were reported to be identified from Athirappilly (49 species), followed by 25 species from Kuttampuzha covering the Pooyamkutty and Edamalayar. The inter linkage of migratory birds and fish fauna in Thattekkad and the lack of sufficient literature on this topic from the project landscape were also highlighted. Further, general findings such as community fishing from dam areas such as Gundala, Mattupetty and Athirappilly areas were presented.
- The State Nodal Officer suggested to study the changes in fish diversity pre and post floods, wherever it is applicable. She stressed on the need for recommendations towards regenerating or reintroducing the indigenous varieties. She also asked to elucidate the dependence of local community on fishing, taking into consideration the impacts of introduction of exotic species. She further suggested to explore any shift in fish species post flood, analyse pre-flood and post-flood scenario and means of revival. She also requested to record the extent of invasive species in bird sanctuaries, since migratory birds are dependent on indigenous fish species.
- The PMU suggested to study the impact of the loss of riparian forests in the project landscape on the indigenous fish varieties.
- The Chairman requested the PMU to immediately follow-up the status of the proposal to study the impact of invasive alien species on ecology of

GEF-Munnar landscape project area and adopt requisite measures to facilitate commissioning of the study on urgent basis.

- The fifth presentation was made by The Kerala State Biodiversity Board (KSBB) on “Documentation and compilation of existing information on various taxa (flora and fauna), and identification of critical gaps in knowledge in the GEF-Munnar landscape project area.” KSBB identified several gaps in maintenance of People’s Biodiversity Registers (PBRs) in the panchayats and reported that the Biodiversity Management Committees (BMCs) are ineffective in the project areas. Another finding reported was pertaining to the overexploitation of medicinal plants and lack of awareness in Access and Benefit Sharing (ABS) was raised as a major concern. Trade analysis of Pinari, Karimkuri, Marotti and Pachottitholi was shown in the presentation.
- The Chairman and the State Nodal Officer enquired whether sufficient literature was available from the project area. They suggested to focus more on the prominent bio-resources such as honey, jaggery etc. They also indicated that the project implementation should focus on the capacity building of BMCs and suggested KSBB to work in collaboration with the PMU. The State Nodal Officer further suggested to focus on the biodiversity heritage sites, documentation of traditional knowledge and its use in livelihoods and water conservation. In response to this, KSBB specified that only limited literature is available on tradable bio-resource.
- The PMU suggested to focus on value-chain analysis of potential products like honey, jaggery, cardamom, etc. It was also decided to convene a separate meeting between the PMU and KSBB to device conservation strategies to protect the RET species and degraded forests.
- KSBB further presented the updates on “Review of ecological and development history of various sectors and changes in selected ecological units in GEF-Munnar landscape project area”.

- The Chairman and the State Nodal Officer specified the need to source secondary information from earliest timeline available by reviewing Gazettes, old work plans and Reserve Notifications. They also requested to define the gaps in secondary data.
- Shri Baiju suggested to focus on vulnerable and endangered specific niches and habitats.
- The following modalities were suggested by The Chairman and the State Nodal Officer to enable the smooth functioning and implementation of the project.
- Monthly review meeting between the Technical Agencies and the PMU by means of Skype calls/Video Conferences, wherein, the alignment of project activities with outcome may be reviewed.
- All studies should state necessary literature review and based on it the uniqueness of the study.
- The project deliverables may be reviewed by a group of experts, selected by the

State Nodal Officer, State Project Director and PMU.

- Status of payment can be intimated to Principal Investigator and PMU.
- Project officers of PMU will be the point of contact of all Technical Agencies and all reports may be copied to PMU.
- For duplication check of project activities, as well to have better coherence with the Project objectives and outcomes, the PMU will share a template to the Technical Agencies for sharing information on the nature of work and data.

- Field visits in Munnar landscape will be facilitated by the PMU, upon prior intimation through the State Nodal Officer. Visits of various agencies to remote areas like Edamalakudy may be coordinated and calendar may be prepared for the visits.
- The second progress report may be submitted by the Technical Agencies to UNDP with copy to PMU, incorporating the comments and reviews of this meeting.

The Chairman thanked the committee members for their valuable presence and updates and requested a coordinated effort between the Technical Agencies and PMU to avoid duplication and facilitate implementation of the project.

List of participants of the first Technical Agencies meeting for the GoI-UNDP-GEF India High Range Mountain Landscape Project, held on 18.06.2019.

