Final Report

Directory of Wetlands of Kerala

Research Project: KFRI 555/08

KFRI

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Project Proposal

Title	Mapping Wetlands of Kerala
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Introduction	Wetlands of Kerala include the fresh water lakes, rivers and streams, small ponds, reservoirs and mangroves. These have not been mapped to sufficient accuracy so far. High resolution satellite images open the way for rapid mapping. KFRI is undertaking a project for mapping the seven southern district of Kerala. The northern half will be covered by SACON through a similar project. The project is submitted to the Kerala state Biodiversity Board based on their specifications.
Objectives	1) To map the wetlands of Kerala. 2) To examine the linkages of hydrology and land use changes and arrive at guidelines for preserving biodiversity.
Method	1) The streams and lakes will be digitized from 1:50,000 survey of India toposheets. Multispectral, IRS P6 satellite images of 5.8m will be used. For topography public domain data of 90m resolution will be used. Mapping will be carried out by using software MapInfo, Arc GIS, ERDAS and a few public domain software. 2) Satellite images would be classified to show land use. Maps will be prepared at watershed levels and used for ground checking. Student resources and stakeholders participations are also intended to use for data validation. Recent changes will be added and final map prepared. 3) During the first phase of 10 months, a district and river system level map of wetlands would be prepared. The map would be further updated at micro watershed and panchayath level subsequently.
Output expected	1) GIS based maps of wetlands of Kerala at district and river system level. 2) Watersheds and panchayath level map of wetlands. 3) Interactive maps would be produced in CD and web based media.
Duration	One year
Budget	Rs 4,50,000

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Abstract

Directory of wetlands of Kerala is a project funded by the Kerala state Biodiversity Board. The southern seven districts were covered by the Kerala Forest Research Institute and the northern districts by SACON. Similar work had already been completed for the rest of India. Kerala has mostly deep fresh water wetlands. Rivers, ponds and paddy fields also come under wetlands. There have been several attempts to enumerate wetlands. CWRDM lists a large number of ponds especially from Palakkad district. However the work is not supported with map of the water bodies. Another attempt has been under the Panfish scheme. Based on government instructions, all ponds were enumerated on a war footing. The list provides details such as location, ownership, type of use and area. This work also lacks map support. A report on wetlands prepared by CED contains very general treatment of the subject using low resolution satellite images.

The objective of this project had been to prepare map and list of wetlands in Kerala. Two sources of data aided the compilation easy. First is the watershed atlas prepared by the Landuse Board of Kerala. This is at 1:50,000 scale and provides basin and sub-basin level numbering scheme and boundaries. Only large water bodies are traced from topo sheets. The CESS-ISRO project was a more ambitious one. The rivers and streams are based on topo sheets and satellite images. The work includes the state wide land use in digital format. We could extract the wetland information from this.

Enumerating wetlands, especially ponds less than 0.1 ha at Panchayath level is a desirable but time consuming task. These objects are distinguishable in satellite maps of about one meter resolution. Therefore a scheme was devised where by users could call their area interactively in Google map and overlay wetland details. This work was carried out by SACON. We extended the concept further to permit user digitizing and central storage of the wetlands in database. Scheme was also devised for incorporating biodiversity attributes.

The report consists of four parts. 1) An interactive website on Wetlands of Kerala prepared by SACON (http://wetlandsofkerala.org). One could hierarchically select a Panchayath and view the wetlands listed by CESS. 2) KFRI has prepared a set of maps which is supplied both in hard copy and softcopy showing basin boundaries, land use and Panchayath boundaries. 3) Since reporting wetlands at block or Panchayath level with map support in hard copy format is not feasible, the same is prepared in softcopy format in the form of an interactive CD. 4) The final component is an interactive website was users can upload boundaries of their wetlands for shared reference. This is currently hosted in the website of Kerala Forest Research Institute, http://kfri.org.

Acknowledgements

We acknowledge the Kerala State BiodiversityBoard, especially Dr.V.S Vijayan for funding the project. We are thankful to Dr KV Sankaran, Director of KFRI for his keen interest in the project and for providing facilities. We thank the planning board of Kerala and CESS, Thiruvananthapuram for making landuse maps available in soft copy. Project staff Mr.Sajayan, Mr Anson, Mr Lijeash did most of the field checking. Ms Ragi, P.G Completed most of the analysis and documentation.

Introduction

Wetlands play an important role in the economy of Kerala. Wetland consists of rivers and streams, paddy fields and marshes. Man made reservoirs, tanks and ponds can also be included under wetlands. Each of these elements have their own characteristics and problems. Of late there has been much conversion of paddy fields, tanks and ponds. Rivers and streams have pollution problems. The paddy fields, especially in the kole wetlands have many issues related with water regulation.

The rivers of Kerala and their tributaries are well mapped and documented. Landuse Board, Kerala in their monumental work on Atlas of wetlands traced out outlines of water sheds and named them in a hierarchical manner. These are used by the government departments in their planning and developmental activities. But unfortunately the Panchayath boundaries do not follow water shed boundaries and therefore any basin dependent planning is difficult. There have been many attempts to map the tanks and ponds of Kerala. Almost all these have their short comings. Water atlases of Kerala prepared by CWRDM in 1995 do not deal with this aspect. Wetland atlas of landuse board contains only the water bodies present in topo sheets. Coverage of this aspect in tanks and ponds of Kerala prepared by CWRDM in 1989 is also incomplete and they lack geo-referenced map of the items. There was remarkable attempt to compile the list of ponds and tanks in a short time for the PAN fish project of government of Kerala. The list though almost complete is plagued with measurement unit problems. Moreover there is no geo-reference given so that any re-confirmation is hardly possible. The land use map prepared by CESS and ISRO do show most of the large ponds and paddy fields. Since all ponds are included under the broad category of water bodies and since names of individual ponds are not given, there is much updating to be carried out.

The present work heavily depend on water atlas prepared by Landuse Board and landuse maps prepared by CESS. Inspite of developments in surveying and cartography the panchayath boundaries available are crude and listing of ponds panchayath wise can suffer. Under the present project, attempt is made to show water bodies with respect to panchayath, municipalities and corporations. Listing each and every pond was too gigantic a task to be carried out in a short time frame. We have devised a scheme to update this information interactively through web based maps. This project examines the status of water bodies at the level of panchayaths and linkage between river basins.

Methods

Wetland atlas of landuse board was scanned and geo-referenced river basin wise. Base maps of panchayath boundaries, rivers and streams and wetlands from sources already mentioned were re-projected to obtain correct overlay. Maps were overlayed and analysed for perpetration of report. Maps are prepared district wise, separate maps dealing with topography, basins, landuse and panchayaths.

Topography and basin boundaries: A relief map of entire Kerala was prepared from 30 m resolution ASTER dataset. Layer of rivers and streams and ponds were overlayed on this, after hiding first and second order streams. Basin boundaries and names are further added. In district wise maps, district other than the one under consideration are masked off. Scale and title for the map are added. Layout prepared in A3 format in Mapinfo is printed as PDF file at 300 dpi and printed in A3 size using color laser printer. Landuse map: The main layer is CESS landuse map. Objects are re-colored to show landuses distinctly and an index picture prepared. As in the topography map, other districts are masked off and PDF file prepared as described above.

Panchayath map: Basic map consist of polygons of individual panchayath. They are colored as per block boundaries. Forest layer is added over this. Names of panchayath and blocks are added. Final PDF map is prepared as described above.

Documentation of wetland status: This include general hydrological description of the district, description of individual basins and linkages between the same. Panchayath level details are provided in the CD ROM.

CD ROM: the accompanying CD ROM is self contained and runs under windows 98 or higher. Users can select hierarchically district, blocks and panchayath. Users can view different maps and tables of panchayaths, blocks and districts.

Development of web mapping technology: Basic development in this aspect was undertaken by the SACON component. Attempts are in progress to add remote map digitizing capability, so that individual ponds and tanks at panchayath level could be mapped and attributes stored in data base.

RESULTS AND DISCUSSION

Kerala has a total of 44 rivers, 3 of them flowing to the east. Of these eleven rivers are more than 100km in length, Bharathapuzha and Periyar are more than200 km in length. Catchment area wise also these two rivers occupy the top position. Hierarchical boundaries of basins and sub basins are digitized from landuse board atlas for overlay purpose.

Kerala has Kerala State has been divided into 14 districts, 21 revenue divisions, 14 District Panchayats, 63 taluks, 152 C Blocks, 1453 revenue villages, 999 Gram panchayats, 5 corporations and 53 municipalities. The boundaries available for these are crude even at 1:50,000 scale. Because of the boundaries of the panchayath are not based on river basin boundaries, planning at the level of water sheds is hardly possible. There are many specialized regions in wetlands. The kole wetlands of Thrissur, the Vembanad wetland system are two such examples.

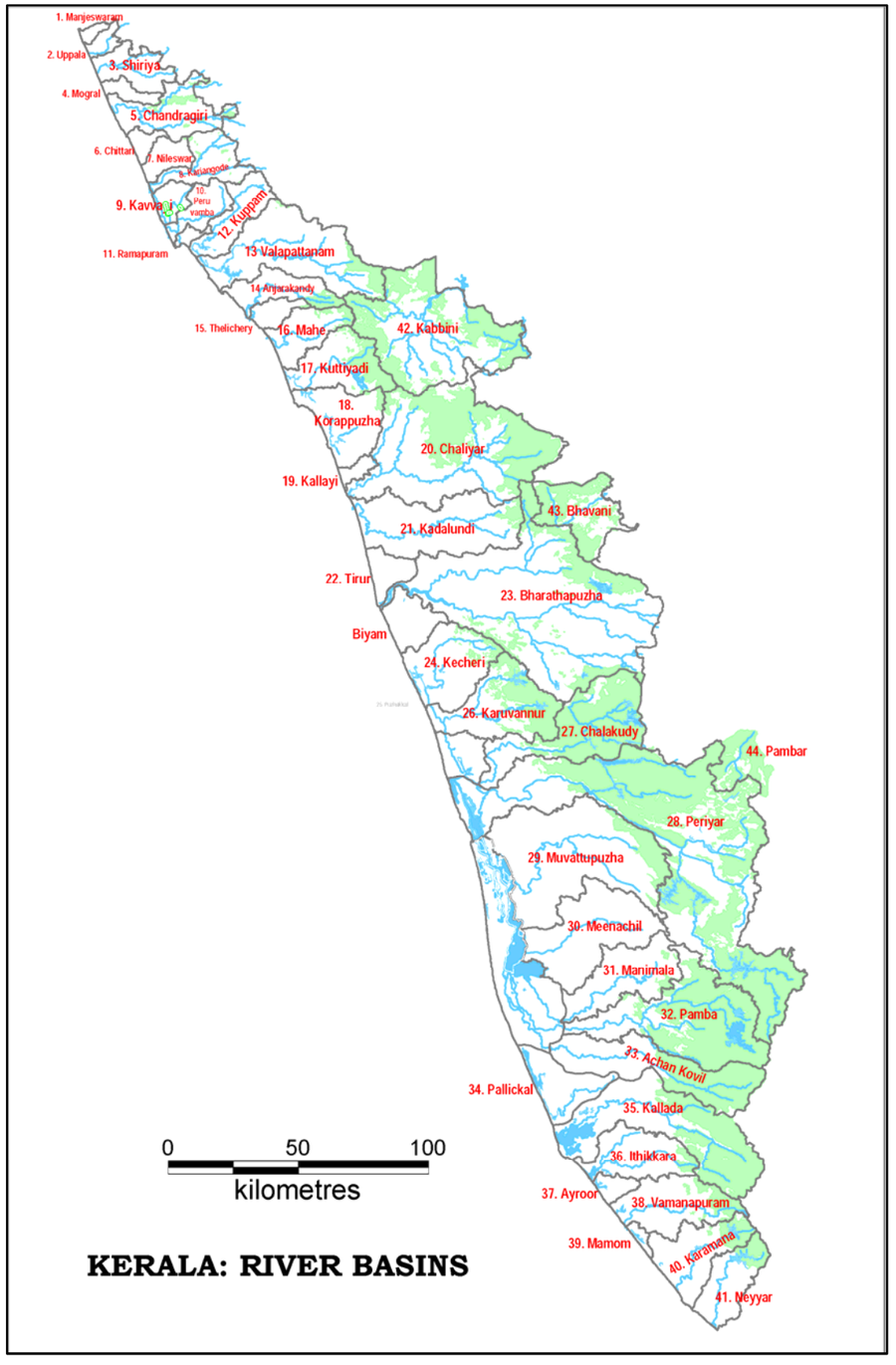
Wetlands are an ecosystem facing large scale changes in land use. The paddy fields themselves are derived from marshes. In many areas, on one side, paddy fields are being filled for constructing buildings, while on another side the same are dug up for extracting clay and sand. Problems facing coastal lakes are somewhat different. Many of these are below sea level leading to salt water inflow. The salt water inflow has been halted by construction of barriers and the lake drained for cultivating paddy. The kole land system has impacts on surrounding hills and river systems. In many areas adjacent hills are leveled and soil used for construction of bunds in kole wetlands. The kole system is a very dynamic system, where inflow from rivers, in turn moderated by reservoirs in the catchment area, water retained in the elevated canals and water discharged to the sea from the elevated canals playing their part. Kole wetlands accumulate pesticides which in extreme case can be problem. The mangroves are being destroyed at a fast rate due their private ownership.

The rivers, along with dams, reservoirs and bridges play an important role in irrigation, transportation and tourism. Kerala state is largely dependent upon hydroelectricity. There are dams in almost all rivers in Kerala, some of the older ones face problems due to siltation. Water from Chalakudy River and Periyar are diverted for irrigation in dry areas in Tamil Nadu. Many small reservoirs supply drinking water to towns.

Kerala has only very few inland lakes. Pokkode lake in Kozhikkode district, Sasthamkotta lake in Kollam district and Vellayani lake in Thiruvananthapuram district are examples. Of these Sasthamkotta lake is a narrow tributary of Kallada River, the trapped flood waters of past supply drinking water to Kollam town. The water level is fast

decreasing, unless augmented with water from upstream Kallada River, there can be water deficit. Mullaperiyar and Idukki dams trap all the water in the catchment area of Periyar. The water from Idukki reservoir is fed to the Muvattupzha river system after power generation. Ithikkara River is probably the only river in Kerala without dams. It can be seen that ponds are usually found in areas with seasonal water shortage. Sometimes irrigation canals seem to facilitate construction of tanks at lower levels. A large number of ponds are associated with places of worship. These are often maintained clean. There are another set of ponds and tanks often at the upper ends of valleys which collects water for irrigation in dry seasons. An inventory of ponds and tanks is one of the essential steps in planning. Quarry ponds are another set of water bodies that need attention. These are sizable reservoirs of fresh water, often in water starved surrounding. Some of them are used for pisciculture.

Ponds and tanks play an important part in the ecology and culture of Kerala. Ponds are mainly of two types, holy ponds and irrigation tanks. Kerala has a well connected network of canals. These served as a water continuous transportation system for people and material for the entire length of Kerala. With the increase in road, rail and air traffic, many of these canals fall into disuse.



List of rivers, their length and catchment.

