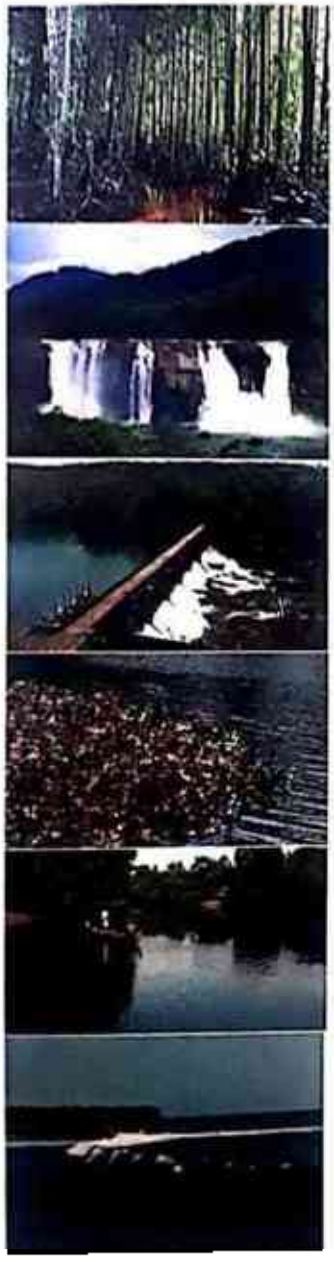


Rivers, Lakes, Ponds and Wetlands of Kerala

October 2017

Kerala Forest Research Institute
Kerala State Biodiversity Board

Published by

Director,
Kerala Forest Research Institute
Peechi, Thrissur, 680 653, INDIA

And

Chairman
Kerala State Biodiversity Board
Trivandrum, INDIA

Authors

Vijayakumaran Nair, P
Amruth, M
Hrideek, TK
Jose, PA
Joseph, S
Mallikarjuna Swamy
Pillai, PKC
Raghu, AV
Sandeep, S
Sreejith, KA
Sreekumar, VB
Sujanapal, P

ISBN 81-85041-64-4

Contents

Preface

Wetlands include rivers, lakes, marshes, ponds, tanks and paddy fields. Statistics and features of wetlands at district level are described first, followed by river basins and administrative units. Watersheds are natural way of dividing land surface. Most planning is carried out on the basis of boundaries of administrative units. The present approach is to bridge these two approaches. There is a need for planning based on watersheds. Availability of elevation data in digital format from ASTER(2015) and land use data from NREDB (2008) (ISRO-CESS mapping project) have made the analysis feasible.

One can examine the wetlands at various scales. At block or panchayat level, local problems can be focused. This would need much familiarity with local situation. Such information can be maintained on a participatory basis through an interactive online mechanism similar to Wikipedia. Planning process needs historic data, maps, visualization techniques and prediction capability. Spatial data can go a long way in providing information on many of these aspects.

Acknowledgements

We acknowledge the Kerala State Biodiversity Board, especially Dr.RV Varma for funding the project. Dr Oommen V. Oommen, Dr.S.C. Joshi. IFS, Dr, K.P. Laladhas and Dr. Dinesan Cheruvat provided continued support, We are thankful to Dr.K.V. Sankaran, and Dr. S. Pradeep Kumar, Directors of KFRI for their keen interest in the project and for providing facilities. Dr T.V. Sajeev, Research Coordinator extended all possible help in completing the project. We thank the planning Board of Kerala and NCESS, Thiruvananthapuram for making Landuse maps available in soft copy. Project staff, Prejith MP, Sajayan S, Anson J, Lijesh TK, and Ragi, PG worked in field data collection, analysis and documentation. We are indebted to the external editor Prof AP Pradeep Kumar, Associate Professor and Head of Department, Department of Geology, University of Kerala went through the book carefully and suggested many modifications. Dr. Dinesan Cheruvat, Member Secretary, Kerala State Biodiversity Board also critically examined the report and pointed out several corrections.

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 has their own characteristics and problems. Of late, there has been much conversion of paddy fields, tanks and ponds to dry land. Rivers and streams have pollution problems. The paddy fields, especially in the kole wetlands have many issues related with water regulation.

Information generated by field surveys, satellite images, wetland atlas, survey of water bodies, and mapping projects were overlaid using GIS techniques in this analysis. A three dimensional background map, colour coded on altitude basis was generated from 30m resolution ASTER (2015) data. Watershed boundaries from KSLUB (2000), River Atlas of Kerala, administrative boundaries, land use and hydrological features from NREDB (2008) were super imposed on these using GIS programs. The watershed classification of KSLUB (2000) provides only the starting materials; the watersheds had to be grouped into sub basins of increasing coverage for description at useful level. Masks have been devised to deemphasize areas outside area of interest. Land use classes were also suitably merged for a realistic description of area.

Data on ponds and tanks are still scarce, the Panfish (1992) data could hardly be used in a GIS context due to lack of map support and reporting errors. Location of ponds and tanks could be obtained from topo sheets and online mapping services. NREDB (2008) data did not name ponds and tanks as such and separating them from larger water bodies was a time consuming task.

Problems facing wetlands in different locations are not the same. In some places it is the flooding in rainy season, other places non availability of water when needed or fouling up of the water. Irrigation includes supplying water to dries areas, and led to construction of ponds and tanks to prolong availability of water. Traditional sources of water, ponds and tanks become superfluous in many situations as paddy cultivation, for which they were constructed is no more an economical operation. Inter basin transfer of water in hydro electric projects have also changed the hydrological process. Kuttanad, Vembanad and Kole lands have their own peculiarities due to change in water flow.

Kerala State is divided into 14 Districts, 21 Revenue Divisions, 14 District Panchayats, 75 Taluks, 152 Blocks, 1453 Revenue Villages, 947 Grama

Panchayats, 6 Corporations and 87 Municipalities. The boundaries available for these are crude even at 1:50,000 scale. Because of the boundaries of the Panchayat are not based on river basin boundaries, planning at the level of watersheds 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 the other 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 cases can be a 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 across 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 Wayanad District, Sasthamkotta Lake in Kollam District and Vellayani Lake in Thiruvananthapuram District are examples. Of these Sasthamkotta Lake is actually a tributary of Kallada River, the trapped flood waters of which 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 and Vamanapuram River are probably the only rivers 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 collect 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 serve as a continuous water transportation system for people and material for the entire length of Kerala. With the increase in road, rail and air travel facilities, many of these canals fall into disuse.

Interstate water sharing has also received much attention in recent times. The safety of Mullaperiyar dam and impact of a dam break has been discussed in much detail. Mangroves and *Myrisitca* swamps are wooded vegetation of the wetlands. Mangroves in private ownership are disappearing at a very fast rate. Mapping of the *Myrisitca* swamps have been completed Nair PV *et al* (2012) .

Wetland atlas of Land Use Board was scanned and geo-referenced, river basin-wise. Base maps of Panchayat boundaries, rivers and streams and wetlands from sources already mentioned were re-projected to obtain correct overlay. Maps were overlaid and analyzed for preparation of report. Maps were prepared District-wise, separate maps dealing with topography, basins, Land use and Panchayats.

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 overlaid on this, after hiding first and second order streams. Basin boundaries and names were further added. In District-wise maps, district other than the one under consideration were masked off. Scale and title for the map were added. Layout prepared in A3 format in MapInfo was printed as PDF file at 300 dpi and printed in A3 size using color laser printer.

Land use map: The main layer is NREDB (2008) Land use map. Objects were re-colored to show land uses distinctly and an index picture prepared. As in the topography map, other Districts are masked off and PDF file prepared as described above. Panchayat map: Basic map consisted of polygons of individual Panchayats. They were colored as per block boundaries. Forest layer was added over this. Names of Panchayat and blocks are added. Final PDF map was prepared as described above.

Documentation of wetland status: This includes general hydrological description of the district, description of individual basins and linkages between the same. Panchayat-level details are provided in the DVD.

DVD: The accompanying DVD is self contained and runs under windows 98 or higher. Users can select hierarchically district, blocks and Panchayat. Users can view different maps and tables of panchayats, 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 Panchayat level could be mapped and attributes stored in database.

Wet lands have several aquatic weeds. Weeds such as *Eichornia* thrive in water rich in organic matter. Inter linking man-made canals used for water transport earlier are getting choked with this weed. The weed *Salvinia* is seen in ponds and lakes. In lakes, they obstruct movement of boats. Fortunately this weed dries up when there is salt water intrusion. Lotus and water lily are becoming weeds in many ponds. There are other weeds in lakes in Calicut district. The cat fish, African mushi accidently introduced in a temple pond eliminated other fishes and has become attraction for onlookers.

Often innovative approaches are required to prevent stagnation in canals. Adequate flow of fresh water or even salt water can be ensured by diversion or uplift. Several dams have come up especially after independence. The Neyyar reservoir irrigates large areas in Kerala and Tamil Nadu. This has eliminated threat of flood downstream. Storage of large quality of water in an elevated area brings about changes in water table downstream. Large number of ponds near the irrigation canals of Neyyar is one example. Similarly there is large number of ponds along Vazhani River and Bharathapuzha tributaries. A dam across a river can turn an open estuary in to one closed with sand bar.

The case of reduced flow and its effect on Vembanad Lake is well known. Large dam across Periyar has reduced the threat of floods downstream unless a dam break occurs. The water table in Thodupuzha area has come up. Muvattupzha River has stabilized at much higher level in addition to changing salinity in Vembanad Lake. Several dams in Chalakudi basin altered the hydrology downstream and new dams threaten the Athirapally water fall. Dams in Kurumali and Chimminy Rivers reduced water flow downstream and necessitated construction of barrages downstream to prevent salt water intrusion. With the dam at Vazhani, the water balance in kole lands became totally altered. Large number of dams in Bharathapuzha has almost dried up the river downstream.

Water bodies form the main source of drinking water for towns. Water from Aruvikkara and Peppara supply drinking water to Thiruvananthapuram town. The Sasthamkotta Lake supply drinking water to the Kollam town. Muvattupuzha River also has several drinking water schemes. Peechi reservoir is for supply of drinking water to Thrissur. Drinking water for Kozhikkod and Palakkad are from Mananchira and Malampuzha. Coastal areas have severe drinking water shortage due to salt water

Rivers and lakes provide facility for fish and shrimp cultivation. Fisheries is very important for areas like Vembanad where coconut and paddy cultivation has declined. Often, innovative technique such as cage rearing is tried successfully.