Sl. No.	Name, designation & Organisation	Contact Details
1.	Dr. S.K. Khanduri Senior Technical Advisor, UNDP	9871800409 skkhanduri57@gmail.com
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9	Mr. C. DinilSony Scientist, CWRDM	9447192202 dsc@cwrdm.org
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KERALA STATE BIODIVERSITY BOARD

Opening:

Meeting minutes

June 26, 2019

The regular meeting with consultative experts for the implementation of UNDP-HRML

Projects:

- i. Documentation and Compilation of Existing Information on Various Taxa (Flora and Fauna), and Identification of Critical Gaps in Knowledge in the GEF-Munnar Landscape Project Area;
- ii. Review of ecological and development history of various sectors and changes in selected ecological units in Gef-Munnar landscape project area.

Meeting was called to order at 11:00 AM on June 26, 2019 in the Head Quarters of Kerala State Biodiversity Board. •

Present:

Dr. S. C. Joshi IFS (Retd.), Chairman, KSBB (Principal Investigator)

Prof. (Dr.) B.R. Reghunath, Retd. Dean, Agro biodiversity, Kerala Agriculture University, Vellayani

Prof. E. Kunhikrishnan, Associate Prof. (Retd.), Dept. of Zoology, University of Kerala, TVM

Dr. Radhakrishnan P., Director Project, Global Urban Canopy, Thrissur

Mr. Anand Zacharias, Scientist, MSSRF, Changanassery

Dr. V. Balakrishnan, Member Secretary, KSBB (Co-Principal Investigator)

Dr. N. Preetha, KSBB (Technical Associate)

Dr. S. Rajasekharan, Senior Project Consultant (only in AN session)

Mr. A. L. Aneesh kumar, KSBB (Research Associate)

Mr. M.K. Justin, KSBB (Research Associate)

Mrs. Haritha, KSBB (Project Assistant)

Miss. A. Bindya, KSBB (Project Assistant)

Presentations:

Aneesh kumar and Justin presented the activities done so far and major difficulties faced in the field level implementation. In between the presentation, chairman and other technical experts raised questions and suggestions were made for next level programme. The highlighted suggestions are listed below.

Key outcomes:

The key outcomes of the Study 1 based on discussions and the review meeting of UNDP are:

1. Data of flora and fauna of project areas Focus on threatened and endemic species.
2. Data of tradable bio-resources Focus on medicinal plants and threatened species.
3. Identification of areas of biodiversity importance (e.g. Areas where endemic species of Balsam are found).
4. Checklist of RET and endemic flora of Anjunad valley.
5. One of the most important outcome is to develop methodology for PBR upgradation. (This should be done as suggested in Technical suggestion point 2)
6. (Video and Success stories) of best practices related to Biodiversity conservation.
7. Checklist of Illegal (smuggling) and unsustainable bio-resources traded with emphasis on medicinal plants and threatened species.
8. Identification of bio-resources with ABS potential. Chairman suggested that this should be done after discussing with foresters, angadikada people,

Vaidyans, tribal societies and other known sources as suggested by Dr. B.R. Reghunth in Technical suggestion point.

8. Chairman in gist suggested to use all possible sources of information both secondary and primary after brainstorming on probable sources with the help of experts on the subject both of line department, stakeholders (Tribals, Tribal Cooperative Society, Angadikada, middle men, final consumers or traders etc.).
9. Documentation of the impact of landslides/ floods on selected ecosystems and Keystone/ Indicator species and suggest management practices based on this.

The key outcomes of the Study 2 based on discussions and there view meeting of UNDP are:

1. Spatial delineation of landscape-level changes in Munnar.
2. Details on cultural, historical events and development activities that led to landscape changes.
3. Documentation of agents that driven landscape changes; its impacts and root causes.
4. Finally to suggest strategies of Sustainable development.

Technical suggestions:

- a. Chairman pointed out that during identification of areas of biodiversity importance the criteria should include ecologically significant flora and fauna along with economically significant ones.
- b. Chairman also pointed that social impacts and livelihood of natives will be worked in the area and developmental activities in the development sectors such as (i) Plantations & horticulture; (ii) Animal Husbandry; (iii) Tourism; (iv) Transportations and (v) Hydel (buffer zone impacts); (vi) Quarries (vii) Man-Animal Interactions (various Social-Rehabilitation Policies). In the plantation sector, the following sub sectors can be

prioritized, Tea, Cardamom, Eucalyptus, sugarcane, Fruit and vegetable crops; Rattans; Sandals. He also mentioned that the impact of swapping cultivation of tea to eucalypts and vice versa should be included in the study. In short Chairman emphasized for the second project a landscape level change ie. how different land uses have changed with increased tourism, conversion of CHR area into resorts, conversion of CHR areas into hardy cardamom crop after felling evergreen species, taking up cultivation on slopes, changing courses of rivers etc.