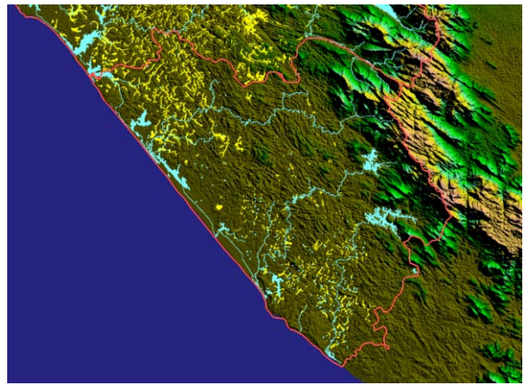
No	Name	Length (km)	Catchment (km2)
1.	Bharathapuzha	209	6186
2.	Periyar	244	5398
3.	Chaliyar	168	2923
4.	Pampa	176	2235
5.	Valapattanam	112	1867
6.	Chalakkudy	144	1704
7.	Kallada	120	1699
8.	Muvattupuzha	120	1554
9.	Achenkovil	128	1484
10.	Chandragiri	104	1406
11.	Meenachil	67	1272
12.	Kadalundi	130	1122
13.	Karuvannoor	48	1054
14.	Manimala	91	847
15.	Karamana	67	702
16.	Vamanapuram	80	687
17.	Itthikkara	56	642
18.	Korappuzha	40	624
19.	Shiriya	65	587
20.	Kuttyadi	73	583
21.	Kaariyankode	64	561
22.	Kuppam	80	539
23.	Neyyar	56	497
24.	Anjarakkandi	52	412
25.	Keecheri	43	401
26.	Maahi	54	394
27.	Perumpa	40	300
28.	Uppala	50	250
29.	Puzhakkal	29	234
30.	Pallickal	42	220
31.	Neeleshwaram	46	190
32.	Chittar	25	145
33.	Kavvai	31	143
34.	Maugral	33	132
35.	Thalasseri	28	132
36.	Tiroor	48	117
37.	Mamom	27	114
38.	Kallai	22	96
39.	Manjeshwaram	16	90
40.	Airoor	17	66
41.	Ramapurampuzha	19	52
42.	Bhavani	1	1
43.	Kabani	1	1
44.	Paampar	1	1

THIRUVANANTHAPURAM DISTRICT

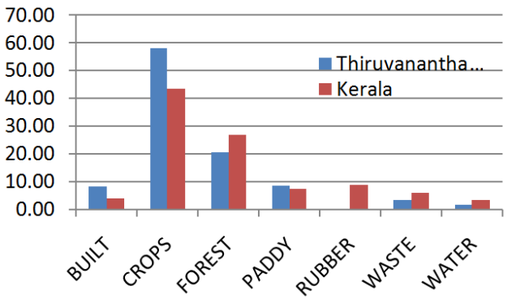
Thiruvananthapuram District is located at the southern tip of Kerala State. The District has three large west flowing rivers, Neyyar, Karamana and Vamanapuram.

The topography of the District is with forest and mountains on the eastern side and plain areas on the western side. The rainfall in this region is distributed over eight months and this increases water availability. There is a dam across Neyyar River which distributes water for irrigation of areas in Kerala and Tamil Nadu. Karamana River has two reservoirs, at Peppara and at Aruvikkara. These are meant for supplying drinking water to Thiruvananthapuram District. Vellayani Kayal and Akkulam Kayal are prominent water bodies.

On the western side, the rivers often enter fresh-water lakes which eventually drain to the sea. Major back waters are Veli, Kadinamkulam, Anchuthengu and the Edava- Nadayara lakes. Besides these, there is a fresh-water lake at Vellayani in Thiruvananthapuram Taluk, which has the potential to become the major water sources of the District in future.



In addition to the three man made reservoirs, Thiruvananthapuram District has several fresh water lakes linked through canals. Vellayani Kayal is an inland water body. Akkulam Kayal is another fresh-water lake. The canals provide a means of transport along water and it was a very important mode of transport, in the last century. Parts of Kallada basin and Aiyroor basin fall in Thiruvananthapuram District, but since most of these basins fall in Kollam District, it is dealt there.



More than 60% of the area of the District is dryland cultivation. This includes mixed crop of coconut, plantain, etc. Compared to State average, this type of land use is more in Thiruvananthapuram District. Next comes forest areas, which is less than State average. Built up areas are higher than average, wetlands are also less than State average.

As per Panfish data, there are a total of 154 ponds and streams, which occupy an area of about 336 ha. Of these the majority are Panchayath ponds. This does not take into account man made reservoirs and lakes.

More realistic picture is given in CESS Landuse 2008.

No	Pond Type	No of ponds	Area in ha
1.	Quarry ponds	5	2.46
2.	Irrigation tanks	9	5.54
3.	Private ponds	32	15.224
4.	Holy ponds and streams	26	20.03
5.	Panchayath ponds	82	297.25
	Total	154	336.504

As per CESS (2008) enumeration, reservoirs and lakes account for most of the wetland area. There are a total of 309 ponds.

Wetland	Area in ha	Count
River sands	0.29	2
River stream	100.73	15
Reservoir	1149.34	2
Ponds	2384.76	309
Total	3635.12	328

The area can be divided into two geographical regions, the midlands and lowlands. The midland region comprises low hills and valleys adjoining the Ghats. The lowland is a narrow stretch comprising shorelines, rivers and deltas, dotted with coconut palms. Vellayani Lake, the largest freshwater lake in the District, is in the suburbs of the City. The major rivers that flow through the City are the Karamana River and Killi River. There are highlands, which form the eastern suburbs of the City. The highest point in the District is the Agasthyarkoodam which rises 1869 m above sea level. Ponmudi and Mukkunnimala are hill-resorts near the City.

The mean maximum temperature 34 °C and the mean minimum temperature is 21 °C. Humidity is high and rises to about 90% during the monsoon season. Thiruvananthapuram is the first City along the path of the south-west monsoons. The City gets heavy rainfall of around 1700 mm per year. The City also gets rain from the receding north-east monsoons which hit by October. The dry season sets in by December. December, January and February are the coldest months while March, April and May are the hottest.

Among the three rivers in the District, the Neyyar (56 km), the southernmost river of the State, has its origin in the Agasthyamala. Karamanayar (67 km) and the Vamanapuram River have their

origin from Chemunji Mottai of the Western Ghats.

Travancore had a well developed transport system in the past. Using country boats and a chain of natural lakes, streams and man made canals a transport network was built.

NEYYAR BASIN

Neyyar River has a total length of 56 km. The catchment area of 497 km^2 is situated entirely in Kerala. Annual rainfall in the basin is 2300mm. The basin is in north to east direction. About one third of the basin falls in hilly forest region. The Neyyar Dam is situated at the lower end of this. Remaining region is gently undulating and inhabited regions. Two or three major streams join the river downstream. Landuse Board divides the basins into 63 units. The basin can be divided into about eight higher order sub basins. The ninth basin is a standalone stream which joins the sea directly. Five Panchayath Blocks fall within this basin, three of them fully. Neyyar basin falls in rainfall regions of 1000-2500 mm. Canals from the reservoir irrigate large areas in Kerala and Tamil Nadu.

Neyyar River joins the sea through a fresh water lake which has southward connections. Tanks and ponds are numerous in the plain areas. Northward Connection for Neyyar River along sea cost is doubtful. A small stream empties directly to sea. Neyyar watershed has a total area of about 500km^2 spread over 5 Block Panchayaths and 24 Grama Panchayats in Thiruvananthapuram District. The upper regions are forested (100km^2, 20%). There is one dam with a reservoir of km2 area. Average annual rain fall of the catchment is about 1500 mm.

Neyyar watershed is divided into 27 sub-watersheds and 41 micro-watersheds. We have grouped the basins into 9 groups. Group 1 is the catchment area of Neyyar reservoir and falls in the Kallikkad Panchayat of Perumkadavila Block. Downstream, the left side of the river fall in other Panchayaths of Perumkadavila Block(groups 2,4,6) and Parassala Block (group 8).

The five Block Panchayaths are Parassala, Perumkadavila, Athiyannoor, Nemom and Vellanad. One small watershed of Neyyar falls outside the State boundary in Tamil Nadu. Two small watersheds of Thamraparni River fall inside Kerala. Neyyar flows into the sea near Poovar. Regions on the right side of the river fall in Blocks such as Vellanad, Nemon and Athiyannor. It may be noted that bulk of these Blocks lie in the Karamana basin.

Group 9 drains directly to the sea. Kallikad, Ottasekhramangalam, Perumkadavila, Neyyattinkara, Olattani and Poovar are some of the major towns beside the river.

Some parts in the upper reaches are prone to landslide. Coastal Puthen canal links Neyyar to Tamraparni River. The left and right canals from Neyyar reservoir flow along the side of the river. The right bank canal Passes through locations such as Kallikad, Pongumud, Balaramapuram, Pallichal and eventually come near Poovar. The left bank canal pass through Ariyankodu, Munnur, Parassala, Kalikkavila and some parts of Tamil Nadu in Tampraparni basin. There do not seem to be coastal navigation link from Poovar northwards.

Main landuse in the basin is mixed land agriculture and built up areas. Paddy fields are seen in a few places beside the river only. Two large patches of rubber are seen near the forest area. Most of the area is under mixed land cultivation.

KARAMANA BASIN

Karamana river has two main branches, Killiyar and Karamanyar. Killiar flows in a north- south direction and Karamanayar south west direction. Both rivers join near the confluence. Basin area is about 700 km^2. Total length of the main stream is 68 km. There are two main dams across the river, one at Peppara and the other at Aruvikkara. These reservoirs supply water to Thiruvananthapuram City. Region around the Peppara dam is forested. Forests occur at downstream area of the dam also.

There are 85 sub basins within Karamana basin (Land use Board). We have divided the basins into 10 groups. Group 1 is catchment area of Peppara dam, it is hilly and covered with forest. Groups 2 and 3 are downstream of Peppara dam on either side of the river. Groups I, 2, and 3 come under Vellanad Block. The region is hilly and few streams join the river. Groups 7 and 8 are on the left side of the river and in Nemom Block. Group 4 and 9 area situated along the Killiyar River.

Group 10, 11 and 12 are isolated stream joining a link canal. In fact, these can be considered as separate basins. Streams from Kazhakkoottam, Sreekariam regions flow into the Akkulam Lake, Small streams from regions such as Alathara and Cheruvikkal also join the lake. Another major stream originating near Powdikonam, flow through locations such as Ulloor, Kannammoola and join the lake. Karamana River splits into two branches, rejoins and drains into the sea. A small lake is formed at the estuary, which extends south, nearly up to Kovalam.

Similarly, Vellayani Lake and streams joining it from another basin. Vellayani lake drains into the Karamana River just before its junction with Killiyar. Another independent stream joins near Vizhinjam port. Main Landuse in the basin is mixed land agriculture and built up areas. Paddy fields are seen in few areas only. Rubber is in two localities, one near forest and the other on the northern side of the basin.

VAMANAPURAM BASIN

Aiyroor basin is 66km^2 in area, Vamanapuram 687 km^2 and Mamom 114km^2. The river lengths are 17, 88 and 27 km respectively. There are no dams in this river. Vamanapuram basin

is grouped into 14 sub-basins. They can be further grouped. Groups 1, 2, 3, 4 and 5 are forested hilly regions. Groups 6,9 and 12 are on the left side of the river. Most of the Panchayaths on the left side of the river fall in Vamanapuram Block. Groups 7, 8, 10 and 11 are on the right side of the river. Groups 13 and 14 are separate streams that join the Kadinamkulam Lake directly. Group 14 has parts of Blocks Varkala and Chirayinkeezh. Panchayaths on the right side fall in Kilimanoor and Varkala Blocks. Mamom and Aiyroor basin are separate basins themselves. Mamom basin has parts of Chirayinkizh and Kazhakkoottam Blocks. Aiyroor basin has parts of Varkala, Ithikkara and Kilimanoor Blocks.

One notable feature of this basin is the presence of extensive of rubber platation. Nearly 25% of the area of basin is under rubber.

AIYROOR AND MAMOM BASINS

Aiyroor basin is 66km^2 in area, Vamanapuram 687 km^2 and Mamom 114km^2. The river lengths are 17, 88 and 27 km respectively. There are no dams across this river.

THIRUVANANTHAPURAM DISTRICT, BLOCK PANCHAYATS

Blocks in the Neyyar basin is described first. This will be followed by Blocks in Karamana and Vamanapuram basins.

Thiruvananthapuram District. Block Panchayats

Perumkadavila Block

Neyyar River originates and flows through the Perumkadavila Block Panchayath in Thiruvananthapuram District. This is a medium sized Block of about 80 km^2. The Neyyar Reservoir also falls within this Block. There are eight Grama Panchayaths in this Block.

Landuse	Area km^2
Rubber	1.67
Wet lands	3.07
Built u	8.69
Waste land	10.31
Forest	21.69
Crops	38.08
Total	**83.51**

Overall landuse in Perumkadavila Panchayat

Area of the Panchayaths range from 3 to 25 km^2. Panchayaths in this Block are Amboori, Aryancode, Kallikkad, Kollayil, Kunnathukal, Ottasekhara manglam, Perumkadavila and Vellarada. Land use in this Block is shown above. A substantial area is under forest.

Among the wetland features, paddy fields are about 2,8 km^2 and water bodies 0.28km^2. There are hardly any small ponds in this Block. The Neyyar reservoir and its catchment are situated in the Kallikkad and Amboori Panchayaths. The remaining panchayats are downstream and on the left bank of the river. Small portions of Vellanad and Nemom Blocks fall on the right side of the river. Two of these Panchayaths, Poovachal and Kattakkada are situated in two basins, Neyyar and Karamana.

Neyyattinkara Muncipality

The main landuse in Neyyattinkara is dry land crops followed by built up areas and wetlands.

Landuse	Area km^2
Neyyattinkara MCP Total	**19.77**
Crops	15.39
Waste land	0.05
Built up	2.70
Wet lands	1.63

Overall landuse in Neyyattinkara Municipality

Wetlands consist of paddy fields and water bodies. There are a total of 15 water bodies.

Wetland	Count	Area km2
Water body	15	0.02
Agri. Paddy	122	1.61
Total	137	1.63

Wetlands in Neyyattinkara Municipality

The river occupies the major area, the remaining are small ponds, each, less than one ha in area. Much inundated areas are seen near Nochiyur. The basin is irrigated.

Inundated areas near Nochiyur.

Athiyannoor Block

Athiyannoor Block is complicated from a geographical and hydrological point of view. The constituent Panchayaths differ from one another. The Block has mostly dry land crops and built up area. The Panchayaths in this Block are Athiyannoor, Kanjiramkulam, Karumkulam, Kottukal, Venganoor and Vizhinjam.

Athiyannoor Block: Topography

Athiyannoor Panchayath is situated on the right side of Neyyar river. There are a large number of ponds in this Panchayath. The region is irrigated by canals from Neyyar reservoir.

Landuse	Area km2
Wet land	1.21
Waste land	2.21
Built up	6.07
Crops	67.05
Total	**76.54**

Overall Landuse in Athiyannoor Panchayath

Wetlands consist of paddy cultivation, small streams and ponds.

Wetland	Count	Area km2
Water body	19	0.10
Agri. Paddy	55	1.11
Total	74	1.21

Wetlands in Athiyannoor Panchayath

The main stream in Kottukal Panchayath empties directly into the sea. There is a small estuary near the confluence. Vizhinjam Panchayath has isolated hills and irrigation canals.

Coastal areas around Vizhinjam

One arm of Vellayani Kayal extends into Venganoor Panchayath.

Parassala Block

This Block is situated at the extreme south end of Kerala. Neyyar joins the sea in this Block; the Block is also irrigated by Neyyar Reservoir. The Block has dry land crops, built up areas, wet lands and a small area under rubber cultivation. The Panchayaths in this Block are Thirupuram, Chenkal, Poovar, Kulathur, Karode and Parassala.

Landuse	Area km2
Rubber	0.01
Waste land	0.47
Wet land	3.64
Built p	7.14
Crops	164.81
Total	**176.07**

Overall landuse in Parassala Block

Wetlands include Neyyar River, estuaries and ponds. There are a large number of ponds in Panchayaths on either sides of the river.

Wetland	Count	Area km2
River stream	1	0.01
Water body	32	0.95
Agri. Paddy	122	2.68
Total	155	3.64

Wetlands in Parassala Block

Vellanad Block

In Karamana basin in Vellanad Block is the largest and occupy the catchment area of Karamana River. Comparatively, this is a larger Block. Landuse is dry land crops, forest, wetland, built up areas, rubber, etc. A southern spur of the Block extends into the Neyyar basin. The Panchayaths in this Block are Aryanad, Kattakkada, Kuttichal, Poovachal, Tholikkode, Uzhamalackal, Vellanadu and Vithura.

Landuse	Area km2
Waste land	9.45
Rubber	13.72
Built up	14.78
Wet land	16.46
Forest	35.72
Crops	134.87
Total	**225.00**

Overall Landuse in Vellanad Block

Wetlands include reservoir, paddy fields, river and ponds.

Wetland	Count	Area km2
Water body	14	0.04
River/stream	3	0.08
Agri. Paddy	171	4.84
Reservoir	2	11.50
Total	190	16.46

Wetlands in Vellanad Block

Nedumangad Block and Municipality

Part of Nedumangad Block lies in the Vamanapuram Basin. The Block is drained mainly by Killiyar.

Topography of Nedumangad Block and MCP

Karamana River proper is on the eastern side. Karakulam Panchayath has a large number of ponds. The Panchayaths in this Block are Anad, Aruvikkara, Karakulam, Panavoor and Vembayam.