In spite of heavy rain fall, several irrigation schemes supply water mainly to paddy fields. The canals from Neyyar reservoir irrigate areas in Tamil Nadu and Kerala. Irrigations scheme in Chimmony basin and Chalakkudy basin support the kole wetlands. Various reservoirs in Bharathapuzha basin irrigate paddy fields in Palakkad District.

Sewage from hospitals and urban areas are invariably dumped into nearby streams or lakes. With passage of time some of the waste generation is decreasing in area such as fish waste (for manure) , coir retting (due to mechanization) .

KSLUB (2000) provides a notation for naming micro water sheds. The micro watersheds are serially numbered from one end to the other. They often range from few to hundreds. There is no way of determining the hierarchy or order of the watershed. To overcome this, we have grouped watersheds of KSLUB into sub basins. Such a sub basin would refer to sub watersheds in a stream or tributary of river. The naming adopted by KSLUB has been enhanced to accommodate the sub basins. The name 1N10 would refer to the 10^{th} basin in river 1, Neyyar. As per notation coined in this report, a sub basin would be called 1N/A/n1..n2, n3. 'A' refers to sub basin 1 and n1..n2, n3 refers to KSLUB watersheds. For example, a sub basin named 'Catchment' is given the notation 1N/A/10..16. This means the first basin in Neyyar, called the 'Catchment' is made up of KSLUB micro watersheds 1N10 to 16. This allows hierarchical classification of water sheds, an omission in the KSLUB watershed numbering scheme. Sub basin grouping was not necessary in the case of short streams or rivers.

Watershed can play an important role in planning at local body level. Water bodies are not sufficiently deal with in the development plans of local bodies, often it is limited a list of civil works to be carried out. This book offers starting material to deal with the water bodies on a watershed basis.

District wise description of the wetlands follow. Accompanying DVD contains additional maps and tables.

List of rivers, their length and catchment.

No	Name	Length (km)	Catchment (km^2)
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.	Ithikkara	56	642
18.	Korappuzha	40	624
19.	Shiriya	65	587
20.	Kuttiadi	73	583
21.	Kaariyankode	64	561
22.	Kuppam	80	539
23.	Neyyar	56	497
24.	Anjarakkandi	52	412
25.	Keecheri	43	401

No	Name	Length (km)	Catchment (km^2)
26.	Maahi	54	394
27.	Peruvamba	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.	Mogral	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	39	562
43.	Kabani	63	1920
44.	Pampar	26	337

Map of River Basins in Kerala

THIRUVANANTHAPURAM DISTRICT

Introduction

Thiruvananthapuram District is located at the southern tip of Kerala State. The district has three large west flowing rivers, Neyyar, Karamana and Vamanapuram. The annual rainfall, about 1700 mm, 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 this part of Kerala and Tamil Nadu. Karamana River has two reservoirs, at Peppara and at Aruvikkara. These are meant for supplying drinking water to Thiruvananthapuram District. There are no dams in the Vamanapuram basin.

Fig. 01 Thiruvananthapuram District: River Basins

The district boundary on the north does not follow any geographical feature. The midland region comprises low hills and valleys adjoining the ghats. The lowland is a narrow stretch comprising shorelines, rivers and deltas.

The mean maximum temperature is 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 monsoon. The district also gets rain from the receding north-east monsoon which sets in 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.

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 kayals. Besides these, there is a fresh-water lake at Vellayani in Thiruvananthapuram Taluk.

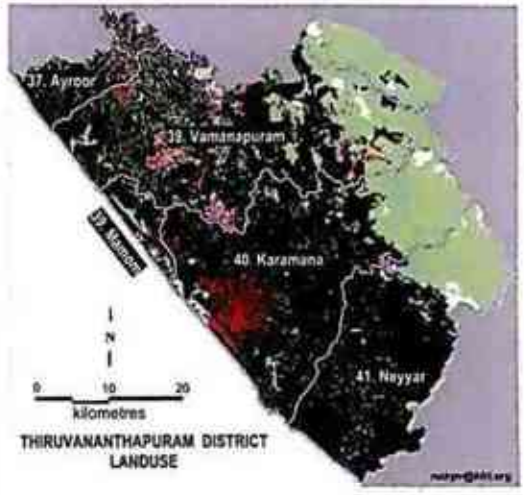


Fig. 02 Neyyar basin, topography and sub basins

When the whole district is considered, mid land region has mostly dry land cultivation involving coconut, plantains, tapioca, etc. There is considerable amount of paddy cultivation, and the Neyyar basin has facilities for this in terms of irrigation canals, ponds and tanks. Thiruvananthapuram corporation comprising mostly built up areas are in the Karamana basin. Midland regions of Vamanapuram basin are mostly under rubber cultivation. High elevation areas of all the three basins are forests. There is tea cultivation in the elevated areas of Vamanapuram basin.

The rivers in the district used to play an important role in transportation. There is a canal system linking the coastal lakes. Now this system is mostly in disuse. Major environmental problems are sewage inflow in town areas, sand mining and filling up of water bodies. Tourism activity is also on the increase.

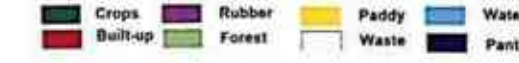
Fig. 03 Neyyar basin, topography and sub basins

This is the southernmost river in Kerala. It originates from Agasthyamala, flows through Neyyattinkara Taluk and empties into the Arabian Sea at Poovar. After its origin, the river flows rapidly along steep slopes in its higher reaches and winds its way through flat country in the lower reaches. In the initial stages the course is in a south-westerly direction but at Ottasekharamangalam the river turns and flows west. It again takes a south-westerly course from Valappallikonam till it reaches the Arabian Sea.

Neyyar River has a total length of 56 km, one of the medium length rivers in Kerala. The catchment area of 497 km^2 is situated entirely in Kerala, smaller in comparison with major rivers. Annual rainfall in the basin is from 1400 (plains) to 2400 mm (hills). Rain fall is fairly spread over the entire year. Annual average stream flow is comparatively low (207 Mm^3), probably due to dam at Neyyar. Neyyar originates at an altitude of 1800m. The river nurtures localities like Ottasekharamangalam, Maranalloor, Perumkadavila, Neyyattinkara, Chenkal and Kulathoor. Kallikad, Ottasekharamangalam, Perumkadavila, Neyyattinkara, Olattani and Poovar are some of the major towns along the river.

The basin lies in west to east direction. About one third of the basin falls in hilly forest region. The Neyyar dam is situated at the bottom of sub basins in the forested hilly area. Remaining portion of the basin is gently undulating and inhabited regions. Two or three major streams join the river downstream. KSLUB (2000) divides the basin into 63 units. The basin can be grouped into eight sub basins. The ninth sub basin is a stream which joins the sea directly. Five panchayat blocks fall within this basin, three of them fully.

Fig. 04 Neyyar basin, land use



The five block panchayats are Parassala, Perumkadavila, Athiyannoor, Nemom and Vellanad. One small watershed of Neyyar falls outside the state boundary in Tamil Nadu.

The catchment area of Neyyar receives both south-east and north-west monsoons. Occasionally the region receives very high rainfall in a short period. There is only one large dam which is for irrigation purpose at Neyyar. The earthen dam gets filled occasionally and raises safety threat for area downstream.

Some parts in the upper reaches of the river basin are prone to landslide. Coastal Puthenar Canal links Neyyar estuary to Tamraparni basin. 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 reaches Poovar. The left bank canal pass through Ariyankodu, Munnur, Parassala, Kalikkavila and some parts of Tamil Nadu in Tampraparni basin. Unlike other parts of Kerala, there are no coastal canals for navigation from Poovar northwards due to low hills near the coast.

Fig. 05 Crocodiles in Neyyar reservoir

Main land use in the basin is mixed dry land agriculture and built-up areas. Paddy fields are seen in a few places along the river. The Neyyar dam restricts flow downstream in dry season. In case of heavy rainfall, there has been case of the dam getting filled up and causing overflow. Release of too much water at a time leads to erosion of banks. Even in dry season there is flowing muddy water downstream. There are several bridges across Neyyar as it approaches the city limits.

At Neyyattinkara there is a bridge on national highway. There are three more major bridges across Neyyar River downstream. One could notice sand mining in some areas. Bamboo growth is noted along the banks downstream of Neyyattinkara. The river front is slowly becoming important for tourism activities such as river front lodges and boating. In these localities the river banks are strengthened with retaining walls.

The river branches as it nears Poovar. Near the exit, Neyyar River flows into an estuary. There were few scattered clumps of water weed *Eichornia*. There is a sand bar at the estuary.

Origin of River: Neyyar River originates in the forested hilly areas of Agasthyamala. The Neyyar dam is situated at the confluence of the hill streams, there by impounding water from a large portion of the basin. Most of these streams are perennial in nature. Chitar and Mulla Ar are the main tributaries. The region is almost continuous forest area. There are few tribal settlements inside the forests.

Neyyar Dam: Neyyar dam was constructed in 1958 and is situated in Kallikkad Panchayat of Neyyattinkara Taluk. The peak Agasthyakooodam is very near to Neyyar dam. The dam was built for irrigation purposes. One canal of Neyyar flows to southern districts of Tamil Nadu.

Sprawling over an area of 128 km^2, the Neyyar Wildlife Sanctuary is one of the most frequented wildlife sanctuaries of Kerala. 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 spread over 9.06 km^2 in extent.

Fig. 06 Neyyar dam @suniltg (GNU)

Catchment area of Neyyar dam is prone to landslides, massive landslide that occurred in 2001 at Amboori and is reported to have resulted in substantial silting of the reservoir. There are reports of a scheme for constructing another dam up stream at Oruvappara to reduce silt load to Neyyar reservoir. Crocodiles introduced in the reservoir had to be relocated as they proved to be a menace to people living on the banks.

River course and sub basins: Neyyar watershed has a total area of about 500 km^2 and is spread over five block panchayats and 24 grama panchayats in Thiruvananthapuram District.

Neyyar watershed is divided into 27 sub-watersheds and 41 micro-watersheds (KSLUB,

2000). Sub basins are shown over 3D map in illustration above. We have grouped the basins into 9 sub basins. Sub basin A is the catchment area of Neyyar reservoir and falls in the Kallikkad Panchayat of Perumkadavila Block. As per notation coined in this report, the sub basin may formally be called 1N/A (1N refers to Neyyar River). KSLUB micro watersheds 1N10 to 16 fall in this (1N/A/10..16). This allows hierarchical classification of water sheds, an omission in the KSLUB watershed numbering scheme. This covers major streams joining Neyyar reservoir. The streams pass through steep terrain as the reservoir level is about 100m.