- c. Chairman suggested that II study should ultimately be suggesting probable strategies for sustainable development of the area for future based on the changes, factors causing changes, all consequences.
- d. Chairman pointed out that solutions for sustainable management also be included after the analysis of landscape changes regard to all the usually not captured details.
- e. It was stressed that development of a methodology for updation of PBR should be a significant outcome. Essentially to identify and standardize the techniques of field level data collection through personal interaction with formal and informal tools with regard to all the usually not captured details. For identification of species/ varieties best possible software can be suggested after thorough search and study of existing software.
- f. Kunhikrishnan Sir suggested that clarity about the selected Grama Panchayath and study area should be there. Also, it was suggested that instead of 'Anjunad Valley' study area should be mentioned as 'Munnar Landscape'. Another suggestion is that Periyar catchment area should be assigned as prime concern other than Chalakkudy catchment area as all the 10 Panchayath except Athirapally is coming in Periyar catchment. This is supported and agreed by the Chairman, KSBB. Dr. Kunhikrishnan suggested that landscape study should be based on (i) Riparian; (ii) Sholas and (iii) Grasslands. These are the fragile ecosystems which dramatically

change the Munnar landscape. 20 years changes will be compared with the help of Satellite images.

- g. Tribal' s socio-economic activities and other life styles which include handicrafts and associated cultural activities should be considered, along with other missing details in existing PBR and how to capture them through a tool proof practical methodology.' Methodology has to be discussed and standardised.
- h. Categorization of RET list of flora and fauna should focus on two specific aspect (i)Economic significance and (ii) ecological significance.
- i. Prof. (Dr.).B.R. Reghunath suggested that data for tradable bioresources can be obtained from tribal societies. Prepare questionnaires and discussions should be focused in to Tribal Co-operative sectors, Forest watchers, traditional practitioners etc. For collecting primary data related to the tradable bio-resources there will be practical difficulty in obtaining data from Angadi kada.
- j. Soil information should be collected and soil maps obtained from Soil survey dept. 1, Panchayath/ agriculture Dept., 2, Land use board etc.
- k. Mr. Anand Zakariya pointed that the soil texture is completely changed after the flood. So comparison study (Area in 10 years before flood; present; 10 years after flood) is necessary and can be used for wider area planning such as soil quality assessments and conservation in future.
- l. Mr. Anand zakariya suggested the identification of BHS with the help of free software 'MaxEnt' (from AMNH) which is used for modelling species niches and distributions. [https://biodiversityinformatics.amnh.org/open source/maxent/](https://biodiversityinformatics.amnh.org/open_source/maxent/).
- m. Dr. V. Balakrishnan pointed that encroachments/Anayirankal/ Ecological issues related to legal and illegal quarries/ Natural disasters/landslides/climate change/soil & drainage problems should be studied under the sector Social Rehabilitation Policies and measuring the

- carrying capacity of protected areas will be helpful for analysing the tourism sector and thereby ecological issues.
- n. Balakrishnan also pointed that Dynamic quantification of canopy architecture is needed for the characterization of Tree vigour should include the study.
 - o. FRAGSTATS: A software programme for spatial pattern analysis is recommended by Anand Zakariya. Recently this programme is upgraded in to the ArcGIS 10 (Version).
 - p. Dr. Radhakrishnan also added additional points to this such as analysis of Batch processing/ Sampling strategies/ Structural and functional metrics/ Surface metrics/ cell-based metrics/ Patch-based metrics/command line execution etc.
<https://www.umass.edu/landeco/research/fragstats/fragstats.html>.
 - q. Dr. Radhakrishnan suggested that dynamics and changes in landscape pattern over time and landscape fragmentation can be analysed through patch analysis using satellite images and Geotagging of Bio resource should be included in this study. Study of Changes in Landscape ecology is necessary for developing management plan.
 - r. Dr. Radhakrishnan suggested that GIS based landscaping is more relevant in this study. For that purpose he recommended the data collected from Bhuvan, Earth Explorer and NRSC [https://bhuvan.nrsc.gov.in/bhuvan links .php](https://bhuvan.nrsc.gov.in/bhuvan_links.php); [https:// earthexplorer. usgs.gov/](https://earthexplorer.usgs.gov/); <https://www.nrsc.gov.in/>.
 - s. Dr. Radhakrishnan sir also recommended books (Principles of landscape ecology), (Assessing landscape changes & dynamics using patch analysis and GIS modelling) and research articles etc. for the landscape study.