Thiruvananthapuram Rural Block

This is a small Block situated on the northern side of Thiruvananthapuram Corporation. Kudappanakunnu and Vattiyurkkavu Panchayaths come in this Block. On the western side there are few ponds. Karamanayar is on the eastern edge of the Block and Killiar at the centre.

Thiruvananthapuram Corporation

Killiyar and Karamanayar join together and empty into a fresh water lake which in turn empties into the sea.

Sewage farm and airport

There is a link canal from Puntura to Akkulam Kayal. This continues northwards and joins Akkulam Kayal.

Akkulam Kayal and connecting links

Two streams originating from Kazhakuttom Block on the northern side also join Akkulam Kayal. They are Ulloor-Kannammoola thodu and Kulathur thodu. Kulathur thodu has two arms upstreams one from Pangapara and the other from Kazhakuttam region. On the southern spur, few water bodies are seen.

Nemom Block

Nemom Block is situated on the left side of Karamana River. Streams flowing in east west direction join Karamana river.

Landuse in Nemom Block

Vellayani lake is one of these streams. Major Landuse is dryland crops, built up areas and wetland. The Panchayaths in this Block are Kalliyoor, Malayinkeezhu, Maranalloor, Pallichal, Vilappil and Vilavoorkkal.

Landuse	Area km2
Rubber	0.66
Forest	0.68
Waste land	1.02
Wet land	7.22
Built up	14.47
Crops	112.84
Total	**136.89**

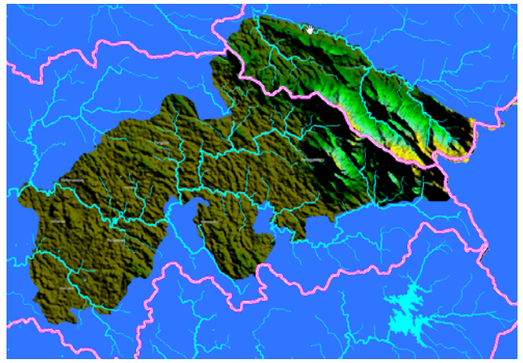
Overall landuse in Nemom Block

Wetland includes paddy fields and ponds. Ponds are more numerous in the southern parts. Irrigation channels from Neyyar reservoir reach this region.

Wetland	Count	Area km2
Water body	43	3.28
Agri. Paddy	249	3.94
Total	292	7.22

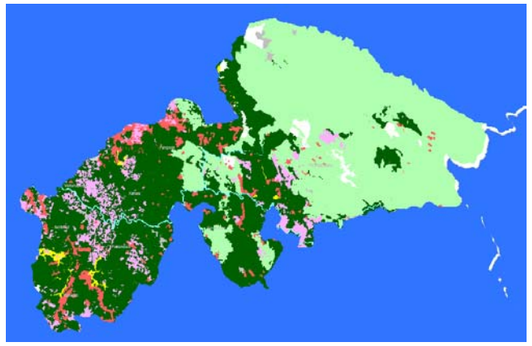
Wetlands in Nemom Block

Vamanapuram Block



Topography: Vamanapuram Block

Vamanapuram Block lies in two basins, Vamanapuram and Kallada.



Landuse in Vamanapuram Block

The main land use is dryland crops and forest There are only a few ponds.

Landuse	Area km2
Wet	3.09
Crop tea	5.26
Waste	6.09
Built	14.92
Rubber	38.39
Forest	58.33
Crops	194.85
Total	**320.93**

Overall landuse in Vamanapuram Block

Wetland is mainly paddy fields. The Block is mainly catchment area of the river. The Panchayats in Vamanapuram Block are Kallara, Manikkal, Nanniyode, Nellanadu, Pangod, Peringammala, Pullampara and Vamanapuram.

Wetland	Count	Area km2
River/stream	1	0.00
Water body	4	0.02
Agri. Paddy	29	3.07
Total	34	3.09

Wetlands in Vamanapuram Block

Kilimanoor Block

Kilimanoor Block is very interesting because there are three drainage slopes to three different basins, Airoor, Vamanapuram and Ithikkara. The Panchayaths in Kilimanoor Block are Karavaram, Kilimanoor, Madavoor, Nagaroor, Navayikkulam, Pallickal, Pazhayakunnummel and Pulimathu.

Landuse	Area km^2
Waste land	1.7
Forest	3.22
Built up	10.61
Wet land	11.62
Rubber	43.41
Crops	69.46
Kilimanoor Total	**140.02**

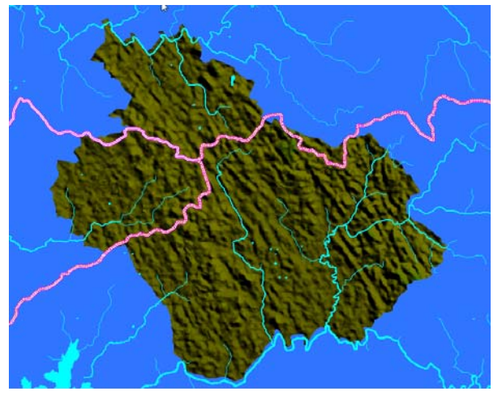
Landuse in Kilimanur Block

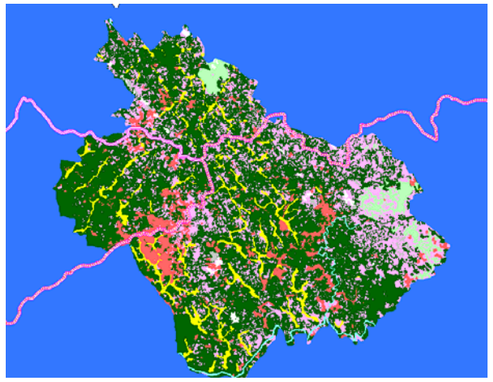
There are few ponds in the lower reaches. Land use is mainly dry land crops and rubber.

Wetland	Count	Area km2
Water body	8	0.01
Agri. Paddy Banana	1	0.02
River stream	2	0.03
Agri. Paddy	302	11.56
Total	313	11.62

Wetlands in Kilimanur Block

In wetlands, paddy is the main cultivation.





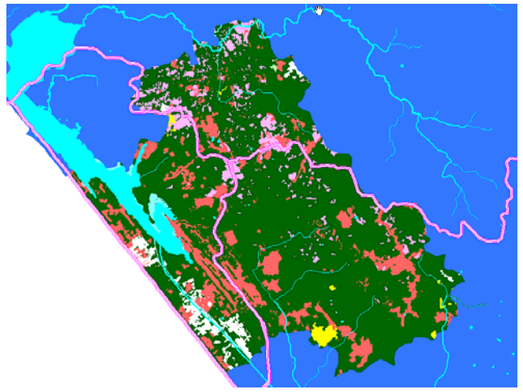
Topography and landuse in Kilimanur Block

Kazhakuttam Block

This Block also falls in three basins, Mamom, Karamana and Vamnapuram. From an elevated point the Block slopes down to three sides. Andoorkkonam, Kadinamkulam, Kazhakkoottam, Mangalapuram, Pothankode and Sreekariam.

Topography: Kazhakuttam Block

Landuse consist of dry land crops, built up areas, rubber growing areas, wet land, etc.



Landuse: Kazhakuttam Block

Landuse	Area km2
Forest	0.07
Wet land	1.11
Waste lad	3.28
Rubber	7.09
Built up	15.45
Crops	54.92
Total	**81.92**

Overall landuse in Kazhakkuttam Block

Main wetlands are paddy fields. There are as many as 15 ponds in the area. Part of a large fresh water lake, Katinamkulam Kayal falls in this Block.

Wetland	Count	Area km2
Water body	15	0.13
Agri. Paddy	14	0.98
Total	29	1.11

Wetlands: Kazhakuttam Block

Canal from Akkulam Kayal joins Katinamkulam Kayal in this Block.

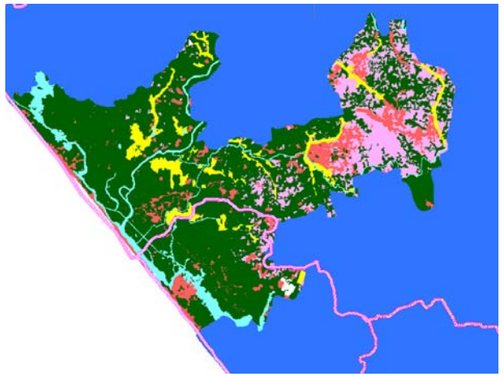
Kazhakuttam Block. Kakkathuruthu area has undergone much change

Chirayinkizh Block

This Block also falls in two basins, Mamom and Vamanapuram. Panchayats are Anchuthengu, Azhoor, Chirayinkeezhu, Kadakkavoor, Kizhuvilam, Mudakkal and Vakkom.

Topography of Chirayinkizh Block

Katinamkulam Kayal occupies a large portion. It is linked to the Kayals further north.



Landuse in Chirayinkizh Block

Landuse	Area km2
Waste land	0.68
Wet land	5.77
Built up	6.97
Rubber	16.32
Crops	65.77
Chirayinkeezhu Total	**95.51**

Landuse in Chirayinkizh Block

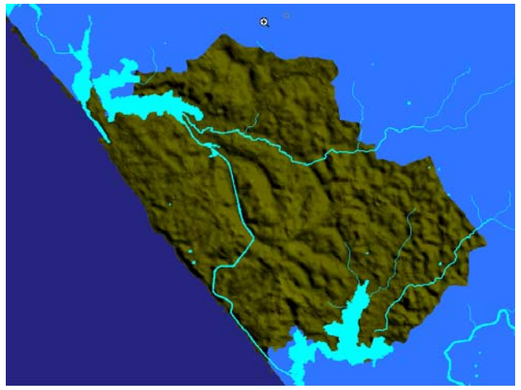
Land use consists of dry land crops, rubber, built up areas, wet lands, etc. Wetlands consist of paddy fields and water bodies. There are a total of 41 water bodies. The ponds are scattered over the Block.

Wetland	Count	Area km2
Water body	41	0.06
Agri. Paddy	35	5.71
Total	76	5.77

Wetlands: Cirayinkizh Block

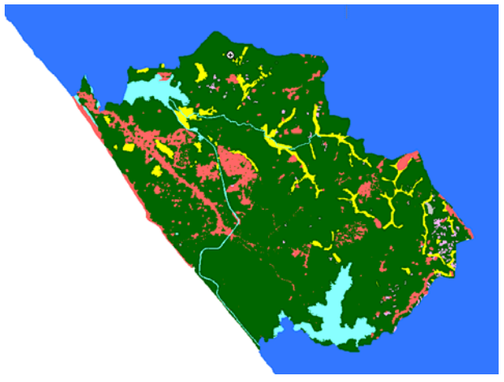
Varkala Municipality and Block

This is the northern portion of Thiruvananthapuram District. There are two major fresh water lakes, Mungottu and Kozhithottam Kayals in the south and Nadayara Kayal in the north. These are linked through a canal.



Topography of Varkala MCP and Block

Land use consists of dryland crops, built up area, wetlands, etc. Wetlands include paddy fields, lakes and ponds. The panchayaths in Varkala Block are Chemmaruthi, Cherunniyur, Edava, Elakamon, Manampoor, Ottoor and Vettoor.



Landuse of Varkala MCP and Block

Neyyar Dam and Reservoir

Neyyar dam lies in Thiruvananthapuram District , located on the foot of the Western Ghats . It was established in 1958 , lying against the southern low hills of the Western Ghats. Neyyar dam is situated at Kallikkad Panchayath of Neyyattinkara Taluk. The peak Agasthya kooodam is very near to Neyyar dam. The dam was built for irrigation purposes. One canal of Neyyar flows to western Districts of Tamil Nadu. The main river Neyyar flows through Kallikkadu, Ottasekhara mangalam, Aryancode, Kezaroor, Marayamuttom, Neyyattinkara and Poovar and ends at the Arabian Sea.

Neyyar Dam and Wildlife Sanctuary

Sprawling over an area of 128 km^2, the Neyyar Dam and Wildlife Sanctuary is one of the most frequented wildlife sanctuaries of Kerala. Tucked away in the southeast region of the Western Ghats, this wildlife sanctuary has vegetation ranging from tropical wet evergreen forests to grasslands. It was notified as a wildlife sanctuary in 1958. It is the catchment area for the Neyyar River, Mullayar and Kallar. The Neyyar Reservoir is about 9.06 km^2 in extent.

The wooded forests and hills of the Neyyar Wildlife Sanctuary offer shelter to rich and diverse flora and fauna. This area is the habitat of Elephants, Nilgiri Tahrs, Sambhar, Tigers, Gaur, wild Boar, Jungle, Cats, Indian porcupine, Barking Dog, Malabar Squirrel, Sloth Bear, Python, Cobra and many other mammals and reptiles. Neyyar Wildlife Sanctuary is also the habitat of diverse species of avifauna such as White-breasted water hen, King Fishers, Woodpeckers, little green heron, Indian cuckoo, Indian hill myna, mynas, egrets, little cormorants, Gray jungle owl, darters etc.

The catchment area forests in upstream of Neyyar irrigation is reservoir extend over 128 km^2 including the water spread area of the reservoir. The Sanctuary is contiguous with the Peppara WLS to the north and with Mundanthurai and Kalakkad sanctuaries in Tamil Nadu. The forests of this sanctuary range in elevation from 80m to 1866m above MSL. Located in the southern tip of the Peninsula, with the crestline height of the Ghats not exceeding 1500m, it has moderately heavy rainfall ranging from 1800mm to 3000mm, per year with a very short dry season ranging from one to two months only. Extensive areas of climax natural vegetation in the sanctuary are degraded to secondary types. The southern secondary moist mixed deciduous forest in the lower reaches and the south Indian sub-tropical hill savannah (woodland) in the higher reaches are the vegetation types common now. The best remaining vegetation type is the southern hill tropical evergreen forest along the Crestline of the Ghats. There are also a small number of scattered pockets of intact west coast semi-evergreen forest along the hill folds and short reaches of riparian fringing forests along the stream margins before they join the reservoir.

Peppara Dam and reservoir

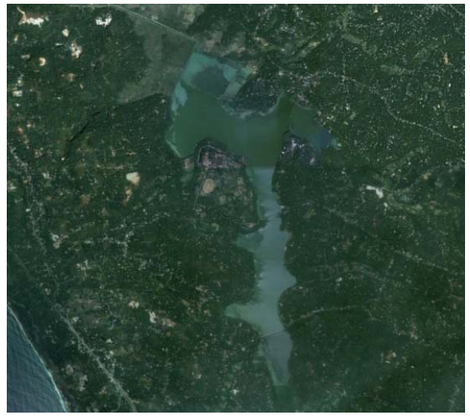
Peppara Dam is located at Peppara in Thiruvananthapuram District . The dam is built across the Karamana River. Constructed in 1983, it meets the drinking water requirements of the nearby places –Thiruvanantha-puram City and suburban areas. The dam has a power project with a capacity of 12 MU annually. The lake created by the reservoir covers an area of about 582 km^2. The catchment area of the dam forms the forests of Peppara Wildlife Sanctuary. Peppara is in Nedumangad Taluk.

Aruvikkara Dam

Aruvikkara Dam is located in Thiruvana nthapuram District of Kerala. It is built across the Karamana River and is around 16 km north of Thiruvananthapuram City.

Aruvikkara Dam

The dam supplies drinking water to Thiruvananthapuram City.

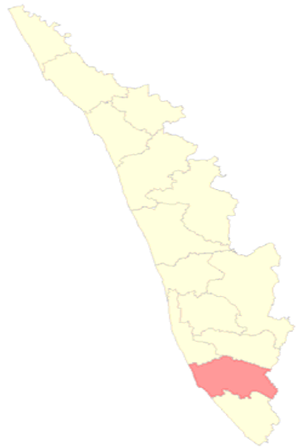


Vellayani Lake

Vellayani lake

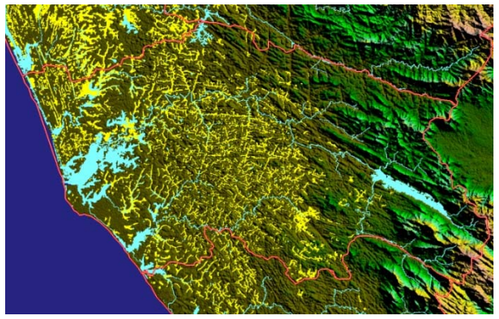
Vellayani lake is one of the three rain-fed freshwater lakes in Kerala, the other two being Sasthamcotta lake in Kollam and Pookkode lake in Wayanad. Vellayani lake, is the largest fresh water lake in Thiruvananthapuram District. The lake is located about 7 km away from Kovalam. The lake water is extensively used for drinking and irrigation purposes. The lake is under the threat of pollution, encroachment and sand mining. It has been observed that the area of the lake, which was 750 ha in 1926, had been reduced to 397.5 ha by 2005. The `Grow More Food' program launched by the Government in the early 1950s had led to the reclamation of vast areas for cultivation. It is a common practice to dewater the lake twice annually for paddy cultivation by the farmers. Five panchayaths surround the lake- Thiruvallam, Kalliyoor, Venganoor, Nemom and Kovalam.