Sub basin A, Catchment (1N/A/10..16) is the only forested region in this basin. Panchayat development plan describes reduction in paddy fields and increase in rubber cultivation. Excluding forests, the land area is only about 18 km^2. There are settlements of Kani tribals inside forest. This area is much prone to landslides. This and digging for precious stones has lead to much siltation of the reservoir. There do not appear to be any ponds or tanks in this sub basin. There were Eucalyptus plantations near the reservoir.

Sub basin B, Puzhanad (1N/B/17), is a small water shed, 1N17 as per KSLUB notation, situated on the left side of the river below the dam. The watershed consists of few hillocks and streams draining from the valleys. Land use is mixed dry land cultivation and built-up areas. Area comes in Kallikkad and Ottasekharamangalam panchayats

Sub basin C, Kallikkad-Poovachal (1N/C/7..9) is opposite group 2 on the right bank of the river. KSLUB (2000) watershed 1N7 to 9 falls in this area. Land use is mixed dry land cultivation, built-up areas, rubber and paddy fields. Topography is gentle hills; several small streams drain the area. Most of the area comes under Poovachal Panchayat. In sub basin C, there is a pond of area 1.4 ha. A stream originates from this and joins Neyyar.

Sub basin D, Chit Ar (1N/D/18) is on the left side of the river, Area falls in Amboori, Ottasekharamangalam and Ayyancode panchayats. Topography is a large number of hills, some of which are notably high. A large stream, Chitar drains the area. Land use is dry land crops with specks of built-up areas and paddy fields. There are patches of forest, rubber cultivation and waste land on the northern part. Area falls in KSLUB water shed 1N18.

Sub basin E, Vandannur (1N/E/5..6). This is a small sub basin on the right side of the river, containing a single stream with KSLUB code of 1N6. Topography is gentle undulating hills. KSLUB 1N5 is an ephemeral streamlet flowing directly into Neyyar. Land use is mixed dry land cultivation, built-up areas and paddy fields. This sub basin falls mostly in Maranalloor Panchayat. There are few ponds in the basin.

Sub basin F, Aruvikode (1N/F/20..21). This sub basin is on the left side of the river, and comprises of large stream - Aruvikode Thodu and a small stream joining Neyyar at Perumkadavila. KSLUB codes are 1N20 and 1N21. Topography is gentle undulating hills. Land use is mixed dry land cultivation, built-up areas and paddy fields. This sub basin falls mostly in Maranalloor Panchayat. Other parts fall in Perumkadavila, Kunnathkal and Vellarada panchayats. There are few ponds in the basin.

Sub basin G, Maruttur (1N/G/2..4). This sub basin is on the right side of the river, containing a major stream, Maruttur Thodu and a small stream in Olatthani region. KSLUB micro water sheds are 1N2 to 4. Topography is gentle undulating hills. Land use is mixed dry land cultivation, built-up areas and paddy fields. This sub basin falls mostly in Athiyannoor and Neyyattinkara Panchayats. There are a large number of ponds in the basin. The sub basin is also well supplied by irrigation canals from upstream.

Sub basin H, Amaraavila-Uchakkada-Parassala (1N/H/22,25): This sub basin is on the left side of the river, and comprise three large streams. The estuary and distributaries also fall in this sub basin. KSLUB codes are 1N22 and 1N25. Topography is almost plain. Land use is mixed dry land cultivation, built-up areas and paddy fields. This sub basin falls mostly in Chenkal, Kollayil, Kulathoor, Parassala, and Karode Panchayats. There are a large number of ponds in the basin. The ponds are generally situated below altitude of 20m. The largest tank, Valiyakulam is about 10.5 ha in area.

Sub basin I, Karichakayal (1N/I/1) is micro watershed draining directly to the sea. KSLUB code

is 1N1. There are not many ponds in this basin. Land use consists of mixed dry land cultivation and built-up areas. Area falls in Nemom and Kottukal Panchayats.

Estuary: Neyyar flows into the sea near Poovar. Regions on the right side of the river fall in Blocks such as Vellanad, Nemon and Athiyannoor. It may be noted that only part of these blocks lie in the Neyyar basin. The Neyyar River is connected south wards along coast after the estuary. Water in the canal is clear, though not flowing. The connecting canal can serve as a source of fresh water.

Fig. 07 A sand bar at the estuary.

At the time of our visit, the sandbar was partially open but it was sea water that was being lashed into the Kayal. One could see people walking across the estuary along the sand bar. Vizhinjam area consists of few hills near the sea. Small streams drain directly to the sea. Vizhinjam harbour is situated in one of the creeks.

Karamana Basin

Fig. 08 Topography of Karamana basin

Karamana River is 68 km in length and basin is about 702 km^2 in extent. The catchment area of Karamana River receives high rainfall, as much as 3400m annually, drops to 1600 mm near the coast.

The Karamana River has its origin from Chemmunji Mottai of Agasthyakoodam hills. The river is formed by the confluence of several streams such as Kavi Ar, Attai Ar, Vaiyapadi Ar and Todai Ar.

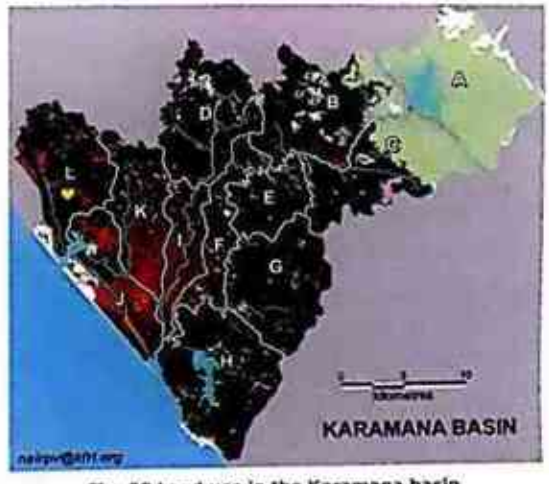


Fig. 09 Land use in the Karamana basin

Karamana River has two main branches, Killiyar and Karamanayar. Killiyar joins Karamanayar at Nadakkara. Killiar flows in a north - south direction and Karamanayar south west direction. Both rivers join at Pallathu Kadavu near Thiruvallam near the confluence. The river takes a north-westerly course throughout and empties into the sea.

Origin: Karamana River originates from the Agasthya malai. En route to the Agasthya peak from Bonakkad, one crosses several streams. These streams join Peppara reservoir. Karamana basin is divided into 85 watersheds and micro watersheds (KSLUB, 2000). For convenience we have grouped these into 12 sub basins. The grouped sub basins are shown over land use map. The rivers originate from valleys of the crest line at altitude of 1400 to 1700m MSL. Peppara reservoir is at about 100 m elevation. Unlike Neyyar, there are major streams joining Karamana River downstream of Peppara dam. Attingal Thodu on the right and Permakand Thodu are on the left. These originate from hills in Agasthyavanam Biological Park, a protected area.

It can be noted that Killiyar, a major tributary of Karamana River, runs almost parallel to Karamana River. There is no pronounced ridge separating these two rivers. River course and sub basins are described below.

Fig. 10 Remnant riverine vegetation is still found in areas of upstream Killiyar.

Sub basin A, Peppara catchment (2K/A/13..17. 2K refers to Karamana River). The catchment area of Peppara dam falls in sub basin A. The region is hilly and several streams flow into the reservoir. The region is mostly forested. KSLUB water sheds 2K13 to 17 falls in this sub basin. Area is part of Aryanad Panchayat.

Sub basin B, Attingal Thodu and Chit Ar (2K/B/9..12). This sub basin is situated on the right side of the river below the Peppara dam. Two large streams Attingal Thodu and Chit Ar flow into Karamana River. Topography is low hills, with high hillock between the tributaries. Land use consists of dry land crops, built-up area, rubber, patches of waste land and forest. Area falls in Aryanad, Tholicode and Uzhamalakkal Panchayats. KSLUB water sheds 2K9 to 12 fall in this sub basin.

Fig. 11 Karamana-Killiyar confluence. Muddy water is from Killiyar.

The Karamana River has several bridges across it. The largest is at Karamana, where the national highway crosses the river. Other important bridges are at Thrikkunnapuram, Mangattu Kadavu, Kundamon Kadavu, Vellakadavu, Aruvikkara (on the dam), Maruthoor kadavu, Aryanad and a low bridge near Malamukal. The latter makes the river unusable for navigation. Some of the bridges provide spectacular views of the river.

Sub basin C, Permakand - Kottur (2K/C/18..22). This sub basin is on the left side of the river below Peppara dam, opposite sub basin 2. Two large streams, Permakand Todu and Kottur Thodu flow into Karamana River. Topography is low hills, increasing in elevation towards the NE side. KSLUB water sheds 2K18 to 22 falls in this sub basin. Land use consists of dry land crops, built-up area, rubber, patches of waste land and forest. Parts of Aryanad, Kuttichal and Vellanad Panchayats fall in this sub basin.

Sub basin D, Nalli Ar/Killi Ar (2K/D/6). This is the basin of a major tributary, Nelli Ar/Killi Ar which joins Karamana River near the estuary. Terrain consists of low hills. Land use is mostly mixed dry

land cultivation, built-up areas increase as one goes south, and attaining full coverage in town areas. Parts of a large number of panchayats and Thiruvananthapuram Corporation fall in this subgroup. Nedumangad Town is also inside this sub basin. Sub basin 9 is important in several respects. There is much built-up area along roads, paddy cultivation in wet areas and mixed crops in other locations. Fresh water lake Vellayani comes in this sub basin. There are a large number of ponds and tanks also in this basin. The catchment area of Killiar is not forest areas, mostly with built-up areas and mixed crops. As a result of this Killiar water is loaded with silt and possibly domestic waste. The water often appears coloured. KSLUB water shed 2K6 form this sub basin.

Sub basins E, F, G, Aruvikkara. Parts of Aruvikkara and Vattiyoorkavu, Vilappil, Malayinkeezh panchayats cover the basin. Further downstream, Aruvikkara dam is situated. Sub basins E and F fall on either side of the Karamana River including Aruvikkara reservoir. Few small streams join the river on either side. Dam is situated at Aruvikkara, which is also a tourist area. Further downstream, sub basin G is on the left side of Karamana River. Land use is mainly built-up areas and mixed crops. Few medium sized streams join the river. The sub basin covers relatively large area. Man made ponds increase as one comes south. KSLUB water sheds 2K7 and 23 to 27 fall in this sub basin.