Methodology/Suggestion for achieving outcomes

1. Identification of BHS : Areas showing high genetic diversity in various Genus of plant and animal such as Andrographis and Orchids etc. may be marked as Biodiversity Heritage Site (BHS). This can be done on the basis of PRA, RRA, Expert consultancy and analysis of images from free software 'MaxEnt' (from AMNH).
2. Checklist of RET and endemic plants: This can be done on the basis of secondary data, along with random field verification to confirm the ground situation.
3. Documentation of best practices of biodiversity conservation: This can be done on the basis of PRA and RRA after meeting identified best practitioners on the basis of preliminary enquiries from foresters, aquacultural officials, Animal husbandry officials, research organizations, NGOs and other local knowledgeable persons.
4. Illegal/ Unsustainable harvest: This can be done discussing with tribal collectors, local medical practitioners, forest guards, Societies etc. Some e.g.: *Drosera peltata* (Conservation status: Least concern), commonly called the Shield sundew/ Pale sundew, locally known as Azhukanni/ Kosuvettipullu/ Kocuvetti seen in higher altitudes (Marayoor) is illegally exported into foreign countries from the Thoothukudi Port. This species is used in Siddha and Folk medicine. However, its actual use is not reported. Rhododendron leaves and several Mosses are also illegally transported to various part of India and abroad. Rhododendrons are valuable species in horticulture as well as Montane ecosystem. Vagavurrai village contain several exotic Rhododendrons are found. Also, these areas are rich wild life (Elephants, Bison, Chevrotain, Sambars and Porcupine).
5. It was decided that instead of purchasing images to download landsat images of the years 1999, 2009 and 2019 for the purpose.

6. It is necessary to get toposheet (1:50000) of study area from the Survey of India.
7. The information available in Bhuvans portal - thematic areas to be collected.
8. The major sectors to be considered are as (i) Plantations & horticulture; (ii) Animal Husbandry; (iii) Tourism; (iv) Transportations and road network (v) Rydel (buffer zone impacts); (vi) Quarries (vii) Man-Animal Interactions (various Social- Rehabilitation Policies).
9. In the plantation sector, the following sub-sectors can be prioritized, Tea, Cardamom, Eucalyptus, sugarcane, Fruit and vegetable crops; Rattans.
10. Land occupancy and Encroachments and impact of KPT Act amendments can be included in Land Policy.
11. The details of licensed quarries can be obtained from Mining and geology and revenue department. For details of existing and abandoned quarries and unauthroized quarries primary data collection will be required.

Meeting concluded at 5: 15 PM. The next meeting will be conducted on the upcoming month. Minutes submitted by: Dr. N. Preetha, KSBB (Technical Associate)

Trade survey

1	Local Name of the Plant
2	Habitat
3	Wild/Cultivated
4	Habitat
5	Parts used
6	Dried/Fresh
7	Distribution Status
8	Changes in the abundance of the plant for the last 10 year
9	Processing details
10	Used in Single/Combinations
11	Is it sold
12	Quantity sold per Day/Month/Year
13	Amount collected per year
14	Buyers
15	Price/Kg
16	Condition of plant sold (Dry/Fresh)
17	Brought to the Market (Daily/Weekly/Monthly)
18	% of people in the area doing the Business
19	Availability
20	How much sold now as compared to the last 10 year
21	Why?(less available for harvest/any other reasons)
22	What kind of traditional methods are used for the processing after the harvest
23	What area the problems faced in this business
24	Any other uses

Questionnaire for BMC members

1. What are the major tradable bio-resources in that Panchayath?
2. As a BMC member have you ever notice the vulnerability of tradable bio-resources in your locality?
3. Have you ever notice the increasing trend of replacing the commercial crops instead of the natural resources?
4. What are the major programmes organized by BMC for the protection of tradable bio-resources?
5. Who are the collectors of the tradable bio-resources? (Private industries, forest department or individuals)
6. What are the changes noticed the bio-diversity during the recent 10 years?
7. Do you think that the tradable bioresources get affected adversely if this situation prevails? If yes, what are the steps will you take to overcome that situation?
8. Do you think that here is a possibility of tradable bio-resources to get extinct in the prevailing situation lasts for the next 10 years?
9. Is there any limit for the collectors for the quantity of collected tradable bio-resources?
10. Have you noticed the over exploitation of natural resources for the profit of the individuals?
11. Thus the BMC members collect levy from the sellers of tradable bio-resources?
12. If no what are the reasons for that?
13. What is the current status of the utilization tradable bio-resources?
14. Have you updated the validity of PBR for tradable bio-resources?