KOLLAM DISTRICT

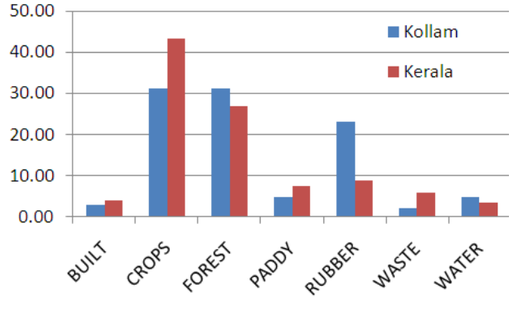


Kollam District is located in the south west coast of India bordered Arabian Sea in the West, Tamil Nadu in the East, Alappuzha in the North, Pathanamthitta in the North East and Thiruvana-nthapuram in the South. District spans 2,492 km^2. It is the seventh largest District in Kerala and is densely populated. Sasthamkotta Lake, the only freshwater lake in Kerala is located here. This lake is instrumental in providing fresh drinking water to the whole of Kollam city. Two major rivers Kallada River and Ithikkara river drain through the District. Ashtamudi Lake and the Paravoor Lake are two important coastal water bodies in Kollam District. Ashtamudi Lake covers 30 percent of total area of the District. Kollam town is located on the banks of Ashtamudi Lake. Major fishing port in south Kerala, Neendakara, is located on the banks of this lake. Edava and Nadayara lakes lie in portions of kollam District.

The average temperature is around 25°C to 32°. Kollam receives an annual average rainfall of around 2700 mm.



In the District, about 32% of land is under forest cover. Lion's share of this falls in the eastern portion of the District. This includes Thenmala, Punalur and a portion of Achenkoil forest Divisions. The Thenmala Range, Aryankavu Range and Shendurney Sanctuary make the Thenmala Division while Achenkoil Range, Kallar Range and Kanayar Range makes up the Achenkoil Division. Pathanapuram and Anchal Ranges constitute the Punalur Division.



Kollam District has a total cultivated area of 218267 (88%) hectares. Paddy, tapioca, coconut, rubber, pepper, banana, mango and cashew are the prominent crops.

About 50% of the area of the District is under dryland cultivation. Compared to State average, this type of land use is less in the case of crops and high in the case of rubber, in this District. Forested areas are comparatively more than State average in Kollam District. Built up areas is less than average, wetlands are also less than State average.

Wetland	Area in ha	Count
Water River Sandy area	14.8	37
Water body River/stream	21.78	9
Water Reservoir bed	504.99	73
Water bodies Ponds	595.46	163
Water Reservoir	1557.52	1
Total	11959.45	338

As per Panfish data, private ponds come to about 205 ha, irrigation tanks 150 ha, quarry ponds 138 ha and Panchayath ponds 63 ha.

No	Pond Type	No of ponds	Area in ha
1	Holy ponds and streams	*52*	24.96
6	Village ponds	5	35.55
3	Panchayath ponds	63	62.93
5	Quarry ponds	20	137.97
2	Irrigation tanks	*13*	150.26
4	Private ponds	62	205.18
	Total	215	616.85

Ithikkara Basin

Ithikara basin is situated north of Vamanapuram and Ayroor basins. Ithikkara basin is 642 km^2 in extent. Length of the river is 56km. The watersheds can be divided into 14 groups. Only two of these groups are forested. These locations have Myristica swamps. Kulathupuzha river and Ithikkara river, are separated by small elevated region. These two distinct parts can be seen, Ithikkara River and Neduvankavu River. They drain into two arms of the lake. Kottarakkara block covers most of group 11. Most of the Panchayaths on the left side of the river fall in Chadayamangalam Block. Those on the right side of the river fall in Anchal Block. One notable feature of this basin is extensive rubber cultivation, nearly 50% of the basin.

Kallada Basin

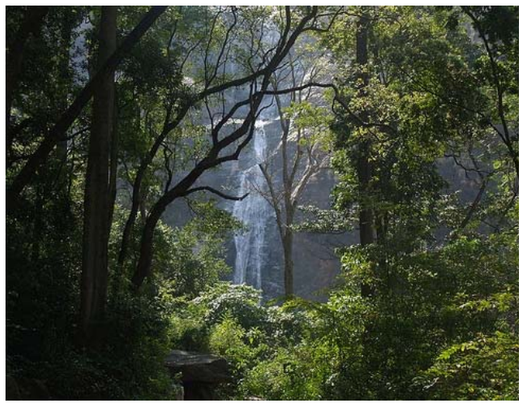
Kallada basin is a large river system extending from the sea coast to the State border. Nearly 30% of the basin is forested. The area around Shendurney reservoir has been declared as wildlife sanctuary.

Myristica swamp

In these river systems, at about 200 meter altitude, Myristica swaps are

located. The middle regions of the Kallada river receive large number of streams from the north and south (through geological fault lines). Initially, the river flows in an east west direction. Kallada River empties into the Ashtamudi Kayal. The connection is permanently open through a built up harbor at Neendakara. Ashtamudi lake has several branches and sub lakes. There are several small water bodies that got separated through siltation or through human activity.

Kulathupuzhayar and Shenthuriniyar are two main river system in Kallada basin. Dam constructed at Thenmala near the confluence of these two rivers is meant for irrigation downstream. Kallada river passes through the Punaloor- Chenkotta gap and through plain areas. Kallada river is about 121 km, its basin area is about 1700 km^2. Average rain fall is about 2800mm. Large area of the basin is forest. Substantial area of the basin is under rubber. The main Panchayath blocks are Anchal, Pathanapuram Parakkode, Vettikavala, Shasthamkotta, Chittumala, Chavara, etc. Kallada River has its origin on the Kulathupuzha hills near Ponmudi in Thiruvananthapuram District. This river traverse through Pathanapuram, Kunnathur, Kottarakkara and Kollam before draining into the Ashtamudi Lake in Kollam District. The major tributaries of this river are Kulathupuzha, Chenthurnipuzha and Kalthuruthipuzha. Palaruvi waterfall is another highlight in this river. Average annual rainfall is between 3600-4000mm in east region of the basin and in west it is between 2600-2400mm. Thenmala dam is in Kallada river. The Dam which was mainly constructed for Irrigating the fields in and around Kollam town as a part of the Kallada Irrigation project also produces electricity of 10 MW.

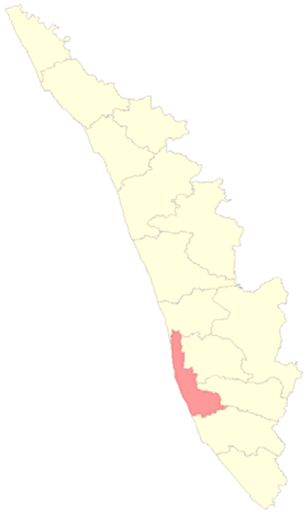


Palaruvi water fall

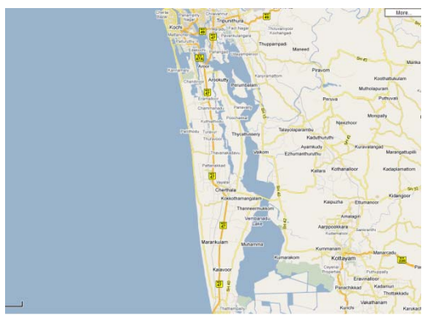
Pallikkal River Basin: Pallikkal basin is 220 km^2 in area and 42 km in length. Pallikal river empties into Kayamkulam kayal, which is linked to Ashtamudi kayal in the south and bigger Kayamkulam kayal to the north. It is situated between confluence of two major river systems, Kallada and Achencoil.

Achankovil River, Achankovilaru in the vernacular, is formed by the confluence of several small streams originating from the hills of Rishimala, Pasukidamettu and Ramakkalteri in eastern Kerala. This river, passes through Mavelikkara, Thiruvalla and Karthikapally Taluks before joining the Pamba River at Veeyapuram in Alappuzha District. Main tributary is Kallar. The Achankovil Dam is built on this river. West region of the basin has the high rain fall around 3000mm annually.

ALAPPUZHA DISTRICT

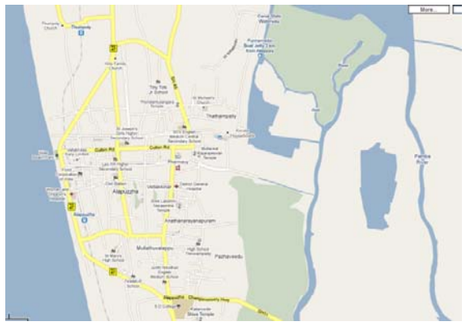


Alapuzha is a Landmark between the broad Arabian Sea and a network of rivers flowing into it. Alapuzha spans over an area of 1,414 $km^{2.}$ The District is bordered by Ernakulum in the North, Arabian Sea in the West, Kollam in the South. To the East it has border with Kottayam and Pathanamthitta Districts.



Alappuzha and surroundings

The District is a sandy strip of land intercepted by lagoons, rivers and canals. There are neither mountains nor hills in the District except some scattered hillocks lying between Bharanikavu and Chngannur blocks in the eastern portion. Cherthala, Ambalappuzha, Kuttanad and Karthikappally lie in lowland region. There is no forest area in this District.



Alappuzha town

The climate is moist and hot in the coast and slightly cool and dry in the interior of the District. The average monthly temperature is 25^0 C. The District also gets the benefit of two monsoons as in the case of other parts of the State. The average rainfall in the District is 2763 mm.

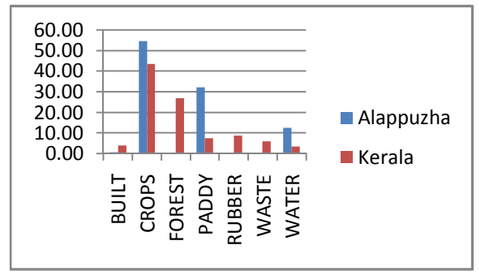
Boat race

The District has a network of rivers, canals and backwaters. Manimala, Pampa and Achancovil are the major rivers.

The Vembanad lake, the most important of the west coast canal system has a length of 84 km and an average breadth of 3.1 km. It covers an area of 204 km^2. Stretching from Alappuzha to Kochi. Kayamkulam Lake stretches between Panmana and Karthikappally. Kayamkulam lake is a shallow lake which has an outlet to sea at Kayamkulam barrage. It has an area of 59.57 km^2, a length of 30.5 km and an average breadth of 2.4 km. It connects Ashtamudi lake by the Chavara Panmana canal.

Traditional fishing setup

Alappuzha has a network of canals included in the west coast canal system which are used for navigation. The important canals are Vadai canal and Commercial canals and the link canals between these two canals. Apart from these, there are many inland canals which are used mainly for passenger navigation and commercial purposes. The lakes are used for inland water transport of passengers and cargo. Inland fisheries flourish in these regions.



More than 50% of the land is occupied by dryland cultivation which is higher than the State average. The land covered by paddy fields is 25% more than the State average. There is no forest in the District. Rubber plantation is also rare in this District. The area covered by the water in the District is high than the State average. Built up area is also very low.

Wetland	Area in km2	Count
Water body	1	2
Water River Sandy area	1.3	1
River/Stream Perennial	6.94	2
Wetland Inland Marshy	298.93	5
Water bodies	841.59	57
Water River Perennial	16665.53	5
Total	17815.29	72

As per Panfish data there are a large number of ponds in the District.

Kuttanad wetland ecosystem situated in the Alappuzha District. Seven rivers flowing from Western Ghats form a river network and an estuarine system to make the Kuttanad wetland. It includes 250 km^2 Vemband Lagoons, 50 thickly populated villages, and

55000 ha paddy fields which makes Kuttanad ‘the rice bowl of Kerala’. In this, 13000 ha is the largest. Kuttanad is world famous as the ‘Holland of Kerala’ since cultivation is made on fields that are below sea level.

No	Pond Type	No of ponds	Area in hector
1	Holy ponds and streams	58	44.24
2	Irrigation tanks	2	16.18
3	Panchayath ponds	55	322.561
4	Private ponds	67	18680.37
5	Quarry ponds	3	1.65
6	Total	185	19065.001

The lakes are used for inland water transport of passengers and cargo.

Rivers of Kuttanad

The Pampa: The Pampa is the third largest river in Kerala and is considered holy. It originates from Thamarakotta of Peermade Plateau. Kozhenchery and Chengannoor are the major towns on the banks of Pampa. Famous pilgrim centers like Sabarimala, Maramon and Chakkulathukavu add a holy touch to this river. The 176 km long Pampa joins with Manimala River and joins the Vembanad lake at Kuttanad.

House boats accommodate provide tourists

Manimala: The Manimala River originates at Tattamala of Western Ghats. Mundakkayam, Manimala and Thiruvalla are major towns beside this river. The river runs 90 km before it reaches in upper Kuttanad.

Meenachil: Meenachil in one of the main contributors of wetland ecosystem of Kuttanad. This 78 km long river originates from Araikunnu mudi and Pazhavatti mudi. Major towns like Erattupettah, Poonjar, Pala, Kottayam are on the banks of the River.

Achencoil: Several streams of Ramakkal Teri and Rishi Malai join to form this River. Pandalam, Mavelikkara and Harippad are prominent towns on the banks of the river. After flowing 128 km, this river flows down to the southernmost part of Kuttanad.

Moovattupuzha: 121 km long, Moovattupuzha river originates from Tharangam Kanam hills of Western Ghats. Thodupuzha, Muvattupuzha, Kothamangalam and Vaikom are the towns on the banks of this river.

Paddy cultivation in Kuttanad

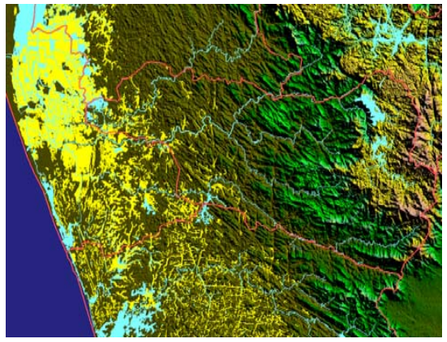
Chalakudy: This 130 km long river originates from Anamalai hills of Western Ghats. Kanjirappally and Chalakkudy are important towns on the banks of this river. The river empties into the Periyar and flows towards the northern portion of Kuttanad wetlands.

Periyar: The Periyar is the longest river of Kerala with a length of 244 km. Sivagiri group of hills in Western Ghats is where the Periyar is formed and from there it meanders through many towns such as Malayattoor, Kalady and Aluva and finally falls into Vembanad lake of the Kuttanad wetlands at Varappuzha.

PATHANAMTHITTA DISTRICT

Pathanamthitta is a landlocked District, spanning over an area of 2,637 km2. The District is bordered by the Districts Kottayam and Idukki in the North, Alapuzha in the West and Kollam in the South. To the East, it has border with the Tamil Nadu State. The District can be divided into three natural geographical regions: the highland, the midland and the lowland. The highland stretches through the Western Ghats, where the hills are tall and covered with thick forests. It descends to smaller hills of midland in the centre and finally to the lowland. The lowland with its abundance of coconut trees, lies along the western borders of Alapuzha.

Pathanamthitta has a moderate climate. Annual temperature ranges between 20°C and 39°C. The South-West monsoon is usually very heavy. About 75 per cent of the annual rain is received during this season.