Sub basin H, Vellayani. Sub basin H is a stretch of low lying area on the left side of the river near the estuary. The Vellayani Lake got separated out as a shallow fresh water lake due to silting up of adjacent areas. Land use is mixed dry land crops, built-up areas and paddy fields. Topography is almost plain ground, streams flowing through depressions. Several streams join the lake. The lake has an exit to the Karamana River, a stream from Pallichal area joins this. Parts of panchayats such as Pallichal, Venganoor Vizhinjam and Trivandrum Corporation cover the area. KSLUB watersheds 2K28 to 30 cover the area. An independent stream originating at Balaramapuram join the sea at Vizhinjam. This together with an even smaller ephemeral stream to the sea form KSLUB water shed 2K31.

Sub basins J, K and L are strictly not part of Karamana basin, but since they are connected through a linking canal, and the short length of the streams does not qualify them to be called rivers are described with the Karamana basin. Akkulam Lake and Amayizhanchan Thodu fall in sub basin J and K. Sub basin L is an independent stream (Kulathur Thodu from Kazhakkuttam area) which joins the Akkulam Lake.

The confluence of this stream with Akkulam Lake has witnessed much construction activity and land use change in the past and these have adversely affected the stream.

Small streams from regions such as Alathara and Cheruvikkal also join the lake. Another major stream, Amayizhanjan Thodu 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.

Dams: Peppara dam: The Peppara Dam was commissioned in 1983 to augment the drinking water supply to Trivandrum City. The total water spread of the reservoir is 5.82 km^2. The Peppara reservoir has at least four noticeable arms. Perennial streams join this. The dam and reservoir are situated inside forest area. The dam is at about 100m elevation. At the forest edge the river is at about 80m elevation. At Aryanad the river is at 60m elevation.

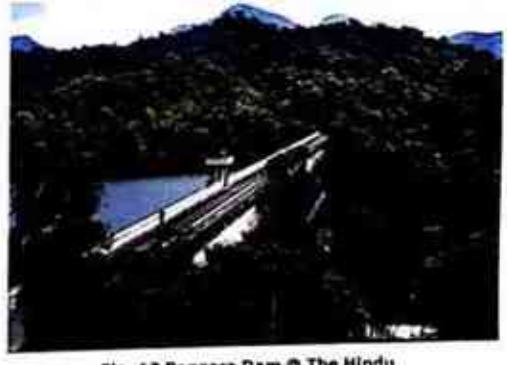


Fig. 12 Peppara Dam © The Hindu

Aruvikkara Dam: It is built across the Karamana River. Constructed in 1983, it meets the drinking water requirements of the nearby places – Thiruvananthapuram City and suburban areas. Aruvikkara is at about 40 meters MSL. The river passes amidst low hills. As it enters Trivandrum

town it is at about 20meters. Aruvikkara Dam is located in Thiruvananthapuram District of Kerala. The dam has a power project with a capacity of 12 MU annually. The lake created by the reservoir covers an area of about 5.82 km^2. The catchment area of the dam forms the forests of Peppara Wildlife Sanctuary.

Fig. 13 Aruvikkara Dam

The Karamanayar joins sea a little distance after confluence with Killiyar. This tract has under gone extensive modification; one side of the estuary is modified with masonry work, probably to prevent sea erosion.

Fig. 14 Karamana Estuary

Near the estuary, the river branches into two and unites again to form a small island. This island is a coconut grove now. The estuary mouth is sandy and wide, the river mouth could easily shift if the water flow alters suddenly. One side is strengthened by piled rocks.

Vamanapuram basin

The Vamanapuram basin, along with Ayroor and Mamom basins occupy an area of 867 km^2. The river lengths are 88, 27 and 17 km respectively. Rainfall in the basin varies from 1800 mm to 3000 mm. The Vamanapuram River originates from the Chemunji Mottai, at about 1,860m above mean sea level. There are no dams or major projects in these rivers. Three lakes come in this area, Kadinamkulam Kayal, Anchuthengu Mungottu Kayal and Kozhithottam Kayal.

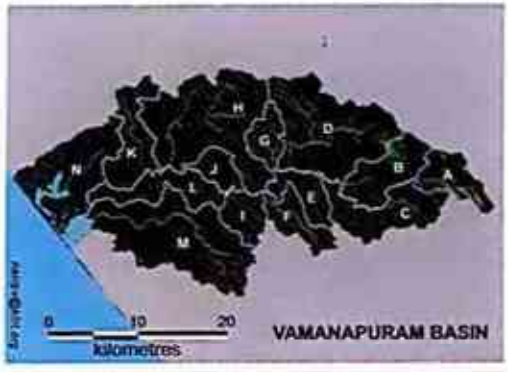


Fig. 15 Vamanapuram Basin

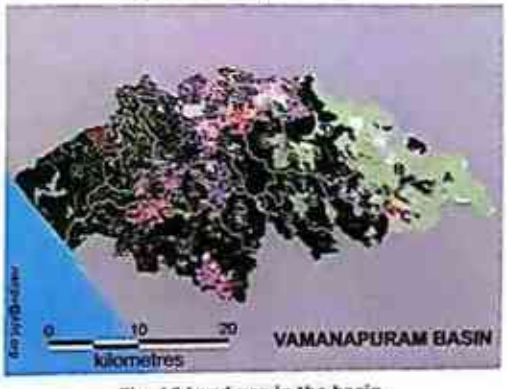


Fig. 16 Land use in the basin

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Panth.

Vamanapuram River originates in the slopes of high rainfall forest of Ponmudi. The main river at the top is called Kallar, Pannivadal Ar joins it. It originates in high slopes of forest. Land use wise, one notable feature of this basin is the presence of extensive rubber plantations. Nearly 25% of the area of basin is under rubber.

Its main tributaries are Kalaipara Ar, Pannivadal Ar, Ponmudi Ar, Chittar and Manjappara Ar. After the confluence with upper Chittar it flows westward, receives Manjappara Ar and continues its western course. About 3 km downstream from Palode, there is a 13m fall known as Meenmutti. About 3 km downstream from Vamanapuram Kilimanoor Ar joins it. The river finally empties in to the Anchuthengu Kayal. The river has a length of 88 km and basin of 687 km^2.

Most of the area falls in Vamanapuram, Varkala, Chirayinkeezh and Kilimanoor blocks. Streams joining are Sarkara Ar, Kari Thodu, Chittar Thodu and Kallar. There are no dams in this river. KSLUB (2000) divides the Vamanapuram basin into 30 water sheds. We have grouped the watersheds into 14 sub basins. Sub basins A, B, C, D and E are forested hilly regions. Sub basins F, I and L are on the left side of the river.

Fig. 17 Vamanapuram River near the origin

Most of the panchayaths on the left side of the river fall in Vamanapuram Block. Sub basins G, H, J and K are on the right side of the river. Sub basins M and N are separate streams that join the Kadinamkulam Lake directly. Sub basin N has parts of Varkala and Chirayinkeezh Blocks. Panchayats 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. Ayroor basin has parts of Varkala, Ithikkara and Kilimanoor Blocks. Vamanapuram River originates in sub basin A, Kallar village is located at the bottom of this group. Altitude ranges from 200-1400m

Sub basin A: is the region where the Vamanapuram River originates. It is forested area; elevation is more than 1300m. The elevation drops to 200m at Kallar where there is a bridge across the river. The river is about 20m wide at this location and water is clear. The region is forested.

Sub basin B is interesting as it is bounded by the river on three sides; the top of the sub basin is Ponmudi hills at about 1000m. The river is almost at 60m elevation at the bottom of this sub basin. There are private lands on either side of the river, remaining areas are forested. There is some rubber cultivation as well.

Fig. 18 Meenmutty water falls

Sub basin C is on the left side of the river, opposite sub basin B. Land use is mainly mixed dry land cultivation, with few rubber growing areas. Sub basin D and E on either side of the river is forested and has mixed dry land crops. Sub basin D is on the right side of the river and harbour much forest plantations. A perennial stream takes 90° turn to join the main river.

Fig. 19 Vamanapuram River in forested area

Sub basin E. There is a perennial stream in sub basin E also, which is on the left side of the river. It contains few low hills. Sub basins F and G on the left and right sides of the river are relatively plain areas. Both are at a distance from the main river.

Sub basin B and C falling on either side of the river below Kallar is mostly forested, lower regions are rubber estates. Kallar takes a westerly course here. Sub basin B, on the right side of the river, is within a V shaped bend of river and several streams flow into it. Sub basin C is on the left side of the river, has tributary Chittar in the upper forested region, a perennial stream through Vidura is also in this sub basin C. Sub basin B and C are situated to the north and south of Palode. Sub basin E contains forest patches, rubber plantations and mixed cultivation. Palode come in sub basin E.

Sub basin D is on the right side of the river, Chittar from this sub basin joins the main river. Upper reaches are forested, lower reaches have rubber plantations and mixed cultivation.

Sub basins F, I and K are on the left side of the river. The trend is towards more and more rubber cultivation as we come down stream of river. Altitude falls from 60m to 20m. Most of the panchayats on the left side of the river fall in Vamanapuram Block.

Sub basin J and K are on the right side of the river. Sub basin L extends up to Attingal, the river is at an altitude less than 20m in this sub basin. Sub basins G, H, J and L are on the right side of the river. These groups have predominantly rubber plantations. Perennial streams join Vamanapuram River.

A large river, Chittar, also called as Kilimanoor Ar drain sub basin H and joins the main river. Locations Karettu, Kilimanoor, Ponganad are located in this basin. A perennial stream from sub basin I, on the left side of the river joins the main river. Paddy fields shown in topo sheets have become dry land crops in recent land use map.

Sub basin K is a narrow watershed on the left side of the river. Both NH 47 (Attingal) and MC Road (Vamanapuram, Venjaramood) are in this basin Sub basin M and N are separate streams that join the Kadinamkulam Kayal directly.

Sub basin M is a very interesting basin as it contains a separate river, which directly joins the Kayal a little distance away from the confluence of Vamanapuram River. Both NH 47 (Mamam) and MC Road (Venjaramood) pass through this basin. The railway line also passes through this. Land use is mixed dry land crops, rubber, paddy and built-up areas. Topo-sheet shows both Vamanapuram and Mamom rivers emptying into a northern arm of Kadinamkulam Kayal and emptying into the sea through the Muthalapozhi. Chirayinkeezh and Vembayam, two well known locations are inside sub basin M.

Sub basin N has Munkot Kayal and Kozhithottam Kayal inside it. Railway line and NH47 (Attingal, Kallambalam) pass through it. Land use is dry land crops and paddy fields. Eastern edge has some rubber cultivation. Sub basin M and N are separate streams that join the Kadinamkulam Lake directly. Main land use in Mamom River basin is rubber cultivation. Mamom River is in Sub basin M and a stream passing through Kavalur drain Sub basin N. Sub basin N has parts of Blocks Varkala and Chirayinkeezh. Panchayaths on the right side fall in Kilimanoor and Varkala Blocks. Mamom and Ayroor basin are separate basins themselves. Mamom basin has parts of Chirayinkizh and Kazhakkoottam Blocks. Ayroor basin has parts of Varkala, Ithikkara and Kilimanoor Blocks. One notable feature of this basin is the presence of extensive of rubber plantation. Nearly 25% of the area of basin is under rubber.