Major identified gaps in PBR

1	Tribal knowledge/Traditional knowledge
2	Traditional practices
3	Corrections or modifications in existing information if any required.
4	Commercially traded bio-resources and details of various agencies involved and nature of market.
5	Sacred groves/ponds
6	Major ecosystems/degraded ecosystems/quarries
7	Unique ecosystems as Mangroves, laterite hills etc.
8	Riparian diversity
9	People Scape
10	Soil and related information
11	Areas which can be proposed for BHS
12	Areas which can be proposed for Miyawaki forests
13	Wetlands data
14	Endemic/local and races for GI registration
15	Prevailing management practices/Community conservation.
16	List of local Vaidyas/Hakims/TK holders

QUESTIONNAIRE

1. Name of the Panchayath:
2. Name of the Village:
3. Name of the Farmer:
4. Religion of the Farmer: H/M/C/O
5. Cast: OC/BC/SC/ST:
6. Total family members:
7. No. of People engaged in Agriculture:
8. No. of Labour using per hectare:
9. Total Agricultural land of the farmer: Acres/Hectares:
10. Land under cultivation:
11. Land under different crops:

Sl. No	Crop	Area	Yielding
a.			
b.			
c.			

12. Land under Irrigation:
13. Land under fallow:
 - a. Current fallows:
 - b. Other fallows:
14. Land under common agriculture:
15. Land under Fruit crops:
 - A:
 - B:
 - C:
16. Land under Permanent Grasslands:
17. Number of farm animals:
18. Number of Draught animals:
19. Poultry:
 - No Yields:

20. Milk animals: a. Cows: b. Buffalos:
 Yields: Yields:
 c. Goats: d. others:
 Yields: Yields

21. Number of fertilizers are using for cultivation: Which are they

22. When compared to the past, the availability of water is less:

yes No

23. We cultivate vegetables organically at home:

yes No

24. Do you believe that the sudden climate changes are due to the deeds of mankind?

yes No

25. We are forced to use chemical fertilizers for cultivation:

yes No

If agree description:

26. Do you think that the illegal quarries in your area causes landslide?

yes No

27. The last year flood caused you a lot of damage:

yes No

28. Does the development of tourism beneficial for you:

yes No

29. The harassment of wild animals is increasing year by year:

Yes No

If yes which animals: Description:

30. Tourism in your area results in pollution:

Yes No

31. Do you believe that tourism helped you to increase the life status?

Yes No

32. Tourism led to increased life expenses:

yes No

33. The development in tourism in your area causes the flow of many vehicles to the area:

yes No

34. Since 10 years, there were lots of developments taking place in your area:

yes No

35. According to the reports, there were many people migrating to your area:

yes No

36. You have noticed many unlicensed quarries coming up in your area

yes No

37. You like people coming to visit your area as a part of tourism:

yes No

38. The plantation sector helped the people in your area with job opportunities:

yes No

39. The flow of tourists in your area gave more job opportunities to the people:

Yes N

Kerala State Biodiversity Board

Two Day Consultative Workshop - Developing Standardized Protocol for biodiversity Survey through Citizen Science for PBR Updation.

Minutes

Opening:

Two day consultative workshop for developing standardized protocol for biodiversity survey through citizen science for PBR updation opened at KSCSTE, Pattom, Thiruvananthapuram on 10:30 AM, 21st November 2019.

Welcome speech was address by Dr. Chandramohanan, Member, KSBB. Dr. V. Balakrishnan (Member Secretary, KSBB) briefly introduced the consultants to the workshop. Dr. S.C. Joshi (Retd. IFS), Chairman, KSBB delivered keynotes address.

Chairman's keynotes address:

Chairman pointed out that development of a methodology for updation of PBR should be a significant outcome. Essentially to identify and standardise the techniques of field level data collection through personal interaction with formal and informal tools with regard to all the usually not captured details. For identification of species/ varieties best possible software can be suggested after thorough search and study of existing software.

Significance of PBR by stressing at its grassroot level. Mentioned the format of PBR and the need for filling the gaps in the following areas such as BHS, Peoplescape, wetlands, management practices etc.

Overview of the workshop by Dr. V. Balakrishnan, Member Secretary:

Member Secretary had a brief talk about why PBR has developed in first place and its need for updation for developing an action and strategy plan for conservation and future references.

MS pointed about the importance of associated knowledge that remained as the major gap in the previously developed PBR.

MS stressed that the potential beneficiaries of the workshop has to be citizens and the formation of ePBR should be based biodiversity survey utilizing citizen science.

MS introduced the existing format of PBR to the consultants. He also showed the layout of the developing PBR.

MS discussed the issues regarding existing PBR-Lack of uniform replicable standardized protocol for survey of flora/ fauna/ecosystem, Lack of training tools for volunteers, Difficulty in data interpretation, available data which cannot be utilized for biodiversity monitoring/ management

Questions to be addressed- who are the potential volunteers? How should biodiversity be recorded? What is the methodology for field survey for flora and fauna and associated knowledge to be adopted for a citizen science project? What is the methodology for ecological survey for identification of biodiversity rich site? What should be recorded? How can technology support recording? How to verify accuracy of data? How should the data be used to produce relevant outputs? What are the training tools requirement for volunteers?