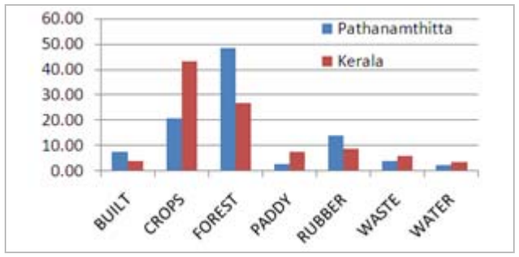


Topography

Pathanamthitta District has a reserve forest area of 1,385.27 km2. This is approximately 50% of the total area. The forest area can broadly be classified as evergreen, semi-evergreen and moist deciduous.

Three important Rivers flow through the District. These Rivers originate from various hills of the Western Ghats mountain range. The Pamba (176 km) which is the third longest River in Kerala has its origin in Pulachimala. The Achenkoil River (128 km) originates from Pasukida Mettu, and Manimala River (90 km) originates from the Thattamalai Hills. A small portion of Kallada River also falls in the southern border of the District. Pamba and Achankovil Rivers together drain more than 70% of the total area of Pathanamthitta.

Agriculture is the main occupation of the people. About 75% people are dependent on this sector. Rubber is the most important crop. The hilly terrain coupled with high humidity makes the region suitable for rubber plantations. Paddy is the most important crop cultivated in the wetlands. Tapioca and pulses are the important dryland crops. Other major crops are coconut, banana, pepper and ginger. In certain areas cashew, pineapple, sugarcane, cocoa and other tree spices are cultivated. The land available for cultivation is less since sizeable area of the District is reserve forest.



The District outputs only 20% of dryland cultivation when compared to State average. Rubber plantation is around 5% more than the State average. Next comes forest areas, which is 20% more than the State average. Built up areas are higher than average, wet lands are less than State average. As per Panfish data there are a large number of ponds in the District.

No	Pond Type	Count	Area in ha
1	Holy ponds	28	3.97
2	Irrigation tanks	5	15.48
3	Panchayath ponds	44	43.13
4	Private ponds	56	44.04
5	Quarry ponds	36	24.93
6	Total	169	131.55

Wetland details are as follows

Wetland	Area in ha	Count
Water bodies	0.45	1
River Sandy area	21.64	43
Water body	146.47	36
River Sandy area	159.62	87
River/stream Perennial	198.88	25
Reservoir	1002.49	4
Wetland Inland Marshy	1352.64	23
Wetland Inland Marshy	1410.72	2
Water body River Perennial	1930.01	12
Total	6222.92	233

Achencoil River Basin

River Achencoil is about 128 km in length. The basin area covers about 1484 km^2. Average annual rainfall is 2600mm.

Achan Koil River

Achencoil River flows in east-west direction and has about 50% of the basin accros under forest. There are no major dams in this River. Achencoil River is one of the five Rivers that drain into the Vembanad lake. In this case also the tributaries are from northern and southern sides. Achencoil River also flows through relatively plain areas. The River is called as Kallar in these regions.

Pamba River basin

Pamba River is situated North of Achenoil River and drains into Vembanad Lake. Pamba River originates from about 1000m altitude where a reservoir is constructed for power generation. Pamba River is about 176 km long. Basins covers around 2235 km^2. Pamba basin has average annual rainfall of 3600mm.

Pilgrims taking holy dip in Pamba

The basin is much broader on the eastern side. There are two branches in the higher reaches. Kakki catchment extents up to the hills on the State border. There is a reservoir in this branch. There is another reservoir in the other branch, Pamba proper also. This River originates from the Pamba-Periyar divide. Pamba River system has a large number of small streams feeding it. More than 60% of the Pamba basin is forested some of which has recently been included in the Periyar Tiger reserve.

Pamba originates at Pulachimalai hill in the Peerumedu plateau in the Western Ghats at an altitude of 1650 metres and flows through Ranni, Pathanamthitta, Thiruvalla, Chengannur, Kuttanad and Ambalappuzha Taluks and finally empties into the Vembanad Lake. Kuttanad, an important rice cultivating area in Kerala gets the irrigation water from the Pamba River. The Pamba basin is bordered on the east by the Western Ghats. The River shares its northern boundary with the Manimala River basin, while it shares the southern boundary with the Achankovil River basin.

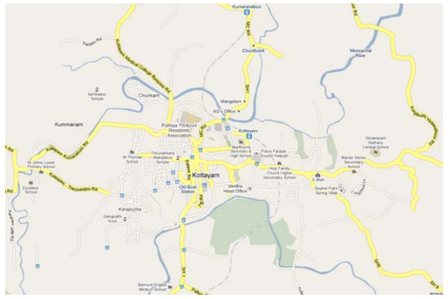
Kakki Reservoir

The tributaries of this River are Kakkiyar, Azhuthayar, Kakkatar and Kallar. It is the third largest River in Kerala. The important projects of this River are the Maniyar Irrigation Project and the Sabarigiri Hydro Electric Project. The two dams, the Pambayar dam and the Kakiyar dam are constructed on the banks of Pamba River. It divides into several tributaries and finally merges into the Vembanad Lake. The annual rainfall in the middle part of the basin is around 4600mm.Pamba River joins the Vembanad lake.

Vembanad Lake

KOTTAYAM DISTRICT

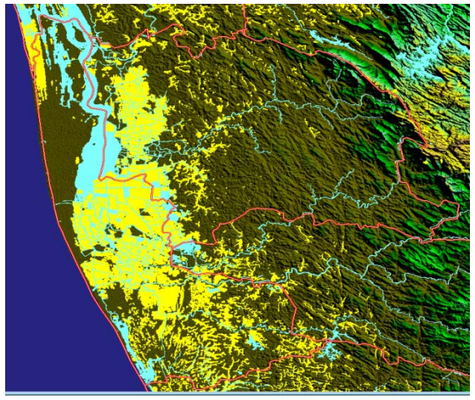
Kottayam District has a total area of 2,208 km2. The District is bordered on the North by Ernakulam, on the East by Idukki and on the South by Alappuzha and Pathanamthitta Districts. The Vembanad lake forms the western boundary.The District is naturally divided into highland, midland and lowland, the bulk being constituted by the midland regions. Meenachil and Kanjirappally Taluks have highland and midland areas while Kottayam, Changanassery and Vaikkom Taluks have midland and lowland areas.



Kottayam town and surroundings

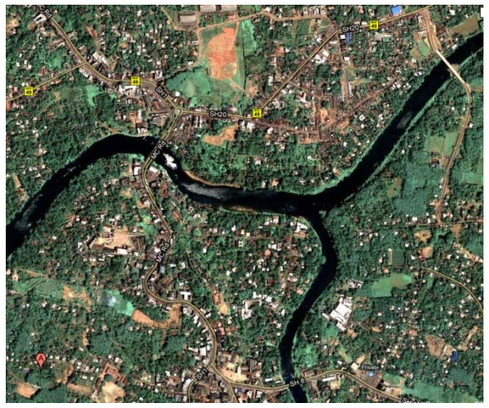
Kanjirappally and Meenachil Taluks have laterite soil, where as Vaikom Taluk and part of Changanassery and Kottayam Taluks have aluvial soil. The District has no coastal area.

The District has a tropical climate with hot season in the plains and plenty of rainfall throughout. The hot season from March to May, is followed by the south west monsoon from June to September. October and November constitute the post-monsoon or retreating monsoon season, when day temperature increases gradually and the heat is nearly as in summer. October to December forms the north east monsoon. Rain cease early in January. The District normally gets an annual average rainfall of 3130mm.



Topography

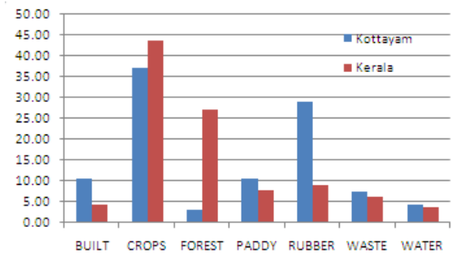
The important rivers of the District are the Meenachil, Muvattupuzha and Manimala. The 78 km long Meenachil river flows through the Taluks of Meenachil, Vaikom and Kottayam. It has a catchment area of 1,272 km^2. The river is formed by several streams originating from the Western Ghats in Idukki District. At Erattupetta, Poonjar River also joins it, takes a sharp turn and flows towards the West. At Kondur, it is joined by the Chittar and at Lalam, it receives the Payapparathodu and flows in a south-west direction till it reaches Kottayam. Here, it branches into several streams before emptying into the Vembanad lake. The important towns in the basin are Pala, Poonjar, Ettumanoor and Kottayam. Meenachil Medium Irrigation Project is having a net ayacut of 9,960 ha, 155 km^2. Catchment area and a water spread area of 228 ha.



Moovattupuzha town

The Muvattupuzha River originates from Ernakulam District, flows through Vaikom Taluk and empties into the Vembanad Lake. The most important town in the basin is Vaikom, the famous pilgrim centre.

The Manimala river flows through Kanjirappally and Changanassery Taluks. The Chittar joins it on its course further down the West as it flows to Alappuzha District. The important town in the basin is Mundakkayam.



More than 25% of the land is under rubber plantation, which is much higher than State average. Built up land covers 10% percentage of the District which is 5% more than the State average.

View of Manimala river

Paddy covers an area of 10% of the District and is comparatively higher than the State average. Forest area is very low in the District. As per Panfish data there are large number of ponds in the District.

No	Pond Type	No of ponds	Area in hector
1	Holyponds and streams	59	25.57
2	Irrigation tanks	20	22.91
3	Panchayath ponds	52	19.04
4	Private ponds	68	385.16
5	Quarry ponds	28	13.44
6	Village ponds	3	0.04
	Total	230	466.52

Details of wetlands as per latest landuse is

Wetland	Area in ha	Count
Water body	10.29	5
River/stream Sandy area	41.1	5
RiverPerennial	59.08	2
Wetland Marshy	828.63	22
Water body Canal	1376.17	3
River Perennial	1377.09	10
Water body Backwater	5354.31	1
Total	9046.67	48

Manimala River Basin

Length of Manimala River is 90 km. Basin area covers around 847 km^2. Average annual rainfall of the basin is 3,300mm.

Three rivers, Manimala, Meenachil and Muvattupuzha originate from hills in the Periyar region and join the Vembanad lake. There are no major reservoirs in this rivers and they flow in east-west direction. They all have large number of streams feeding them. Forest area is also very less in these basins .

Manimala river

MC Road passes in north south direction through these basins. In addition to this, several streams join Vembanad Lake directly. Vembanad lake joins the sea through the Thanneermukkam bund. This is a large barrage meant to prevent entry of salt water inland. But this barrage has created large number environmental problems. Large part of Vembanad Lake is below sea level. There is only one exit near the northern tip for this elongated lake which runs in north south direction.

Manimala River has its origin on the Muthavara Hills near Peerumedu in Idukki District of Kerala. Length of the river is 90 km, basin area covers about 847km^2. The river passes through the Districts of Kottayam, Pathanamthitta and finally joins the Pamba River at Muttar in Alappuzha District. The main tributaries of this river are Kokayar, Valiya thodu, Makkani thodu, Arikka thodu, etc.

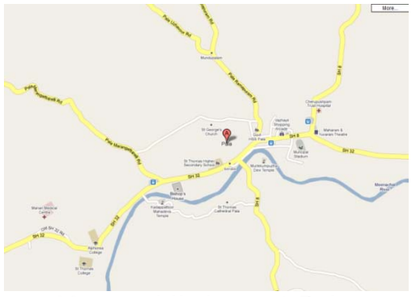
Average annual rainfall of the basin is 3,300mm. The rainfall is high in the month of June and the rainfall is 837.6mm. The Upper region of the basin is mainly under agricultural land, wasteland and forest land. Agricultural land is the mixture of agriculture and horticulture plantations. Middle region of the basin is mainly under agricultural land, and forest land. Lower region comes under agricultural land and water bodies. About 2% of the area is water bodies.

The basin is spread over four Districts, Alappuzha, Kottayam, Pathanamthitta and Idukki. This includes 13 Blocks, 46 Panchayaths and 43 villages. Manimala watershed is divided into 58 sub watersheds and 99 micro-watersheds.

Meenachil River Basin

Kidangoor Temple festival

Three rivers Manimala, Meenachil and Muvattupuzha originate from hills in the Periyar region and join the Vembanad Lake.



Meenachil river at Pala

The Meenachil river flows through Kottayam , Idukki and Alapuzha Districts. The river, 78 km long, flows through Poonjar, Teekoy, Erattupetta, Palai, Ettumanoor and Kottayam before emptying itself into the Vembanad Lake at Kumarakom. The basin is about 1272km^2.

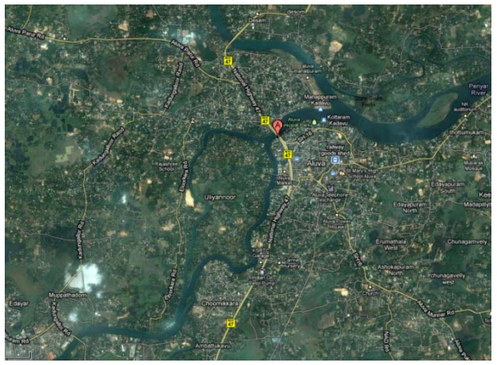
The Meenachil river is formed by several streams originating from the Western Ghats. The general elevation ranges from 77 m to 1,156 m in the highlands and less than 2 m in the lowlands and 8 to 68 m in the midlands. The river has 38 tributaries including major and minor ones. The Meenachil has four main tributaries, namely Kadapuzha, Minadamar, Punjar, Trikovil etc. Average annual rainfall of the basin is 3000mm. the maximum and the minimum temperatures of the region are 30.5°C and 23.5°C experienced during the months of March and December respectively.Upper region of the basin is mainly under agricultural land and waste land. Agricultural land is a mixture of agriculture and horticulture plantations. Wasteland is under barren rock. Middle region of the basin is mainly under agricultural crops. Lower region comes under agricultural land, waste land and water bodies. 2% is water bodies. The basin covers 52 villages spread over 59 Panchayaths and 18 Blocks. The Meenachil watershed is divided into 47 sub watersheds and 114 micro-water sheds.

IDUKKI DISTRICT

This beautiful high range District of Kerala is geographically known for its mountainous hills and dense forests. For the people of Kerala, Idukki is always associated with power generation. About 66% of the State's power needs come from the hydroelectric power projects in Idukki. Idukki District accounts for 12.9 percent of the area of Kerala and only 3.7 percent of the population of Kerala.

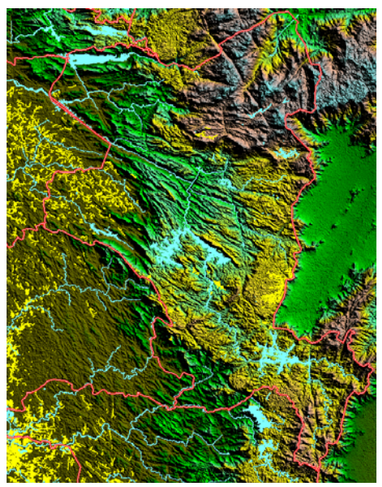
Idukki has many unique topographical and geographical characteristics. Idukki is the largest District of Kerala with an area of 5,105.22 km^2. About 97 percent of the total area of the District is covered by rugged mountains and forests. There is only a strip of midland (3%) in the western part of the District. Lowland area is totally absent in the District. More than 50% of the area of the District is covered by forest.

As the District lies mostly in the highland, it is covered with dense forest, steep hills, and deep valleys. Because of the undulating topography, large area of the District is not suitable for scientific cultivation.



Periyar at Aluva

There are 14 peaks in the District which exceed in height of 2,000 m above M.S.L. They are Anamala, Eravimala, Tathumala, Chenthavara, Kumarickal, Karimkulam, Devimala, Perumal, Ghudoor, Kabhula, Devicolam, Anchanad, Sabarimala and Karimala. Anamudi (Anamala) the highest peak south of Himalayas is in the



Topography

Kuttampuzha Panchayath of Adimali Block and in the K.D.H Village of Devikulam Taluk. The estimated height of the peak is 2,817 meters.

The important rivers of the District are Periyar, Thodupuzhayar and Thalayar. Periyar which is 277km long is the second longest river of Kerala. It originates from Sivagiri in the southeast part of the District and touches all the taluks of the District. The Periyar is harnessed at various points in its course for generating electricity and for irrigation purpose. Mullaperiyar dam, Idukki Hydro-electric project, Idamalayar Hydro electric project and the Lower Periyar are constructed across the Periyar River.