WATER BODIES IN BLOCKS

Area wise, Parassala Panchayat had the maximum area of ponds, count wise Trivandrum corporation, Chirayinkeezh, Nemom, and Parassala Block has a large number of ponds. The blocks are described river basin wise from hill tops to the sea. Vamanapuram, Vellanad has forest.

Fig. 20 Thiruvananthapuram District, Blocks.

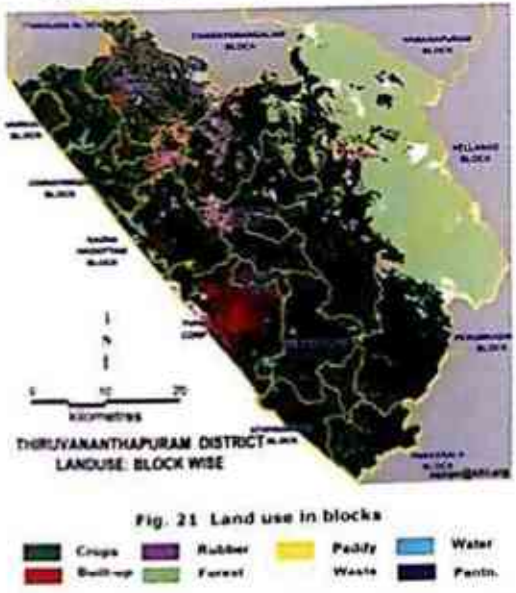


Fig. 21 Land use in blocks

Perumkadavila Block: Panfish (1992) does not list ponds from Perumkadavila block. There are 10 ponds occupying a total area of 5.18 ha as per the topo - sheet. All ponds are less than one hectare in area. As per NREDB (2008) data which include smaller ponds as well, there are 18 ponds but the total area is only 5.34 ha.

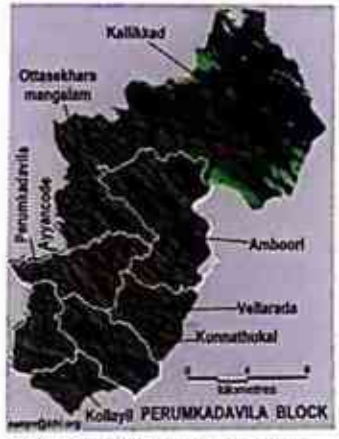


Fig. 22 Perumkadavila Block

Of the eight ponds in Perumkadavila Block, two ponds are fairly large (0.45, 0.53 ha). Of the five ponds in Ottasekhara mangalam, three ponds are fairly large (0.30, 0.35 and 0.57 ha). Two large ponds in Kollayil Panchayat (0.85 and 0.88 ha) receive water from canals of Neyyar project also.

Fig. 23 Perumkadavila Block

Parassala Block: Only four ponds less than 0.35 ha are listed in Panfish (1992) enumeration. This is the southernmost block in Kerala. Topo -

sheet shows as many as 24 ponds (larger than 0.25 ha) occupying a total area of 41.33 ha.

NREDB (2008) report 32 ponds (when ponds larger than 0.25 ha are considered, number of ponds come to 24), but their total area has decreased to 24.72 ha. This indicates a reduction in area of ponds. Panchayat wise break up of NREDB (2008) data follow.

Fig. 24 Parassala Block

Chenkal Panchayat has 10.63 ha of ponds spread over 10 ponds, three ponds are large at 0.5 ha, 1.11 ha and 7.61 ha each. The largest pond, Valiakulam had more than 10 ha in the past (as per topo sheet), it is losing its relevance as paddy cultivation is on the decline in its command area. This is in fact the largest pond in Thiruvananthapuram District and NREDB (2008) enumeration missed it in remote sensing possibly due to full weed cover. Karode Panchayat has a large pond of 3.9 ha. This is in the middle of paddy fields and on a stream.

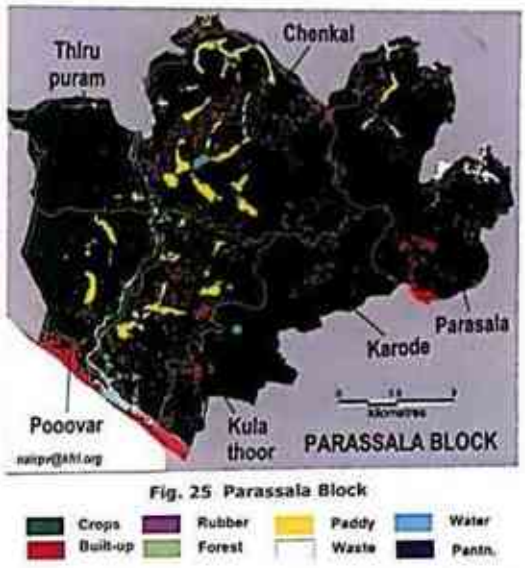


Fig. 25 Parassala Block

Of the 13 ponds in Kulathoor Panchayat, five are around one ha in area. They are associated with paddy fields, streams and canals of Neyyar project. Of the four ponds in Poovar Panchayat, three ponds are fairly large (0.34, 0.53 and 0.62 ha). Thirupuram Panchayat has a pond of 0.35 ha. The region before the estuary has several ponds for irrigation of paddy lands. In some areas paddy is giving way to crops such as plantain and tapioca. The ponds in these areas are covered with weeds, *Salvinia* or lotus or water lily. Some panchayats take steps for keeping the ponds clean, but in general usage is rather low.

Neyyar River joins the sea through a lake which has southward connections. Tanks and ponds are numerous in the plain areas. Unlike other rivers in Kerala, there is no Northward connection with other rivers along the coast due to presence of low hills. A small stream empties directly to sea.

Athiyannoor Block: There are three ponds (0.02ha, 0.58 ha and 1.11 ha) in Athiyannoor block as per Panfish (1992) enumeration.

Fig. 26 Athiyannoor Block

There are a total of 5 ponds with a total area of 4.89 ha as per the topo sheet. NREDB (2008) enumeration lists 18 ponds (includes smaller ponds also) but the total area is only 4.87 ha. Panchayat wise distribution of these ponds is as shown below. Two ponds, of 0.4 ha 1.8 ha reported from Aruvikkara Panchayat are actually extensions of river and reservoir. Athiyannoor Panchayat has 3.3 ha of ponds spread over 15 ponds, two ponds are of about 0.5 ha each. Venganoor has two ponds, 0.48 and 0.87 ha.

Fig. 27 Athiyannoor Block : Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Vellanadu Block: Panfish (1992) lists 23 ponds, with a total area of 17.94 ha. There are six large ponds ranging in area between 0.7 and 5.65 ha. Topo - sheet shows only 6 ponds, the largest of which is 1.41ha. NREDB (2008) map 14 ponds, total area comes to 6.69ha. Two of the large ponds are of area 1.13 ha and 1.27 ha respectively. Vellanad has two ponds; one of them is 0.97 ha. Kattakkada Panchayat has several large ponds; two of which are 1.13 and 1.27 ha in extend. Water from irrigation canals of Neyyar affect water level of these ponds.

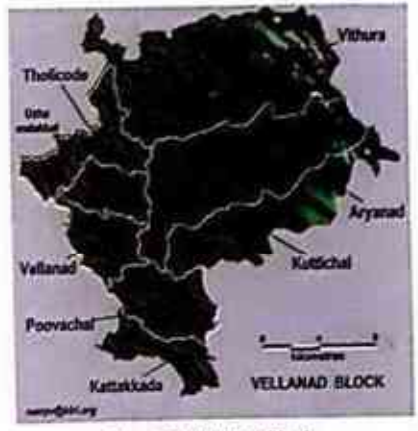


Fig. 28 Vellanad Block

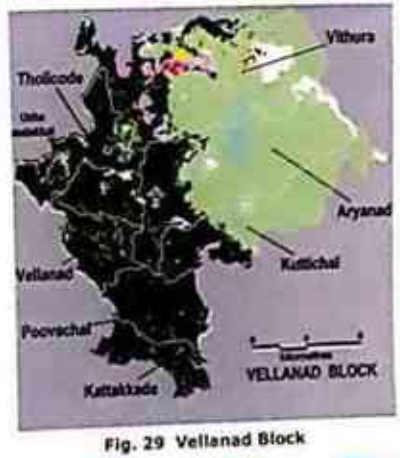


Fig. 29 Vellanad Block

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Nemom Block: There are seven panchayats and Neyyattinkara Municipality in this block. Panfish (1992) reports two small ponds from Nemom block. Topo-sheet show two ponds of 0.62 and 1.23 ha each. NREDB (2008) enumeration shows 41 ponds with a total area of 8.99ha. Three ponds are between 0.75 and 1.0 ha in area. Of the 13 ponds in Pallichal Panchayat, three ponds in are fairly large (0.39, 0.54 and 0.94 ha). The largest of these is situated on a stream and there are canals from Neyyar project in the vicinity (near Balaramapuram).

Fig. 30 Nemom Block

Vilappil has two large ponds, of 0.37 and 0.82 ha. A stream originates from the pond near Peyad junction, the smaller one is near Neyyar River. A large pond of 0.91 ha and smaller ponds in Kalliyoor Panchayat get water from Neyyar project canals also. Maranallor has 7 ponds one of which is comparatively large, 0.41 ha. Accumulated waste from Trivandrum city deposited at Vilappilsala has become a serious problem affecting public health. The leachate from the waste has started polluting the Karamana River.

Fig. 31 Nemom Block: Land use

This block is situated between Karamana River and Neyyar River. There is no pronounced ridge in between, streams flow to the rivers. Balaramapuram is famous for hand loom textiles. Kalliyur is famous for precious stones. NH 47 passes through the block. Vellayani Kayal is situated in this block. It serves irrigation purpose, is a tourism location and supplies drinking water to the town also. Irrigation canals from Neyyar dam pass through the area. Some areas have drinking water problems. As in other localities, paddy cultivation is on the decline, coconut and dry land crops replace it. Being near to the capital, the villages are mentioned in Kerala history in many situations. Kartamana bridge is in the national high way.