Finally MS showed the experts the reporting format to be submitted after group discussions. Lead talks by experts based on the use of citizen science for Biodiversity survey:

1. First lead talks by Dr. Bijukumar A., Professor and Dean, Dept. of Aquatic Biology and Fisheries, University of Kerala.

He pointed out various drawbacks in PBR and its methodology. He also suggested that:

- ✓ Collaboration should be needed between institutions (national and international) Involving taxonomists and biodiversity experts.
- ✓ Developing trained manpower in biodiversity surveys, monitoring and preparation of reports/action plans.
- ✓ Local/regional field guides and survey manuals on major groups and for local biodiversity surveys/rapid biodiversity assessments
- ✓ Prioritising work on HOTSPOTS and knowledge gaps.
- ✓ Scientific work undertaken by common people, in collaboration with scientists and research institutes.

- ✓ Electronic field guides (Required more for various groups- develops e-guides and circulate to all members in the team)

2. Talk by Dr. T. Sabu, Program Director, CED

He suggested different methods to collect floristic data and analysis using citizen scientists.

- ✓ Proper documentation of biodiversity outside the protected areas needs capacity building and awareness creation of policy makers as well as common people.
- ✓ Mentioned various tools for capacity building such as flowering plants of Kerala - Software developed by Dr. N. Sasidharan, KFRI, FRLHTENVIS website to check medicinal value-Search facility Botanical/Vernacular name http://envis.frlht.org/bot_search, The *Useful Tropical Plants Database*- contains information on the edible, medicinal and many other uses of around 12 thousand plants that can be grown in tropical regions. <http://tropical.theferns.info/>

3. Dr. Amitabachan K.H, Assistant professor, MES Asmabi College, he talked about indigenous communities, address their traditional right, instincts and also the livelihood dependence.

- ✓ Ecosystem conservation, monitoring, ecorestoration and sustainable harvesting projects at GP level.
- ✓ Need a special design and format for long-term monitoring of specific function

4. Mr. Arun, ICFOSS, talked about Geospatial tools which can easily be incorporated in the field of biodiversity. Here commended Open Street Mapping using platforms such as SYMBIOTA, ODK (oldest version for user friendly).

5. Dr. V.V. Sivan, MSSRF, talked about Agrobiodiversity, he suggested that how to collect data from the field by means of different survey

methods (Transect walk, Household survey, Focus Group Discussion, Interview with KI). He proposed various criteria's to be recorded for Agrobiodiversity.

6. Dr. Rajasekharan, Senior consultant, KSBB and JNTBGRI, talked about Protection of Traditional Knowledge.

- ✓ He mentioned the significance of TK, Integration of TK in to planning process or the various developmental activities at grass root level.
- ✓ TK related to art and culture, Agriculture, Animal husbandry, Architecture, Biodiversity conservation and utilization, eco-friendly practices, fisheries, forest and management, health care, medicinal and food plants, rural technology.

6. Mr. Roshnath Ramesh, MARC, explained about Bird Atlas, and it can be used as a citizen model and its protocol.

After these presentations, a brainstorming session to develop a standardized protocol of Biodiversity survey, for that three groups were formulated based on Flora, Fauna and Ecosystem. The format was circulated in each groups and final output was presented by Dr. T. Sabu, Sujith V. Gopalan, Balakrishnan Valappil and Amithabachan. Dr. Edison chaired the panel discussion that was held as a part of group discussion.

Vote of thanks by Dr. Sudheesh, Scientific Officer, KSBB.

UNDP Munnar Landscape Project Review Meeting

Date: 2020.04.29

Time: 10:30

Platform address: Microsoft Teams

Agenda

1. KSBB study objectives briefing.
2. Methodology applied.
3. Status of work done so far
4. Issues & Challenges
5. Scope of Convergence with other activities of IHRML project
6. Working arrangement -Covid-19 & post-Covid-19 scenario
7. Any other things need to discuss with UNDP team by KSBB related to study

List of participants

IHRML team

1. Mr. Arun Ramachandran (PO, convergence)
2. Dr. Rameshan M (PO, conservation ecology)
3. Mr. Jerin Thomas Abraham (PO, NREM)
4. Mr. Tony Jose (PO, Livelihood)
5. Mr. Jikku Kurian (Prgm. Ascte. State Nodal Office)
6. Mrs. Liji George (Prj. Ast, SPMU)
7. Mrs. Anusha Sharma (NPO, Delhi)
8. Mr. Sehajdeep Kaur, Project Assistant, NPMU, Delhi.