Elephants in Periyar

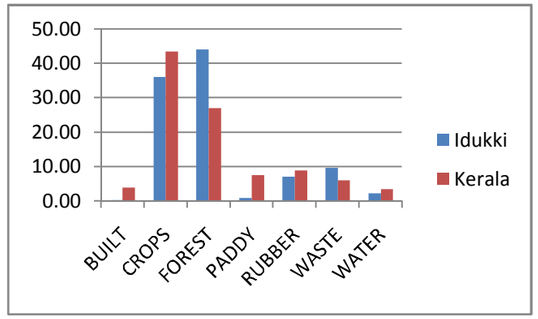
Kundala Dam, Mattupetty Dam, Munnar head works, Ponmudi Dam and the Kallarkutty Dam are constructed across various tributaries of Periyar. There are a few natural lakes in the District. They are Eravikulam and Devikulam lakes in Devikulam Taluk and Elavizhapunchira in Thodupuzha Taluk. Two types of soil are found in the District. The highland area is covered by forest soil (Alluvial soil) and the other parts by laterite soil.

Wetland	Area km^2
Water bodies	148.66
River Sandy area	372.63
River Perennial	1806.05
Reservoir	7393.80
Total	9719.20

As per Panfish data, there are a large number of ponds in Idukki District.

No	Pond Type	No of ponds	Area in ha
1	Holy ponds and streams	15	0.75
2	Irrigation tanks	22	4.03
3	Panchayath ponds	25	2.45
4	Private ponds	49	36.25
5	Quarry ponds	9	1.92
	Total	120	45.42

Periyar divides into Marthandavarma and Mangalapuzha branches. The Mangalapuzha branch joins Chalakkudy river and empties into the Arabian sea at Munambam, and the Marthandavarma branch flows southwards, through the Udhyogamandal area and joins the Cochin backwater system at Varapuzha. The Cochin backwater system is a part of the Vembanad wetland, a tropical estuary on the South-West coast of India. It has a natural opening at Cochin. The Cochin backwater and lower reaches of the river are subject to tidal influence.

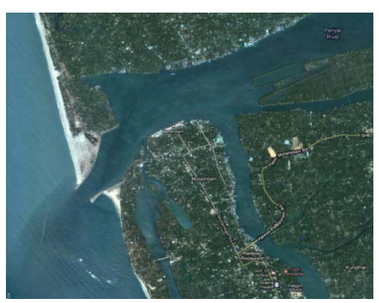


Forest area is higher than State average. Paddy cultivation and built up areas are less than State average.

Landuse	Area
Built	1,316.92
Crops	157,625.04
Forest	192,222.71
Paddy	3,923.99
Rubber	30,729.15
Waste lands	42,264.42
Water bodies	9,719.20
Total	437,801.43

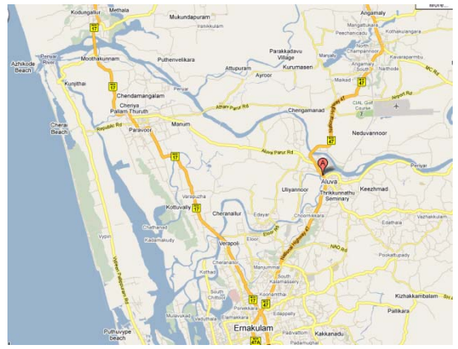
Periyar River Basin

Length of Periyar River is 244 km and the basin area covers around 5398km^2. Average annual rainfall of the basin is 3,200mm.



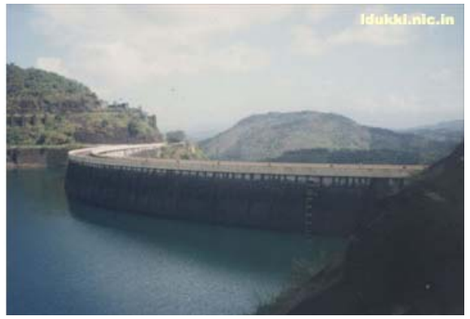
Periyar at Azhikode

Periyar River emerges from Udamala near Periyar Wild Life Santuary at an elevation of 1,593m. After flowing for about 48 km, the Periyar is joined by the Mullayar, then it turns west to flow into the Periyar Lake at Thekkady, which is an artificial reservoir created in 1895 by constructing a dam across the river. The largest hydro- electric project of the State, namely Idukki with its arch dam is across this river. Pallivasal, Chenkulam, Panniyar, Neriyamangalam and Lower Periyar are the other hydro electric projects in Periyar. Mullaperiyar, Bhuthathankettu, Mattupetty, Munnar, Idukki, Cheruthoni, Kulamavu, Irattayar, Lower Periyar, Edamalayar, Chenkulam, Anayirangal and Ponmudi are the important dams across this river.



Aluva and surroundings

The important tributaries of Periyar are the Muthirapuzha, Mullayar, Cheruthoni, Perinjankutty and the Edamalayar. On its way to Arabian Sea, the river is enriched with water of minor tributaries like Muthayar, Perunthuraiar, Chinnar, Cheruthony, Kattappanayar and Edamalayar at different locations.



Idukki dam

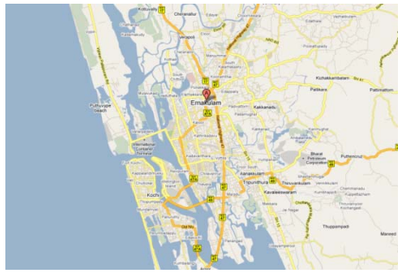
Upper region of the basin is covered with forest, agricultural land, waste land and water bodies. Middle part of the basin is also under agricultural land and small portion is under semi evergreen forest, the lower region has a little forest and main portion is under agricultural land and wasteland.

Periyar basin covers 88 villages and is spread over 102 panchayaths, 21 Blocks and 3 Districts. Periyar watershed is divided into 183 sub-watersheds and 448 micro watersheds.

ERNAKULAM DISTRICT

The District which has an area of 2,407 km² can be divided geographically into highland, midland and coastal area. The altitude of the highland is about 300 m. The borders of the District are the Arabian Sea in the West, Thrissur District in the North, Idukki District in the East, and Alapuzha and Kottayam Districts in the South.

The Periyar River, Kerala's second longest, flows through all the taluks except Muvattupuzha. The Muvattupuzha River and a branch of Chalakudy River also flow through the District. The Eastern portion is formed by a section of Western Ghats. Muvattupuzha, Kothamangalam and Aluva can be called the hilly Taluks. The midland consists mainly of plain land having natural facilities of drainage via backwaters and canals. The Parur Taluk which lies in the flat delta region of the Periyar River and cut by several canals, which have resulted in the formation of many islands and entire Kochi Taluk as well as the western part of Kanayannur come under lowland region. Major part of Kunnathunadu and eastern portion of Kanayannur Taluk come under mid land region. 20 percent of the total area is lowland region.

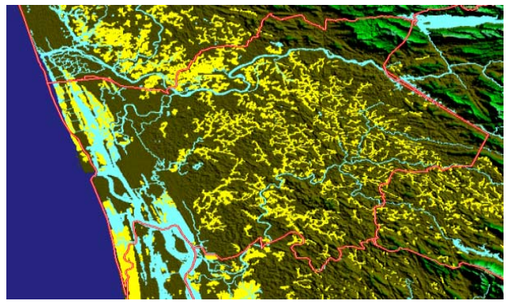


Ernakulam District, coastal region

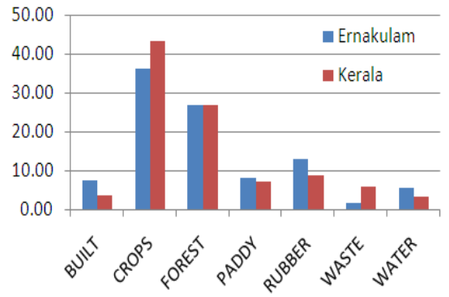
The Malayattoor high range and northern and north eastern tip of the Muvattupzha and Kothamangalm Taluk form the forest area of the District. Area under forest is 81.23 km². Area under water bodies area is 127 km².

Satellite image view

Agriculture constitutes the most important segment of the District's economy and it is the biggest source of employment. Of the 2,353.19 km² area, crops are grown in 2,104.38 km². Coconut is the principal crop followed by rubber, paddy, and tapioca. A paddy cultivation system called pokkali is peculiar to the District. Under this system only one crop can be taken in a year, After harvest suitable varieties of fishes and prawns are grown in the fields which is more profitable. Activities allied to agriculture such as dairy, poultry and fishery play an important role in the economy of the District. 29.40% of cultivated area is irrigated in the District.



Topography



Landuse pattern

The extent of rubber plantations is higher than the State average. Areas of water bodies are also higher than the State average. Forest seems to be the same as the State average. Paddy fields are comparatively high in the District. Built up area are more than the State averages.

Wetland	Area in ha	Count
River island	29.16	47
River Sandy area	141.74	37
Water bodies	228.20	61
Reservoir bed	371.04	21
Reservoir	2636.77	1
River/stream Perennial	14098.85	19
Ernakulam Total	17505.76	186

As per Panfish data

No	Pond Type	No of ponds	Area in ha
2	Irrigation tanks	24	13.98
1	Holyponds and streams	66	26.94
5	Quarry ponds	37	37.14
3	Panchayath ponds	73	233.16
6	Village ponds	11	245.94
4	Private ponds	81	747.14
7	Total	292	1304.3

Muvattupuzha River Basin

Muvattupuzha River is about 121 km long. Basin covers around 1,554 km². Muvattupuzha basin has average annual rainfall of 3,100 mm.

Three Rivers Manimala, Meenachil and Muvattupuzha originate from hills in the Periyar region and join the Vembanad lake. There are no major

reservoirs in this Rivers and they flow in east-west direction. They all have a large number of streams feeding them. Forest area is also very less in these basins .

Muvattupuzha is the union of three Rivers -Thodupuzha, Kaliyar and Kotha-mangalam River. Thodupuzha originates from Tangakkanam Hills; Kalliyar is formed by confluence of Velurpuzha and Kannadi Puzha and Kothamangalam River originates from Mannankavu Mala. These Rivers join together at Muvattupuzha and then flow towards South-West as a single River to the Vaikkom Lake. Finally, it merges with the Arabian Sea. The famous Thommankuthu Waterfalls is situated in the River Muvattu puzha. There is a dam constructed for irrigation purpose and for small hydro electric project at Malankara near Thodupuzha.

Main tributaries of the River are Kudayattur Puzha , Manipuzha thodu, Valiyar thodu, Chuzhilikanam Thodu etc. Muvattupuzha River basin has an average annual rainfall of 3,100mm. The maximum temperature is experienced in the month of March (30.7°C) and lowest is in the month of December (23.8°C).About 75% of the basin is under cultivation. 15% of the basin includes forest area and rest of the basin includes water bodies, waste land and built-up area.

Muvattupuzha River basin covers 113 villages spread over 112 Panchayaths, 24 Blocks, Cochin Corporation and four Districts namely Ernakulum, Alapuzha, Kottayam and Idukki. Muvattupuzha watershed is divided into 103 sub and 202 micro-watersheds.

MC Road passes in North-South direction through these basins. In addition to this, several streams join Vembanad Lake directly. Vembanad lake joins the sea through the Thanneermokkam bund. This is a large barrage meant to prevent entry of salt water in land. But this barrage created large number environmental problems. Large part of Vembanad Lake is below sea level. There is only one exit near the northern tip for this elongated lake which runs in north south direction.

Moovattupuzha River receives water diverted from the Periyar basin which has increased the water availability.

THRISSUR DISTRICT

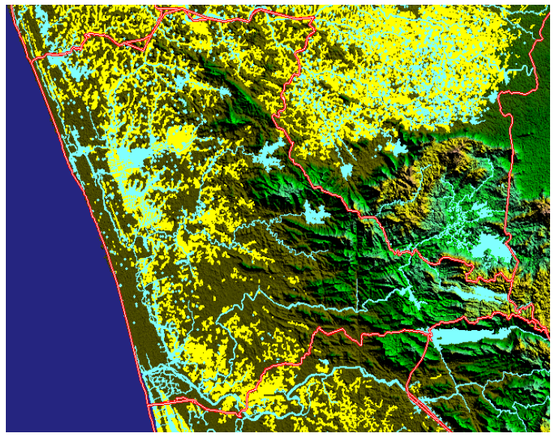
There are mainly three River basins in Thrissur District, Kechery, Karuvannur and Chalakudy. Some of the north eastern portions drain to Bharathapuzha. Only the northern parts of Chalakudy basin fall in Thrissur District. There are several reservoirs in the Rivers. All these Rivers drain to Kole wetlands which is unique ecosystem

Karuvannur River basin

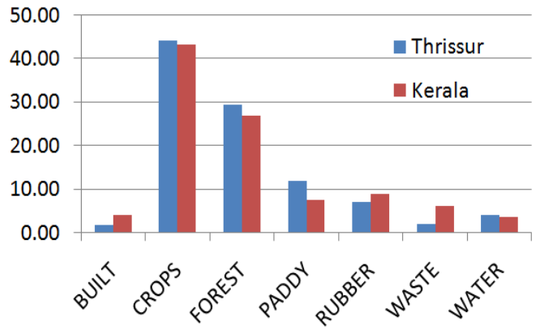
Karuvannur River flows through southern parts of Thrissur District especially between Kecheri and Chalakkudy Rivers. The River has mainly two tributaries; they are Manali Puzha and Kurumali Puzha. Kurumali Puzha has its own tributaries, namely Mupli Puzha and Chimmoni Puzha. All tributaries of Karuvannur River are originating from Peechi and Chimmoni Wildlife Sanctuaries and reserve forest of Western Ghats. Peechi dam was constructed in the Catchment area of Manali Puzha. and Chimmoni dam, in the catchment area of Chimmoni Puzha. Both Manali Puzha and Kurumali Puzha join together before Arattupuzha, then flow in the middle of Kole wetlands. The River divides the Kole wetlands into two, Northern Kole and Southern Kole. The River joins to Connolly Canal after Kole wetlands and finally to Arabian Sea. Karuvannur River basin can be divided into three sub-basins; they are Manali basin, Kurumali basin and Kole wetland basin. Northern Kole wetlands of Thrissur is not part of this River basin, but still southern parts of Northern Kole wetlands using River water from Karuvannur as well as flush out water to River through canals during monsoon.

Manali Basin

Manali basin is the upper basin of Karuvannur River. One of the main tributaries of Karuvannur River namely Manali Puzha and its streams flow through the basin. Manali Puzha has five major streams. Two streams directly flow to Peechi reservoir and rest of them join the main River later. Peechi dam was constructed across Manali Puzha. The catchment area of this tributary is Peechi Wildlife Sanctuary and reserve forest.



Land use pattern

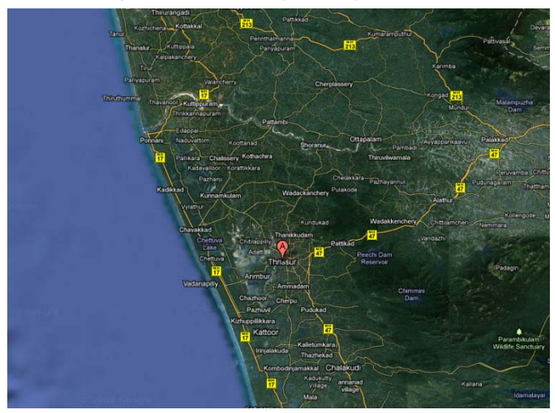


As per Panfish data there are a large number of ponds

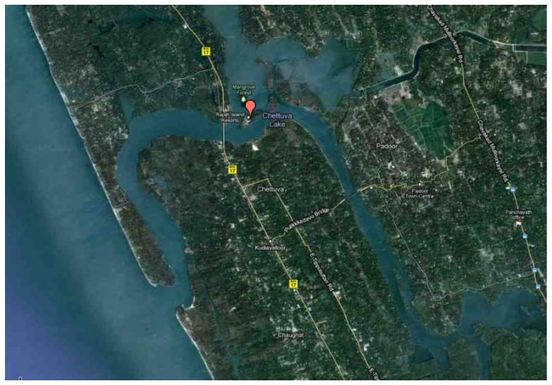
No	Pond Type	No of ponds	Area in hector
1	Village ponds	2	40.48
2	Quarry ponds	18	16.72
3	Irrigation tanks	39	507.72
4	Holyponds and streams	62	111.77
5	Panchayath ponds	76	240.68
6	Private ponds	84	559.58
7	Total	281	1476.95

Length of Kecheri River is 51 km and puzhakkal River is 29 km. Kecheri basin covers area around 401km^2 and Puzhakkal basin covers and area around 234km^2. Average annual rainfall of both the basin is 3000mm. Kechery and Puzhakkal Rivers originate from Machademala. Both flow through Thrissur District and Kechery River has tributaries called Choondal Thodu. Peramangalam Thodu,Chettupuzha etc.Nadu Thodu is the tributary of Puzhakkal River.