Nedumangad Block: Panfish (1992) reports 5 ponds with a total area of 3.38 ha; the largest pond is 1.34 ha. Topo - sheet show a pond of 0.97ha. NREDB (2008) maps 19 ponds with largest pond measuring 1.81 ha. Aruvikkara Panchayat has three large ponds, 0.3, 0.44 and 1.81 ha near the reservoir. Panavoor Panchayat has 3 ponds of 0.32, 0.52 and 1.17 ha. Karakulam has several ponds, the largest of which is 0.64 ha. Nedumangad Municipality: Pan fish lists a pond of 3.15 ha. Topo-sheet and NREDB (2008) maps do not show ponds, probably due to the recent demarcation of the Municipality.

Thiruvananthapuram: Includes Ccorpo-ration and rural block. Panfish or topo-sheet does not show ponds in this block. NREDB (2008) show 13 ponds with a total area of 1.43 ha. One of the ponds in Kodappanakkunnu, near paddy fields in panchayat is 0.77 ha. Vattiyoorkavu has five ponds, one of them is 1.43 ha. Thiruvananthapuram Corp: Panfish lists two ponds, having area 14.14 ha and 17.08 ha respectively. Topo-sheet shows a pond of 5.47 ha. This pond has resulted from clay mining. There is a swimming pool in the vicinity. Other ponds are not depicted due to priority for town details.

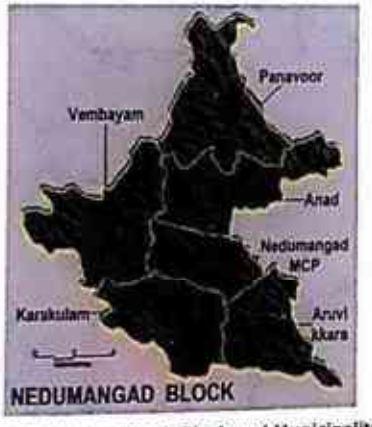


Fig. 32 Nedumangad Block and Municipality

Fig. 33 Nedumangad Block and Municipality

Fig. 34 Thiruvananthapuram

Fig. 35 Thiruvananthapuram

Kazhakuttam Block: Panfish (1992) lists 18 ponds with a total area of 15.85 ha. The largest pond is 6.77 ha in extend. Topo-sheet show three ponds, 0.10 ha, 0.94 ha and 3.52 ha. NREDB (2008) maps 15 ponds with total of 6.95 ha. Kadinamkulam Panchayat has several large ponds (0.3 to 6.95 ha). The larger ones are remnants of arms of the lake. Others are associated with paddy cultivation. Kazhakuttam has a large pond of about 0.52 ha. Stream from this flow to Akkulam Lake via Kulathoor. There is a temple pond of about 0.33 ha at Kazhakkuttam junction. A large pond, Menankulam shown in topo-sheet is at present a swimming pool inside a building complex. Another large pond of 0.55 ha in Sreekarium Panchayat also join this stream. Mangalapuram Panchayat has two large ponds of 0.59 and 0.81 ha, they appear to be quarry ponds. Of the five ponds in Pothankode Panchayat, three ponds are fairly large (0.2 0.49 and 0.59 ha) .

Fig. 36 Kazhakoottam Block

Fig. 37 Kazhakkoottom Block

Vamanapuram Block: Block consists of 8 panchayats. Panfish (1992) lists 8 ponds having a total area of 4.31 ha, the largest of which is 1.11 ha. Ponds do appear in topo sheet, NREDB (2008) mapping show 4 ponds with a total area of 2.07 ha.

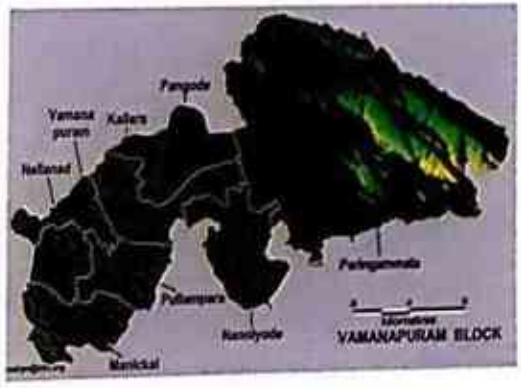


Fig. 38 Vamanapuram Block

Peringammala has a pond of 0.87 ha. There are two ponds of 0.33 and 0.61 ha in Manickal Panchayat. The Tropical Botanical Garden is in this Block. The block is drained by Vamanapuram River and its tributaries. Inhabitants include Kani tribals. There are steep hills on the eastern side, the hills tops have tea plantations. Main land use in the mid land region is rubber cultivation.

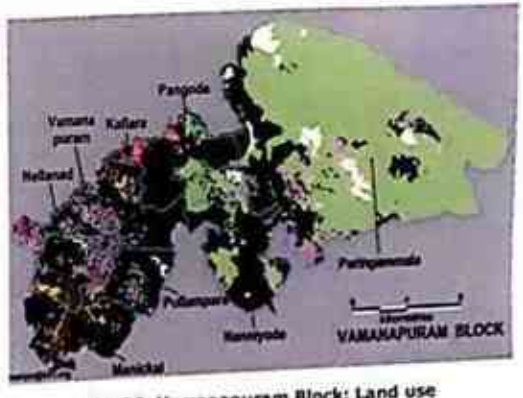


Fig. 39 Vamanapuram Block: Land use

Kilimanoor Block: Panfish (1992) lists 5 ponds having a total area of 1.15 ha. Ponds do not appear

in topo sheet. NREDB (2008) map 8 ponds having a total area of 2.02ha. Navaikkulam has a pond of about 0.35 ha. Pallickal has pond of 0.59 ha.

Fig. 40 Kilimanoor Block

Attingal MCP: Panfish (1992) lists a pond of 1.32 ha. Topo-sheet show a pond of 0.66 ha. NREDB (2008) maps 7 ponds having a total area of 1.71 ha. Attingal has two large ponds, 0.36 and 0.56 ha. Varkala MCP: Panfish lists a pond of 1.16 ha. NREDB (2008) maps 5 ponds having a total area of 1.49 ha. There are 5 ponds, two of the larger ones have area 0.57 and 0.65 ha.

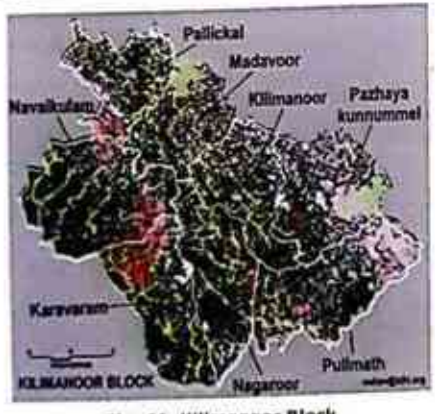


Fig. 41 Kilimanoor Block

Chirayinkeezh Block: Panfish (1992) list 13 ponds having a total area of 13.86 ha. Six of the large ponds range in area between 0.75 and 3.91 ha. Topo-sheet shows only 4 ponds having a total area of 7.7 ha. NREDB (2008) maps 41 ponds having a total area of 12.08 ha. The largest four ponds range in area between 1.0 and 2.36 ha. Chirayinkeezh Panchayat has 3.9 ha of ponds spread over 27 ponds, only one pond is larger than 0.25 ha, at 0.36 ha. Some of these ponds are associated with temples in the area. Kadakkavoor Panchayat has a pond of 2.13 ha. There are several large ponds (1.04 ha, 1.21 ha, 2.36 ha) in the adjoining Vakkom Panchayat also. The land use in the command area of these ponds is paddy cultivation. There area impoundments along streams. The three ponds in Vakkom panchayat are more than one hectare each (1.04, 1 and 2.36 ha). They are seen amidst paddy fields and one can expect irrigation role.

Fig. 42 Chirayinkizh Block

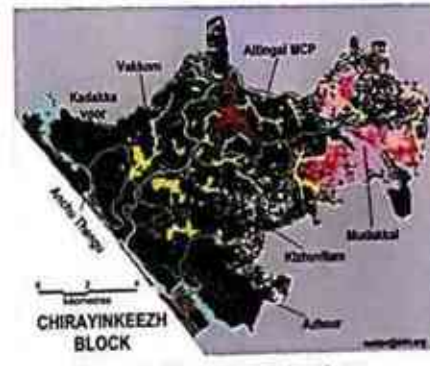


Fig. 43 Chirayinkeezh Land use

Varkala Block: Panfish (1992) list 5 ponds having a total area of 16.18 ha, the largest of these have area 3.09 ha and 9.04 ha respectively.

Toposheet does not show ponds, NREDB (2008) maps 3 ponds having a total area of 1.03 ha.

Fig. 44 Varkala Block

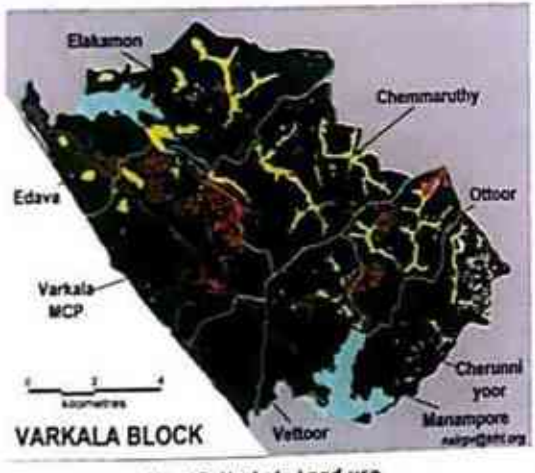


Fig. 45 Varkala Land use

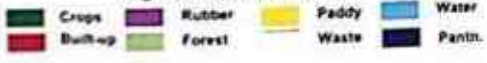


Fig. 46 A holy pond in the plains

Fig. 47 A pond in the plains, overgrown with weeds

Aiyroor basin is 66 km^2 in area, Vamanapuram 687 km^2 and Mamom 114 km^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. Sub basins 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. Sub basins 7, 8, 10 and 11 are on the right side of the river.

Mamom basin: Water bodies

Mamom and Ayroor basin are separate basins themselves. Mamom basin has parts of Chirayinkizh and Kazhakkoottam Blocks. Aiyroor basin has parts of Varkala, Ithikkara and Kilimanoor Blocks.

NH 47, Location Alamkod form the boundary between groups 12 and 14.Two streams drain to

the main river, about half the paddy fields along these have been converted to dry land. Location Nagarur is in this group of watershed.

Sub basin M. This is a small river originating from the Panthalakkottumala near Vembayam. During its course to west, it crosses MC road at Vembayam and NH47 Mamom. It takes westward direction after Mamom and empties in to Anchuthengu kayal near Chirayinkizh. During its course a channel branches off from the main river at Koonthallur to join the Vamanapuram River. Mamom River has a length of 27 km and an area of 114 km^2.