KSBB team

1. Dr. V. Balakrishnan (Member Secretary and Co-Principal Investigator)
2. Dr. Preetha Nilayangode (Technical Associate, KSBB)
3. Dr. A.L. Aneesh Kumar (Research Associate, KSBB)
4. Mr. R.S. Reshnu Raj (Research fellow, KSBB)
5. Mrs. Bindya (Research fellow, KSBB)

KSBB Consultant:

Dr. Prakash Nelliyaat (NBA)

Member Secretary, KSBB gave an overview of the progress of the work. This was followed by detailed discussion of the objectives, outcomes and progress achieved so far. The details presented are attached.

The UNDP team pointed out that Peermedu Development Society is carrying out value chain analysis of 5 species of traded bioresources, hence it was suggested that synergy with such work may be ensured. It was also pointed out that there is overlap between the works in the two studies being conducted by KSBB. KSBB team explained that the work is being carried out as a single study and the whole project will be undertaken in a holistic fashion.

Explaining about the working arrangements during COVID 19, it was clarified that as part of the project several knowledge products are being produced, and such desk work is being carried out presently. The knowledge products include brochures on ABS, and major regulation relating to Environment in local language, Roles and Responsibilities of RFO and a booklet on species notified under Section 38.

In addition KSBB has developed a Methodology Manual for Biodiversity Documentation and

monitoring in e-PBR which details the methodology for data collection through Rapid biodiversity surveys, Source of secondary data, Spatial and mobile apps available for species identification through artificial intelligence for flora and fauna, criteria for selecting the study team, training needs, statistical tools for data analysis, data validation methodology. Anusha Sharma, UNDP pointed out that since this will be beneficial in the national scenario the manual may be send for validation to experts in the field. One of the major outcome of the studies will be empowering BMC to prepare Local Biodiversity Strategies and Action Plan. It was suggested that this will be done on a pilot scale in at least one panchayat and can be replicated in others also later on.

High Range Mountain Landscape Project - Kerala State Biodiversity Board Project in Brief

No	Project	Objectives	Output	Outcome	Deliverables
1	Documentation of existing information on various taxa, and identification of critical gaps in knowledge in area	Documentation of various flora and fauna (biological resources) in the Munnar landscape. Document the tradable and/ or economic (ABS) potential bio-resources and examine its supply chain	Updated PBR Understand the variations on biodiversity and biological resources in the region.	Draft Methodology for updating the PBR. Design appropriate biodiversity management and conservation strategies considering the changes on flora and fauna. Standardized methodology for Tradable bio-resources documentation. Effective enforcement of ABS (Identification of bioresources and end users of the bio-resources from Munnar region)	Guidelines 1. Methodology Manual for Biodiversity Documentation and monitoring in e-PBR 2. Tradable bio-resources documentation: A standardised format 3. Local Biodiversity Strategy and Action Plan
2	Review of ecological and development history of various sectors and changes in selected ecological units in GEF Munnar landscape project area	Explore the hydro-geological and land use changes over a period and its impacts on biodiversity in the Munnar region. Identify the major causes for biodiversity change and its socio-economic, cultural and livelihood impacts on	A set of maps to understand the dynamics / trends on: land use, vegetation cover and its nature (forests and agriculture practices), build-up areas, hydrological parameters, geological criteria, soil characteristics, etc. on different periods (2006, 2016 and 2020). Reasons for biodiversity change (degradation) in Munnar landscape. Impacts of biodiversity change (socio-	Propose ecologically sustainable land-use strategy (which enriches the biodiversity) for the Munnar region. Make strategies for avoiding / reducing the further reduction of the biodiversity Come-up with action	Policy Mainstreaming biodiversity in Production sectors Brochures ABS, and major regulation relating to Environment,

		different group of local (tribal) communities	economic, cultural, and livelihood)	programmes for enriching the biodiversity.	Roles and responsibilities of RFO
		Policies for mainstreaming biodiversity concerns in the regional planning/strategies of Munnar landscape.	Policy documents for biodiversity conservation for decision makers.	Implementation and enrich the biodiversity in Munnar landscape.	