Vazhani irrigation project is situated at kechery River. Vazhani, one of the biggest clay dams in Kerala with a length of 792.48 metres, is situated 23 km away from Thrissur. This water is used mainly for irrigation and drinking purposes. This project in Thrissur District envisages construction of an earth dam built across the Vadakkancherry Puzha, The project was completed during the year 1962.



Thrissur Location Map



Closeup view of coastal wetlands

Kecheri River basin has its presence in 10 Blocks in Thrissur District and one in Palakkad District. There are 48 Panchayaths and 39 villages in this basin. Kecheri watershed is divided into 51 sub watersheds and 79 micro watersheds.

The upper region of the basin is mainly agricultural and forest land. Agricultural land has a mixture of agriculture and horticulture plantations. Middle region of the basin is mainly under agricultural land, waste land and forest land. Lower region comes under agricultural land

and water bodies. Agricultural land is around 40% of the area and comprise twice cropped paddy lands. Rest of the area is water bodies.

PALAKKAD DISTRICT

Palakkad District is situated in the South West region of India, bounded on the North by Malappuram, in the East by Coimbatore of Tamil Nadu, in the south by Thrissur and in the West by Thrissur and Malappuram Districts. It lies between 10°21' and 11°14' North latitude and 76°02' and 76°54' East longitude. The total geographical area of the District is 4,480 km^2 representing 11.53 per cent of the State's geographical area. The forest land covers about 25%.

The District has a humid climate with a very hot season extending from March to June in the Western Part of the District whereas it is less humid in the Eastern sector. The most important rainy season is during South-West Monsoon which sets in the second week of June and extends upto September. About 75 per cent of the annual rain is received during the south west monsoon period. During the period December to May, practically no rain is received. The temperature of the District ranges from 20°C to 45°C. The maximum temperature recorded at Palakkad was 43°C.

Bharathappuzha, with her tributaries, sprawls across the entire District. The river takes its origin from Anamalai Hills and flows through the Districts of Palakkad, Malappuram and Thrissur before emptying into the Arabian sea at Ponnani. Its four main tributaries are Gayatrippuzha, Kannadippuzha, Kalpathyppuzha and Thuthappuzha. "Rice bowl of Kerala" is the synonym for Palakkad. The net cultivated area of the District is 284 lakh hectares, ie, 64 per cent of the geographical area. Major portion of the cultivable land is used for raising food crops. All food crops together account for about 80 per cent of the gross cropped area and paddy alone accounts for about 60 per cent of it. Coconut, groundnut, cotton, sugarcane, pepper, banana and cashewnut are some of the major cash crops raised.

Palakkad District is blessed with irrigation facilities. Dams have been constructed across almost all the important tributaries of the Bharathapuzha to provide irrigation facilities to the District. Completed irrigation projects in Palakkad District are Walayar, Malampuzha, Cheera kuzhi, Gayathri (Meenkara, Chulliar), Mangalam and Pothundy. The total ayacaut of all these completed projects is 77,306 ha. In addition to this, construction of two major irrigation projects, viz., Chitturpuzha and Kanhirappuzha are in progress. The total ayacut of these projects is 542 km^2.

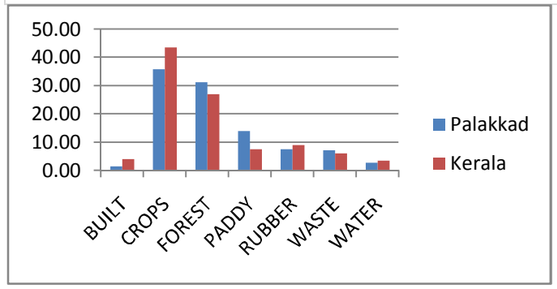
Block	Number of Wetlands-1992	Area of Wetlands (ha)-1992	Number of Wetlands-2005	Area of Wetlands (ha)-2005	Difference: Number of Wetlands	Difference: Area of Wetlands
Alathur	76	496.45	283	738.13	207	241.68
Attappadi	2	158.16	19	776.55	17	618.39
Chittur	64	260.28	277	558.69	213	298.41
Kollengode	24	186.87	422	576.20	398	389.34
Kuzhalmannam	21	87.42	252	310.03	231	222.61
Malampuzha	47	1618.31	251	2834.26	204	1215.96
Mannarkkad	9	431.87	64	945.28	55	513.41
Nemmara	55	2353.98	415	3366.18	360	1012.20
Ottappalam	20	287.04	134	416.97	114	129.93
Palakkad	32	130.86	136	466.87	104	336.01
Pattambi	30	856.20	97	809.61	67	-46.59
Sreekrishnapuram	24	107.17	62	219.17	38	112.00
Thrithala	19	302.55	36	304.89	17	2.34

SACON (2009) statistics

Landuse CESS	Sum of AREA ha	Count
Reservoir Reservoir	3290.2	12
Reservoir bed	2871.02	29
River/stream Perennial	5062.55	39
River/stream Sandy area	106.37	11
Water bodies	865.47	2167
Wetland Marshy	107.75	6
Wetland Marshy (R.F)	261.33	95
Palakkad	**12564.69**	**2359**

Panfish data

No	Pond Type	No of ponds
1	Holyponds and streams	77
2	Irrigation tanks	18
3	Panchayath ponds	73
4	Private ponds	88
5	Quarry ponds	40
6	Village ponds	4
7	Total	300



Landuse	Area
Built up	6,896.31
Crops	158,615.89
Forest area	137,842.14
Paddy	62,098.04
Rubber	33,573.89
Waste lands	31,905.07
Water	12,564.69
Waste lands	4.46
Total	443,496.03

Bharathapuzha River Basin

Length of Bharathapuzha River is 209 km. basin area covers around 4,400km^2 in Kerala. Average annual rainfall of the basin is 2,300mm.

The river originates in the Annamalai Hills located in the Western Ghats region in Tamil Nadu. It flows in the west direction along with many of its tributaries including the Tirur River through Palakkad Gap, Palakkad, Thrissur and Malappuram Districts. For the first 40 kilometers, Bharathapuzha River flows northwards till Pollachi. The Kannadippuzha and Kalpathippuza, the tributaries of Bharathapuzha meet at Parli and flow in the west direction as Bharathapuzha River. The Bharathapuzha River then surrenders itself into the Arabian Sea at Ponnani. Gayathripuzha River, Kannadipuzha River, Kalpathipuzha River and Thuthapuzha River are the main tributaries of the Bharathapuzha. The Thutapuzha River merges with Nila at Pallippuram making the waters of Nila richer in mineral content.

The tributaries also branch out and form several tributaries, which are the distributaries of the Bharathapuzha River. The tributaries of Thuthapuzha River are Kunthippuzha, Kanjirappuzha, Ambankadavu, and Thuppanadippuzha. The tributaries of Gayathripuzha are Mangalam, Ayalurpuzha, Vandazhippuzha, Meenkarappuzha and Chulliyar. The tributaries of Kalpathipuzha are Korayar, Varattar, Walayar and Malampuzha. The tributaries of Kannadipuzha are Palar, Aliyar and Uppar.

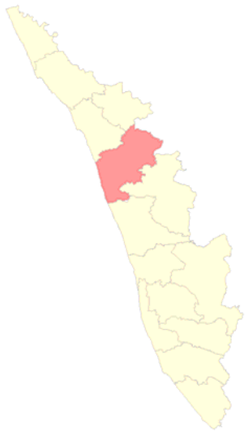
There are several dams constructed across this river of which Malampuzha dam is the largest built across Bharathapuzha and its tributaries. Other dams constructed are Walayar dam, Mangalam dam, Pothundi dam, Meenkara dam and Chuliyar dam. These irrigation projects irrigate an area of 773 km^2.

Malampuzha dam

Bharathapuzha River

Typical pond in the basin

MALAPPURAM DISTRICT



Malappuram District was formed on 16th of June 1969. It is bounded by Nilgiris of Tamil Nadu in the East, Arabian sea in the West, Kozhikode and Wayanad Districts in the North and Palakkad and Thrissur Districts in the South. The District has a geographical area of 3550 km^2, which is 9.13 per cent of the total area of the State. With regard to area, Malappuram District ranks third in the State.

The location of Malappuram District is 75^o to 77^o east longitude and 10^o to 12^0 north latitude, in the geographical map. Like most of the other Districts of the State, Malappuram too consists of three natural divisions, lowland, midland and highland. The lowland stretches along the seacoast, the midland in the center and the highland region towards the east and North-eastern parts. The topography of the District is highly undulating; starting from the hilltops covered with thick forests on the East along the Nilgiris. It gradually slopes down to the valleys and the small hills, before finally ending on the sandy flat of luxuriant coconut groves in the west.

The District has more or less the same climatic conditions prevalent elsewhere the State viz, dry season from December to February, hot season from March to May. South West Monsoon is from October to November. The South West Monsoon is usually very heavy and nearly 75 per cent of the annual rains are received during this season. The climate is generally hot and humid; the temperature varying between 30^0C and 20^0C.

Ponnani estuary

Four important rivers of Kerala flow through Malappuram District. They are, Chaliyar, Kadalundi puzha, Bharathappuzha and Tirurpuzha. The District has a total forest are of 758.86 km^2. The major forest area is concentrated in Nilambur and Vandoor blocks and Melattur in the Western Ghats. Of the forests, 80 percent is deciduous and the rest is evergreen. Teak, rosewood, venteak, chorapine, mahagony, etc. are the important trees. Other varieties like kulamavu and vella pine are used in the plywood industry. Bamboo is extensively grown in all parts of the forest. The District has also several man made plantations, mainly of teak.

Agriculture is the mainstay of the population, involving 75 per cent of the people, directly or indirectly. The main crops raised are paddy, coconut, tapioca, arecanut, cashewnut, banana, rubber, pulses, ginger, pepper and betel vine.

Here, 2.08 lakh hectares of land is available for agriculture. The vast majority of the peasants are small land holders. 2.36 lakh hectares are holdings below one hectare. Only 16,107 hectares of holdings are above 2 hectares in area.

Paddy has lost predominance among crops during the last two decades. Now coconut tops with a total area of one lakh hectares. The annual coconut production stands at 569 million nuts. Paddy is cultivated in 31098 hectares with an annual production of 53,443 tonnes. Cashew is raised in a total area of 10761 hectares with annual production of 4,968 tonnes. Rubber, a main cash crop in the District, has got coverage of 26305 ha. Annual production is below 1,800 MT. An important cash crop is arecanut. It covers an area of 14883 hectares, with an average annual production of 2868 million nuts.

Irrigation

The major irrigation division with the headquarters at Manjeri is entrusted with the responsibility of safeguarding a length of 50.2km of coastline of Kerala in Malappuram District. Of this, 12.3 km length of the coast is vulnerable and can cause heavy damages during monsoon season. In addition to the seacoast protection works, this division also maintains the major river banks in the District affected by monsoon water.

Although three major rivers of Kerala flow through the District, Malappuram District has no major irrigation project and hence frequent drought is experienced. Two major irrigation schemes proposed are Chaliyar irrigation project in Chaliyar at Chungathara Village Nilambur Taluk

and Chamravattom regulator cum bridge across Bharathappuzha at Ponnani.

The National Watershed Development Programe is implemented in this District. Under this, agricultural Development programes, minor irrigation activities, soil and water survey are taken up in 14 watersheds. Under Western Ghat Development Scheme Watersheds of Koramala in Vandoor Block, Olavattoor and Edavannappara in Kondotty Block. Cheppur in Malappuram are also taken up and completed. Payyanad thodu and Edavana schemes are under consideration.

Block	Number of Wetlands-1992	Area of Wetlands (ha)-1992	Number of Wetlands-2005	Area of Wetlands (ha)-2005	Difference: Number of Wetlands	Difference: Area of Wetlands
Areekkode	21	172.91	36	376.86	15	203.95
Kondotty	32	208.60	24	115.05	-8	-93.55
Kuttippuram	25	518.09	74	876.55	49	358.46
Malappuram	9	159.25	76	131.17	67	-28.08
Mankada	26	196.05	75	303.90	49	107.85
Nilambur	3	247.04	303	1520.62	300	1273.58
Perinthalmanna	23	153.64	26	276.12	3	122.48
Perumbadappu	29	2229.81	65	1088.58	36	-1141.22
Ponnani	21	1052.26	45	801.57	24	-250.68
Tanur	19	149.57	9	95.21	-10	-54.36
Thirur	97	2986.47	103	2117.41	6	-869.06
Thirurangadi	65	1353.12	28	678.16	-37	-674.96
Vengara	28	226.05	27	164.77	-1	-61.28
Wandoor	5	236.39	108	378.01	103	141.63

CESS WATER	Sum of AREA ha	Count
Malappuram	**7617.91**	**721**
River/stream Perennial	5681.69	98
River River bed cultivation	22.29	8
River/stream Sandy area	1888.57	580
Water bodies	23.07	33
Wetland Inland Marshy	2.29	2

Kadalundi and Tirur River Basins

The basin covers an area of 1,122 km^2. Length of river is 130km, average annual rainfall is 3,400mm.

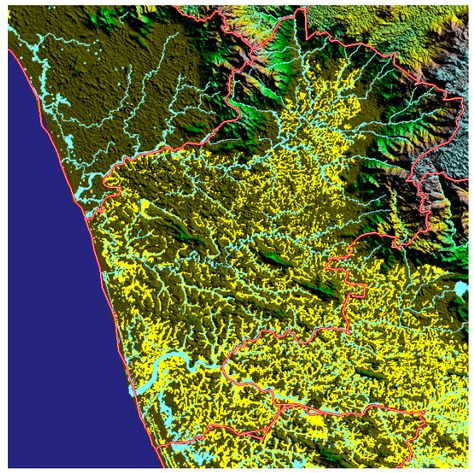
Kadalundi River originates from Cherakomban Mala in the Western Ghats at the western border of Silent Valley and flows through the District of Malappuram. It has two main tributaries namely Olipuzha and Veliyar. The Kadalundi River drains an area of 1,274 km^2.

Korapuzha, Kallai and Chaliyar river basins

Length of Korapuzha, Kallai and Chaliyar river are 40 km, 22 km and 169 km respectively and thier basin cover 624 km^2, 96 km^2 and 2535 km^2(in Kerala) respectively. The annual rainfall of this basin is 3,800mm.

Chaliyar, originates from the Ilambalari (Elembalai) hills in Gudalur of Nilgiris District (inTamil Nadu). This river has a total drainage area of 2,923 km^2, of which 2,535 km^2 is in Kerala and the rest in Tamil Nadu. The river flows through Wayanad, Malappuram and Kozhikode Districts. The Chaliyar joins Arabian Sea near Beypore.

The Kavanakallu Regulator cum bridge is constructed across the Chaliyar River, 13 km away from Kondotty Hill. The important tributaries of the Chaliyar are Chalipuzha, Punnapuzha, Pandiyar, Karimpuzha, Vadapurampuzha, Iringipuzha and Iruthilpuzha.



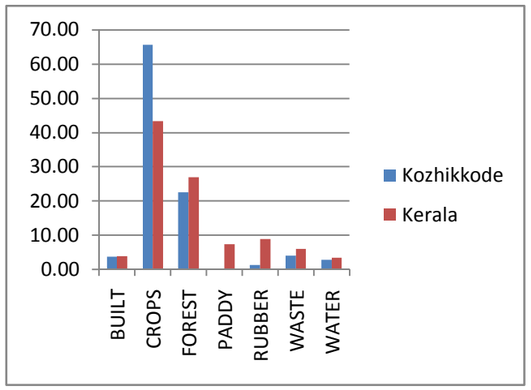
Landuse pattern

KOZHIKKODE DISTRICT

The District has three distinct regions-the sandy coastal belt, the rocky highlands formed by the hilly portion of the Western Ghats and lateritic midland. Of the total area of 2344 km^2, the sandy coastal belt is 362.85 km^2., lateritic midlands 1343.50 km^2. and rocky highlands 637.65 km^2.