Fig. 48 Estuary

Lakes and back waters

Major back waters are Veli, Kadinamkulam, Anchuthengu and the Edava- Nadayara kayals. Besides these, there is a fresh-water lake at Vellayani in Thiruvananthapuram Taluk.

Other aspects

ISRO institute on Ponmudi hill top. Town area near airport would have served the purpose better. Resorts. Ponds in Neyyar basin. Paddy cultivation, sand mining. Drinking water augmentation

Fig. 49 Trivandrum District: Panchayats

KOLLAM DISTRICT

Introduction

Kollam District is located in the south west coast of India and is bordered by Arabian Sea in the west, Tamil Nadu in the east, Alappuzha in the north, Pathanamthitta in the north-east and Thiruvananthapuram in the south. The district spans 2,492 km^2. It is the seventh largest district in Kerala and is densely populated. The average temperature is around 25°C to 32°. Kollam receives an annual average rainfall of around 2700 mm. Two major rivers, Kallada River and Ithikkara River drain the district. Sasthamkotta Lake, one of the inland freshwater lakes in Kerala is located here. This lake is instrumental in providing drinking water to the Kollam city. Ashtamudi Lake and the Paravoor Lake are two important coastal water bodies in Kollam District. Ashtamudi Lake covers 2.5 percent of total area of the district. Kollam town is located on the banks of Ashtamudi Lake. Neendakara, a major fishing port is located on the banks of this lake. Edava and Nadayara lakes lie in part in Kollam District.

Fig. 02-01 Kollam District, topography and rivers.

About 32% of land in the district is under forest cover, mostly in the eastern, hilly areas. This includes Thenmala, Punalur and a portion of Achenkoil forest divisions. The Thenmala Range, Aryankavu Range and Shendurney Wildlife 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.

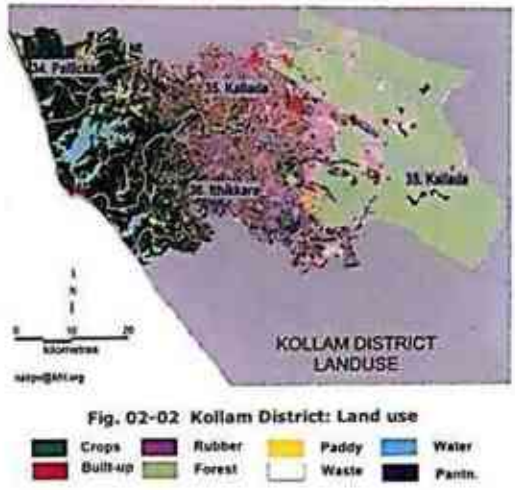


Fig. 02-02 Kollam District: Land use

Ayroor Basin

Ayroor Basin is the 37th river basin in Kerala. The basin consists of three kayals and several large streams draining into them. Ayrur Ar is the largest of these. The land use is mixed dry land crops, built up areas and paddy fields. The lake has mainly three branches, Paravur Thekke Kayal, Kilimukkam Kayal and Nadayara Kayal. There is a southern extension, parallel to the coast on which there is an estuary. Paravur, Kappil, Edava and Varkala are coastal villages. The railway line passes through these locations, over the lake. A southern man made canal links the lakes south wards for water transport. The Maniyamkulam Canal connects the kayals to Paravur Kayal in the north. The Ayroor River proper is on the southern part.

Fig. 02-03 Ayroor Basin

Streams drain to other arms of the lake. The area is more or less plain and is criss-crossed with small roads. NH 47 avoid the western wetlands and pass through locations such as Parippally and Kallambalam.

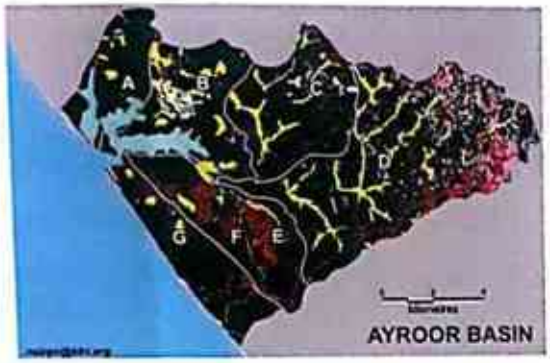


Fig. 02-04 Ayroor Basin: Land use

There are six micro watersheds as per KSLUB (2000) classification. Watershed 5A/A includes Paravur (s) Kayal and a stream flowing into it. 5A stands for Ayroor River. Paravur Town falls in this. Watershed 5A/B is made of Kilimukkam Kayal and a stream flowing into it. Ayroor River and its tributaries form watersheds 5A3 and 4. The watersheds contain a perennial stream each. Watershed 5A5 drain to the link canal and 5A6 directly to the sea.

Estuary: Ayroor River empties into three Kayals, Paravur (S), Kilimukkam and Nadayara Kayal. In fact the last two kayals empty into Paravur (S) Kayal and this opens to the sea. The opening to the sea is also peculiar; the sea front is nearly two km wide, with a narrow Kayal parallel to the sea coast. The land connection between the sea and the Kayal is just a sand bar with few coconut trees. The mouth of the lake keeps changing.

Ithikkara Basin

Ithikara Basin is situated north of Vamanapuram and Ayroor basins. Ithikkara basin is 642 km² in extent. Length of the river is 56km. The river can be said to originate near Challakode near Kulathupuzha. Here the valley is steep and narrow, possibly a geologic alignment. Several ephemeral streams join the river; several perennial streams join as the river flows down stream. Only two of these sub basins are forested. These locations have a very remarkable vegetation of wooded freshwater swamps, the Myristica swamps.

Fig. 02-05 Ithikkara basin and sub basins

There are some curious facts about the Ithikara basin. 1) This river does not originate from crest line of the Western Ghats. 2) It originates from few hillocks in the mid land. 3) There are indications that once the Kulathupuzha River flowed into Ithikkara River. At Chaliakode (between Arippa and Kulathupuzha) the river suddenly takes 90 degree course to the north. This could be due to the creation of a barrier. The barrier as it exists today is a low hillock. Even the remnant of old river course can be seen.

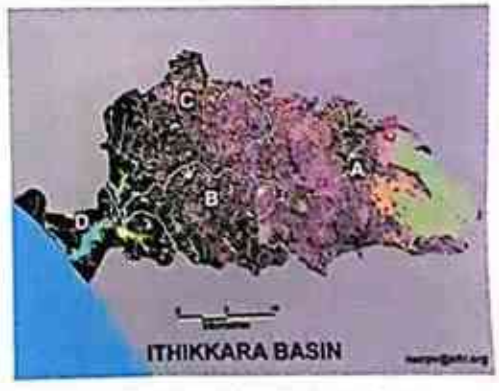


Fig. 02-06 Ithikkara basin: Land use

Ithikkara River collects a large number of tributaries and flows in westward direction till Ayiravally hills and then flows in south-west direction till emptying into the Paravur Kayal. Vattapparambu Thodu and Palliman Ar are the main tributaries. Vattaparambu Thodu joins with Ithikkara River at Palara.

The river is unusually deep in this location. Ithikkara River starts on the other side of the hillocks. The contours on either side of the hillock is 120m, by cutting up the hillock (10-20m) , the direction of the river can possibly be altered, if there is need. This could have resulted from massive landslides the area is famous for. Palliman Ar joins with the Ithikkara River near Ithikkara. This river nurtures localities such as Vayala, Pambira, Ayoor, Thiruvambhagom, Attoorkonam, Adichanalloor, Kottiyam, Chathannoor, Ithikkara and Chadaya mangalam. Kottarakkara Block covers most of group A. 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.

Ithikkara Basin can be divided into three parts at the first level. The first part is the main river itself, originating in the eastern hills and flowing west. The second part is Palliman Ar, a tributary joining Ithikkara river at Chimney. The tributary originates in low hillocks of about 100m elevation on the north side, and the confluence is a marshy area. This sub basin can be further divided into two along stream boundary. Perumpuzhasseri-Nedumpanaikkal Thodu is micro water shed and is 61/2/AB&C as per KSLUB classification. 61 stands for Ithikkara River. Palliman Ar itself form the second part, micro-water sheds 61/2/DEFGHI of KSLUB (2000) fall in this.

The Ithikara sub basin can be divided into 5 parts. Part one is the upstream tributaries of the river. Part 2 is the Kulani Thodu, part 3 is the stream from Nilamel areas, part 4 is few streams directly joining the stream, part 5 is few large streams draining to main river.

Fig. 02-07 Mukkam estuary. Paravur.

Vattam Thodu-Kadavarathu Thodu is a sub basin in Ithikkara River. It comprises KSLUB watersheds 10 a and b. Only a small portion is forested. Next is Eravail Thodu-Man Ar. Ithikkara river originates in this sub basin. The eastern portions are forested and includes KSLUB micro watershed 12c. Vattaparambu Thodu is another sub basin includes KSLUB micro watersheds 14ab and c . Estuary: Ithikkara River empties into Paravur Kayal. Along the coast, this Kayal has a north ward extension, parallel to the coast, separated by a narrow stretch of sandy land. The water flow is controlled by means of sluices and man-made structures.

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.

Fig. 02-08 Sub basins in Kallada basin

In these river systems, at about 200 meter altitude, *Myristica* swamps are located. The middle regions of the Kallada River receive large number of streams from the north and south (through geological fault lines).

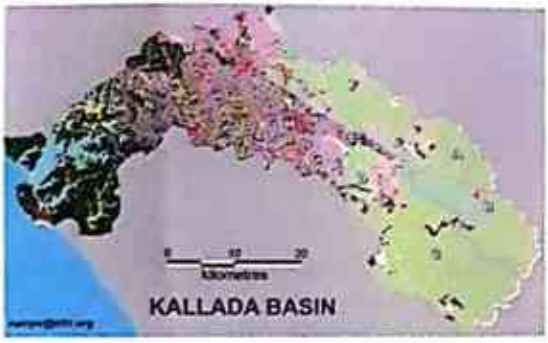


Fig. 02-09 Kallada basin: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Initially, the river flows in an east west direction. Then the course changes slightly to the north and flows westward again. Kallada River empties into the Ashtamudi Kayal.

Fig. 02-10 Myristica swamp

The river is formed by three rivers Kulathupuzhayar, Shenduruniyar and Kalthuru thipuzha. Kulathupuzhayar, formed by three tributaries Pongumala Ar, Girakalayar and Sankalippalam Ar. The river flows North-West direction till it reaches Moyalmedu then it flows in the North direction. At Kalankunnu the river joins with Shenduruni Ar, which originates from Karimalakkadakkal and Aiwarkunchi hills. The river flows in a North-West direction till it joins with Kulathupuazhyar. Kalthuruthipuzha, is formed by many streams from Periyanuruthimala, Padikkattumala, Kottuvambalthery, Pillaya-rkovilmala and Suvarnagirimala.