Progress of Work – 2019-2020

Project title	Objectives	Activity	Sub Activity	Outcome and Output
Documentation of existing information on various taxa, and identification of critical gaps in knowledge in area	Documentation of various flora and fauna (biological resources) in the Munnar landscape.	Consultative workshops	Two state level workshops and three consultative meetings held for developing a PBR updation methodology, Classes, awareness programmes and interactive sections were conducted for Panchayaths officials and BMCs in 10 Panchayats.	Checklist of Mosses, liverworts, lichens, algae, medicinal plants and other plants were prepared. Checklist of Mammals, birds, reptiles, Odonates, butterflies were prepared.
		Updation of PBR	Identified the relevant gap areas in the existing PBR and shortcomings of the existing data collection methods Secondary data regarding flora and fauna in project area collected PBR updation methodology developed. Conducted Biodiversity survey at Mankulam Panchayat with the help of citizen scientists	All Flora and Fauna species were categorized based on IUCN, CITES, WPA. Natural resource mapping of 1 Panchayath is completed. Other Panchayaths are ongoing. Methodology for PBR updation developed based on the gaps identified.
	Document the tradable and/or economic potential resources and examine its supply chain	PRA/ RRA/ FDG with key stakeholders and user groups	Interviews with government officials of Kerala Forest and Wildlife Department (DFO, Wildlife warden, RFO, Assistant wildlife Warden, SFO, BFO, Reserve Watcher, Officials at Forest check posts) Customs officers, Sales Tax officers, Vanashree, Ayurvedic practioners	The current list of flora and fauna can be updated into the PBR of respective Gram Panchayats. The PBR will serve as a base document for development plan of Panchayat and BMC can formulate Local Biodiversity strategies and action plans
			Interviews with Bulk dealers/ traders	Checklist of commercially potential bioresources of the study area were

			<p>Focal Discussions with knowledge providers conducted in 10 Panchayats.</p> <p>Conducted PRA and RRA at Mankulam Panchayat for local peoples, 4 tribal communities, BMC separately for resource mapping and resource use change</p>	<p>prepared</p> <p>Data of 15 NTFPs traded in large quantities during the last two years documented.</p> <p>Detailed supply chain analysis of selected bio-resources is ongoing.</p>
<p>Review of ecological and development history of various sectors and changes in selected ecological units in GEF Munnar landscape project area</p>	<p>Explore the hydro-geological and land use changes over a period and its impacts on biodiversity in the Munnar region.</p> <p>Identify the major causes for biodiversity change and its socio-cultural economic, cultural</p>	<p>List of keystone / indicator species in the study area</p> <p>Classification of ecologically sensitive areas by GIS-based mapping</p> <p>Local perceptions on climate change</p>	<p>Checklist of keystone / indicator species from the study area prepared.</p> <p>Seven sectors were prioritized for analysing land use changes</p> <p>GIS maps to analyse the land use change ongoing</p> <p>Visited 15 tribal settlement during the field work and documented the key issues.</p>	<p>Develop local biodiversity strategies for avoiding / reducing the further reduction of the biodiversity.</p> <p>Come-up with action programmes for enriching the biodiversity.</p>
			<p>Preparation of GIS maps to analyze the land use change is ongoing</p>	<p>Propose ecologically sustainable land-use strategy (which enriches the biodiversity) for the Munnar region</p>
			<p>Local perceptions regarding major drivers of change in the landscape were collected.</p> <p>Documented 4 case studies and 3 best practices in Mankulam which can</p>	<p>Make strategies for avoiding / reducing the further reduction of the biodiversity</p> <p>Come-up with action programmes for enriching the biodiversity.</p>

and livelihood impacts on different group of local (tribal) communities		serve as a set example to other Panchayats including 300 organic farmers at Mankulam.	
For field level data collection, 10 BMC meetings were conducted in 10 Grama Panchayath in Idukki, Ernakulum and Trissur district	Classes, awareness programmes and interactive sections were conducted for Panchayaths officials and BMCs in 10 Panchayats		
Conducted PRA and RRA at Mankulam Panchayat for local peoples, 4 tribal communities, BMC separately for resource mapping and resource use change	PRA covered 8 types of natural disasters, 19 Agricultural crops including traditional varieties and 6 breeds, documented 7 traditional knowledge relating to health care, 6 types of climate change related events during the past 20 years, Identified the species survived these climate changes and those which were affected during the past 20 years, seasonal calendar relating to culture and bioresource harvesting.		
Secondary data regarding major developmental process	Impact of Production sectors such as Tourism, Quarrying, Plantations, Hydal projects that led to land use change studied		

<p>Identification of the research and management priorities for long term conservation of Munnar landscape</p>	<p>Mainstreaming biodiversity concerns in the regional planning/strategies of Munnar landscape</p>	<p>Open street mapping of Mankulam Panchayath completed and uploaded to the site</p>	<p>PRA conducted and biodiversity rich areas identified</p>	
		<p>Identification biodiversity rich areas and best practices</p>	<p>Biodiversity survey conducted in Mankulam and identified a biodiversity rich area "Aanakkulam" in Mankulam Panchayath. The survey at Mankulam documented 50 species of birds, 30 species of butterflies, 20 species of Odonates</p>	<p>Conservation of biodiversity rich areas as Local Biodiversity Heritage Areas</p>



Some selected Photos from the field



Some selected Photos from the field



Some selected Photos from the field



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