All the three taluks are spread over the three regions. The District has a coastal length about 80 kms. Kozhikode District is stimulated on the South-West coast of India. The District is bounded on the north by Kannur District, on the east by Wayanad District, on the South by Malappuram District and on the West by the Arabian Sea. It is situated between North latitudes 11^{0}08' and 11^{0}50' and East longitudes 75^{0}30' and 76^{0}08'.

Basking in the idyllic setting of the serene Arabian Sea on the West and the proud peaks of the Wayanad Hills on the east, this District has all the elements that fascinate a visitor. The highland region accounts for 26.80 per cent and the lowland region 15.55 per cent of the total area of the District.



Land use pattern

Land crops is the major land use in Kozhikkode District. It is much higher than the State average. Forest area is nearly 20%, but less that State average. Wetlands are less than State average. Rubber cultivation is also less than state average. Sacon(2009) statistics is follows.

Block	Number of Wetlands-1992	Area of Wetlands (ha)-1992	Number of Wetlands-2005	Area of Wetlands (ha)-2005	Difference: Number of Wetlands	Difference: Area of Wetlands
Balusseri	32	1053.52	60	891.58	28	-161.93
Chelannur	28	919.37	14	507.71	-14	-411.66
Koduvally	19	53.85	28	237.37	9	183.52
Kozhikode	68	1133.37	58	909.09	-10	-224.28
Kunnamangalam	65	668.97	71	615.59	6	-53.38
Kunnummal	20	193.33	14	266.91	-6	73.58
Melady	29	1285.61	16	555.43	-13	-730.18
Pantalayani	31	1071.39	26	556.89	-5	-514.50
Perambra	39	925.64	35	1149.82	-4	224.18
Thodannur	17	865.54	15	394.24	-2	-471.30
Thuneri	12	108.44	14	151.84	2	43.41
Vadakara	9	221.43	5	57.78	-4	-163.65

In general, there is a decline both in number of wetlands as well as area under wetlands. Land use is tabulated below.

Land sue	Sum of AREA ha	Count
Kozhikkode Total	6567.73	269
River/stream Sandy area	55.16	40
Reservoir bed	87.93	31
Water bodies	262.69	83
Wetland Marshy	424.74	84
Reservoir	1164.35	1
River/stream Perennial	4572.86	30

As per Panfish data, holy ponds and streams are followed by Panchayath ponds and private ponds. Area-wise, private ponds predominate.

No	Pond Type	count	Area in ha
6	Village ponds	5	2.10
5	Quarry ponds	12	4.33
2	Irrigation tanks	14	1.11
4	Private ponds	29	114.61
3	Panchayath ponds	35	13.53
1	Holyponds and streams	38	17.64
7	**Total**	**133**	**153.32**

Landuse	Area
Paddy	166.06
Rubber	3,203.38
Water	6,567.73
Built	8,867.12
Waste	9,735.54
Forest	53,986.70
Crops	157,020.43
Total	239,546.96

Land use pattern

Geographically, the District has coastal areas, midlands and highlands. Korappuzha and Kuttiyadipuzha are the two main rivers. The South eastern portion is drained by Chaliyar. There are two dams across Kuttiyadi River for power generation.

Coastal water bodies

WAYANAD DISTRICT

The total geographical area of Wayanad is 2,126 km^2. It is bounded on the East by Nilgiris and Mysore Districts of Tamil Nadu and Karnataka respectively, on the North by Coorg District of Karnataka, on the South by Malappuram and on the West by Kozhikode and Kannur .

Pookode lake

Placed on the southern tip of the Deccan Plateau, its prime glory is the majestic Western Ghats with lofty ridges interspersed with magnificent forests, tangled jungles and deep valleys. In the centre of the District, hills are lower in height, while the northern area has high hills and they give a wild and mountainous appearance. Some of the major peaks are Vellarimala, Banasura, Brahmagiri, Chembra, etc. ranging from 1,500 m to 2,100 m height.

Wayanad: waterfall

The eastern area is flat and open. Due to the peculiar terrain, there are east-flowing and west-flowing Rivers. The low hills are full of plantations like tea, coffee, pepper and cardamom while the valleys have a predominance of paddy fields.

The altitude of Wayanad varies from 700 to 2100 meters from sea level. The hill ranges of Vythiri Taluk, through which the road from Kozhikode ascends the Wayanad Plateau over mind-boggling bends and ridges, are the highest locations. From the highest altitude of the Western Ghats on the western border of the District , the Plateau of Wayanad gradually slopes down eastward. Further from Mananthavady, it becomes a common plain of paddy fields with the swift flowing Kabani coursing through it.

Elsewhere, Wayanad offers a panorama of undulating hills and dales, which are converted into paddy fields. The hills, which might have been thick forests once, are now plantations of coffee, tea or cardamom. There is luxuriant greenery all round. On a clear day from the River bed of Kabani, Wayanad will seem to be a fairy land with the deep blue mountains juxtaposed with the blue sky and white vagrant wads of cottonwools like clouds amidst them. The soil of the Wayanad District is mainly of the forest type. It promotes a lushy luxuriant growth of vegetation.

Wayanad vayals

Wayanad has a salubrious climate. The mean average rainfall in this District is 2,322mm. Lakkidi, Vythiri and Meppadi are the high rainfall areas in Wayanad. Annual rain fall in these high rainfall areas ranges from 3000 to 4,000 mm. High velocity winds are common during the southwest monsoon and dry winds blow in March-April. High altitude regions experience severe cold. In Wayanad (Ambalavayal) the mean maximum and minimum temperature for the last five years were 29°Cand 18°C respectively. This place experiences a high relative humidity, which goes even up to 95 per cent during the Southwest monsoon period.

Generally the year is classified into four seasons, namely, cold weather (December-February), hot weather (March-May), southwest monsoon (June-September) and northeast monsoon (Octber-November)

The dale,“Lakkidi', nestled among the hills of Vythiri Taluk has the highest average rainfall in Kerala. The average rainfall in Wayanad is 3000 mm per year. There is a decreasing trend in rainfall in this area the average rainfall. Data shows that the lowest rainfall received from northeast monsoon, is in Wayanad District.

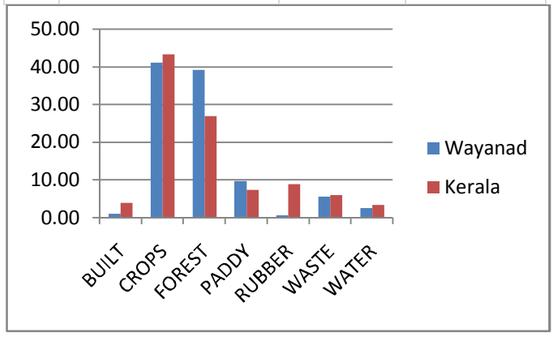
RIVERS

Kabani River, one of the three east-flowing Rivers of Kerala, is an

important tributary of the River Cauvery. Kabani and its tributaries constitute a powerful River system in the landscape of Wayanad.

Panamaram rivulet takes its origin from the Perennial Lake called, 'Pookkode Lake. It flows swiftly through mountain gorges joined by other streams, tumbles down into Panamaram valley. Six km. Further from Panamaram, this River joins the Mananthavady rivulet, originating from the lower regions of the peak 'Thondarmudi'. From this confluence onwards the River is known as Kabani, a mighty, perennial River which after entering Karnataka, joins with the River Cauvery. Almost entire Wayanad is drained by the Kabani River and its tributaries namely Panamaram Mananthavady and Thirunelli .

6	Total	60	74.28



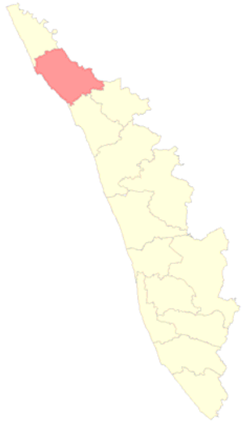
Bird life

Block	Number of Wetlands-1992	Area of Wetlands (ha)-1992	Number of Wetlands-2005	Area of Wetlands (ha)-2005	Difference: Number of Wetlands	Difference: Area of Wetlands
Kalpetta	46	368.02	30	4342.89	-16	3974.87
Mananthavadi	148	570.42	39	117.35	-109	-453.08
Sulthanbathery	73	332.40	47	84.76	-26	-247.64

As per panfish data

No	Pond Type	No of ponds	Area in hector
1	Holyponds and streams	2	2.08
2	Irrigation tanks	10	5.44
3	Panchayath ponds	12	5.16
4	Private ponds	24	47.64
5	Quarry ponds	9	3.30
6	Village ponds	3	10.66

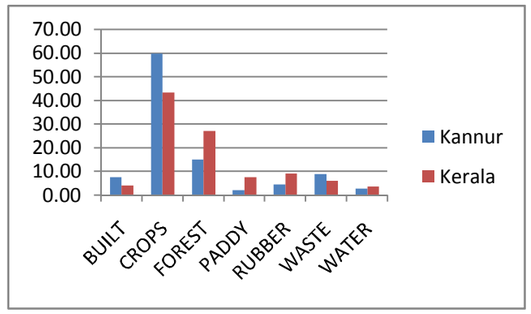
KANNUR DISTRICT



Kannur District is bound by the Western Ghats in the East (Coorg District of Karnataka State), Kozhikkode and Wayanad District s, in the South, Lakshadeep Sea in the West and Kasaragod, the northern-most District of Kerala, in the North.The District can be divided into three geographical regions - highlands, midlands and lowlands.

Coastal landscape

The highland region comprises mainly of mountains. This is the area of major plantations like coffee, rubber, tea, cardamom and other spices. Timber trees like teakand rosewood are grown in plenty in this region.The midland region, lying between the mountains and the low lands, is made up of undulating hills and valleys. This is an area of intense agricultural activity. The lowland is comparatively narrow and comprises rivers, deltas and seashore. This is a region of coconut and paddy cultivation.



Land use

The District has a humid climate with an oppressive hot season from March to the end of May. This is followed by the South-West monsoon which, continues till the end of September. October and November form the post-monsoon or retreating monsoon season. The North East monsoon which follows, extends upto the end of February, although the rain generally ceases after December. During the months of April and May, the mean daily maximum temperature is about 35° Celsius. Temperature is low in December and January -about 20^{o} Celsius. On certain days the night temperature may go down to 16° Celsius. The annual average rainfall is 3438 mm and more than 80 percent of it occurs during the period of South -West monsoon. The rainfall during July is very heavy and the District receives 68 per cent of the annual rainfall during this season.

Kannur District is very rich in vegetation. Natural vegetation, except in some coastal regions, consists of different types of forests. But, in spite of generally favourable climatic conditions, vegetation is not , uniform. In restricted regions, with their own micro climate or special edaphic features, plant formations assume different characters. Thus, plant communities, ranging from psammophytes (Plants that grow best in or tolerate sand, particularly fine to medium sand) and mangroves to evergreen forests are seen in this District . The coastal region is a comparatively narrow zone, characterized by secondary soil which is rather loose and sandy.

Coastal landscape

The serile sandy tract supports only a poor vegetation of the psammophyte type. Plants are few and mostly prostrate. Erect species are small and short. Owing to very poor water holding capacity of the soil, these plants are provided with special xerophytic adaptations. Another conspicuous feature of this area is the mangrove vegetation, found at the estuaries of rivers and backwaters, and often extending to the interior along their banks.

CESS WATER	Sum of AREA ha	Count
Kannur	**7988.27**	**132**
Reservoir bed	6.23	2
River/stream Perennial	7910.26	70
River/stream Sandy area	46.42	21
Water bodies	25.36	39

Water transport

Human interference has much changed the vegetation of the coastal region. Major part of the District comes under midland region with numerous hills and dales and it presents an undulating surface gradually ascending and merging into the slopes of Western Ghats. Soil is secondary and lateritic with underlying rock of laterite or disintegrated gneiss. Typical flora of this area is a moist deciduous forest consisting of a mixture of evergreen and deciduous trees. Undergrowth consists of a variety of annuals and perennials. The mountains are a continuation of the midland region, gradually ascending to the main ridge of the Western Ghats. Soil in the western slopes is a ferrugenous red, sandy loam. Vegetation over the whole area is of the forest type. Irregular distribution of teak, localised areas of bamboo dominance, change of good quality forest into open grasslands, etc are characteristic.

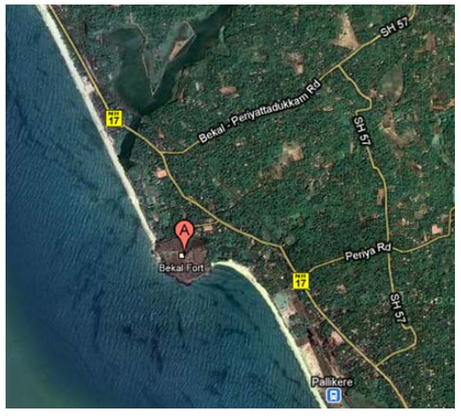
Landuse	Area km^2
Built	22,432.08
Crops	177,894.12
Forest	44,188.96
Paddy	6,214.67
Rubber	13,414.93
Waste	26,136.92
Water	7,988.27
Total	298,269.95

No	Pond Type	No of ponds	Area in ha
1	Holyponds and streams	69	35.77
2	Irrigation tanks	17	90.01
3	Panchayath ponds	55	19.86
4	Private ponds	91	73.91
5	Quarry ponds	16	6.26
6	Village ponds	6	97.13
	Total	**254**	**122.94**

Panfish data

KASARGOD DISTRICT

The District is marked off from the adjoining areas outside the State by the Western Ghats which run parallel to the sea and constitute an almost continuous mountain wall on the eastern side. The Ghats dominate the topography. The coastline is fringed with low cliffs alternating with stretches of sand.

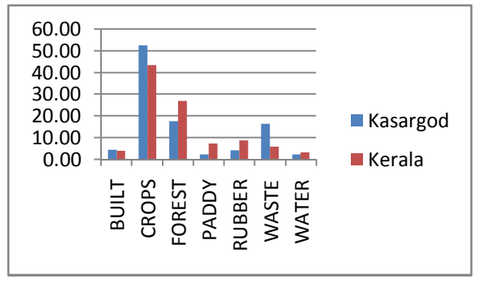


The Bekal fort area

A few kilometres to the interior, the scene changes and the sand level rises towards the barrier of the Ghats and transforms into low red laterite hills interspersed with paddy fields and coconut gardens. Based on physical features, the District falls in to three natural divisions.

Bekal fort

The lowland, bordering the sea, the midland consisting of the undulating country and the forest, clad highland on the extreme east. There are mainly four types of soils namely, sandy, sandy loam, laterite and hill or forest soil. The sandy and the sandy loam soils exist as a continuous narrow belt all along the Western coast about 20 km in width.



Land use pattern

There are 12 rivers in this District. The longest is Chandragiri (105 km) originating from Pattimala in Coorg and embraces the sea at Thalangara, near Kasargod. The river assumes its name Chandragiri from the name of the place of its source Chandragupta Vasti; where the great Maurya emperor Chandragupta is believed to have spent his last days as a sage.

The second longest river is Kariankod (64 km), across which a dam is being built at Kakkadavu.
Shiriya (61 km), Uppala (50 km), Mogral (34 km), Chithari (25 km), Nileshwar (47 km), Kavvayi (23 km), Manjeswar (16 km), Kumbala (11 km), Bekal (11 km) and Kalanad (8 km) are the other rivers. These rivers provide ample irrigation facilities.

As per panfish data

No	Pond Type	No of ponds	Area in hector
1	Holyponds and streams	21	4.71
2	Irrigation tanks	10	1244.28
3	Panchayath ponds	22	11.43
4	Private ponds	16	11.46
5	Quarry ponds	3	0.47
6	Village ponds	7	25.94
7	Total	79	1298.29

Water body details

Adoor, Eleri, Karudukka, Maloth, Parappa, Panathady and Muliyar are some of the reserve forests in the District. These forest areas have different types of medicinal plants and shrubs. Once the river-sea joining lands were abundant with these forests. But now they are seen only in Chittari, Manjeshwar, Mogral, Uppala, Shiriya rivers.

CESS WATER	Sum of area ha	Count
Kasargod	**4990.09**	**141**
River/stream Perennial	4736.43	40
River/stream Sandy area	16.2	7
Water bodies	237.46	94

Landuse	Area
Built	8,972.79
Crops	104,831.44
Forest	35,243.07
Paddy	4,734.76
Rubber	8,715.19
Waste	32,677.94
Water	4,990.09
Total	200,165.28