Fig. 02-11 Wooden bridge at Punalur

The connection to the sea is permanently open through a built up harbour 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. Kallada River has its origin on the Kulathupuzha hills near Ponmudi in Thiruvana-nthapuram District.

Fig. 02-12 Palaruvi water fall@keralapedia.com

The river initially takes a south-west direction and then flows westward till it reaches Thenmala. From there it flows southward and joins with Kulathupuzha at Parappara and forms Kallada River. From Parappar the river flows north-west under the name Punalur Ar up to Urukunnu and then Westward up to Mukkadvu where it is joined by a small tributary, Chittar Ar. Taking a North-West direction upto Pathanapuram, it again flows West

up to Enath. Thereafter it traces a south-west course till it falls into the Ashtamudi Lake.

Fig. 02-13 View from Enath bridge

Kulathupuzhayar and Shenthuriniyar are two main river systems 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 in length; its basin area is about 1700 km^2. Large area of the basin is forested. Substantial area of the basin is under rubber cultivation. The main Panchayath blocks are Anchal, Pathanapuram Parakkode, Vettikavala, Shasthamkotta, Chittumala, Chavara, etc.

Fig. 02-14 Neendakara pozhi

Fig. 02-15 View from Enath bridge

This river traverses through Pathanapuram, Kunnathur, Kottarakkara and Enath before draining into the Ashtamudi Lake in Kollam District. The major tributaries of this river are Kulathupuzha, Senthurnipuzha and Kalthuruthipuzha. Palaruvi waterfall is a highlight in this river. Average annual rainfall is between 3600-4000 mm in east region of the basin and in west it is between 2600-2400 mm. 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.

River course and sub basins: Land use board divides the basin into 50 water sheds. Kallada basin can be grouped into 17 distinct sub basins. Kulathupuzhayar and Shenthuriniyar are two main river systems in Kallada basin. Dam constructed at Thenmala near the confluence of these two rivers is meant for irrigation downstream. One can say that the Kallada River originates in the Kulathupuzha region, on the northern slopes of Ponmudi hills. The Shendurney River is also a large tributary, which originates nearby and join the Kallada River

Estuary: The Kallada River enters the sea through a built-up harbour at Neendakara. This was an open estuary even before the construction of the harbour and bridge. The Neendakara harbour was important in historiacal times, where merchant ships from other countries used to visit and even travel inland. Initial wooden bridge has been replaced by concrete bridge.

Fig. 02-16 Neendakara old bridge@fotosearch.com

Much fisheries development took place under the Indo-Norwegian project. Ashtamudi Lake is the deepest estuary in Kerala (up to 6m) that shelters a huge quantity of fish, about 57 species of birds and a large number of brackish water fish and molluscs. The varieties of mangrove plants that grow along its coasts are of much value. *Syzygium travancoricum* tree are reported from the lake banks.

Fig. 02-17 Neendakara new bridge@tinypic.com

Munroe Island and Chavara South are the major inhabited islands of this large lake. It was so named for the memory of that British official. Now a famous boat race, Kallada boat race is held in this part of the river.

Bridges: There are bridges at Sangli Thenmala, Punalur, and Kulathupuzha Enathu.

Sub basin A Palaruvi (7/K/A/17) consists of Palaruvi, a large tributary that flows into the Shenduruney Reservoir. 7K stands for Kallada River. Aryankavu town falls in this sub basin and both road and railway line to Shenkotta passes through this. The region is forested. Panchayats Thenmala and Aryankavu cover the area. KSLUB (2000) micro watershed 7K17 fall in this.

Sub basin B Shendurney (7K/B/16) consists of the upper regions of Kallada river. Shendurney reservoir is located at the bottom of this sub basin. At the dam site the elevation is about 100m, the streams originate in hills up to 1700m. This sub basin drains some of the steep high altitude areas. The group is important from the view point of Myristica swamps also. Panchayat Kulathupuzha covers the area. KSLUB (2000) micro watersheds 7K16 make the sub basin.

Fig. 02-18 Sub basin2, the Shendurney valley

Sub basin C Kulathupuzha (7K/C/19..36) is the group where the river originates. Sangli is almost at the centre of this basin, where four perennial streams join. The river is about 20m wide at this location, and is at about 200m MSL. The river flows down in a north-west direction till Chaliyakodu. From here the river suddenly takes a north direction and flows through the Kulathupuzha region. The river continues to flow in north-west direction after joining with Shendurney River. The rivers meet at an altitude of 70m. This has some significance which is considered while describing Ithikkara River. At Chaliyakode the river is at about150 m (Ithikkara River is at 140 m MSL,

500m away). The group is important from the view point of *Myristica* swamps. The region is reserve forests. Panchayats Kulathupuzha and Peringammala cover the area. KSLUB (2000) micro watersheds 7K19 to 36 make this sub basin.

Sub basins D and E Below dam (7K/D/37..39 and 7K/E/16) are situated on left and right sides of the Thenmala dam. The region is steep and there are patches of forest, mixed crops and rubber cultivation. There is a large perennial stream in sub basin4. Sub basin4 has parts of Yerur and Kulathupuzha panchayats. Sub basin 5 falls in Thenmala Panchayat. KSLUB (2000) micro watersheds 7K37 to 39 make sub basin4, while sub basin 5 is made of 7K16.

Sub basin F Chittar (7K/F/4). This is a river flowing almost parallel to the main river. Altitude at the river junction is 20m. Shenkotta road and railway line pass through this group. Valiya Thodu and Chittar are the river in this. The river is at an altitude of 100 m at this location. The region is hilly and the river flows through narrow valleys. Land use is mainly forest, with patches of rubber cultivation. KSLUB (2000) micro watershed 4 make sub basin.

Fig. 02-19 Sub basins 4 to 13.

Sub basin G and H Punalur (7K/G/40 and 7K/H/15 41) are further downstream on either side of the river. The river is at an altitude of 100 m at this location. The region is hilly and the river flows through narrow valleys. There is a large river, Manivar in sub basin 7, sub basin 8 is on either side of the main river. Shenkotta road and railway line pass through sub basin 8. Punalur Town falls in this group. KSLUB (2000) micro watersheds 7K15 to 41 make sub basin H, while sub basin G is made of 7K40. Sub basin D has parts of Punalur MC, Yerur and Karavaloor panchayats. Sub basin H falls in Punalur MC.

Sub basins I and J Valiya Thodu, Pazhanthiyil Thodu (7K/O, P, Q) are areas further downstream, on either side of the river. Valiya Thodu is in sub basin 9 and Pazhanthiyil Thodu on sub basin J. KSLUB (2000) micro watersheds 7K/K to M make sub basin 9, while sub basin G is made of 7K43. Parts of Pathanapuram Panchayat cover sub basin 9 and parts of Thalavoor, Vilakkud, Melila and Vettikkavala cover sub basin J.

Sub basin K, L and M Kundayathu Thodu-Anthaman Thodu 7K/K, L, M). Sub basin 11 is mostly under rubber cultivation; remainaing areas have rubber cultivation, built-up areas and mixed crops. The Kallada River crosses MC Road at Enattu, at the end of these groups. The river has reached 40m MSL at this location. Kottarakkara Town is in sub basin L, KSLUB (2000) micro watersheds 7K10 make sub basin K, 7K45 make sub basin L and 7K 7, 8, 9 and 44 make sub basin M. Parts Enadimangalam and Kalanjoor cover sub basin K. Parts of Mylom, Kulakkada and Vettikkavala cover sub basin L. Parts of Enath, Ezhamkulam and Pattazhy cover sub basin 13.

Sub basin N Plains (7K/N) is relatively plain areas, with a large number of water bodies on either side of the river. Few perennial streams join the sub basin lying on either side of the river. Land use is rubber cultivation, built-up areas and mixed crops. Parts of panchayats Kadambanad, Kunnathoor, Kulakkada, Pavithreswaram and Neduvathoor cover the area.

Fig. 02-20 Sub basin 4

Sub basins O, P, Q Delta (7K/O, P, Q). Parts of panchayats Sasthamkotta and West Kallada cover sub basin O. The river drops down to 20m and then to almost sea level. Sasthamkotta Lake and related water bodies are located here. Kallada Ar enters a marshy area as it approaches sea.

Fig. 02-21 River at Kallada

Much of this area has been drained and lakes such as Sasthamkotta Lake and Astamudi Lake remain. Parts of panchayats Pavithreswaram, East Kallada and Kundara cover sub basin P. The area is too low altitude for rubber; main land use is mixed crops followed by paddy fields. A large number of panchayats such as Perayam, Perinad, Thekkumbhagam, Neendakara, Thrikkaruva and Thrikkadavur and Kollam Corporation cover sub basin Q.

Pallikkal Basin

Pallikkal basin is situated between Kallada and Achankovil basins, on the western side. Pallikkal River originates from a series of low hills near Adur. The altitude goes up to 100m in the basin. The river crosses MC road at Adur. NH 47 crosses the river to the south of Karunagappally. The railway line takes a more easterly route.

Pallikkal basin is 220 km^2 in area and 42 km in length. Pallikkal River empties into Kayamkulam Kayal, which is linked to Ashtamudi Kayal in the south and Kayamkulam Kayal to the north. It is situated between confluence of two major river systems, Kallada and Achenkovil. Pallikkal River is in a way, a chain of lakes. Land use consist mainly mixed dry land crops of coconut, plantain, tapioca, etc. Rubber is limited to hilltop in fringe areas. There is extensive paddy cultivation along streams. Built up areas are seen around major towns.

Pallikkal water-shed is divided into 14 micro watersheds as per KSLUB (2000). These consist of streams draining to Pallikkal River. The area is thickly populated and a large number of panchayats like Panmana, Karunagappally, Thazhava, Thodiyur, Sooranad, Poruvazhy, Pallikkal, Adur MCP, Palame, Mavelikkara Thamarakkulam fall in the basin. There are a large number of tanks and ponds in the basin. Puduchira is in Bharanikkavu block at the border of Vallikunnu and Thamarakkulam panchayats. Other prominent water bodies are Vainkara Chira, Vatta Kayal, Vilumel Kayal and Kozhikkottu Kayal.

Fig. 02-22 Pallickal Basin

Ashtamudi Kayal: Ashtamudi Kayal with its spidery arms receive the Kallada River. This lake system is situated to the north of Kollam town.

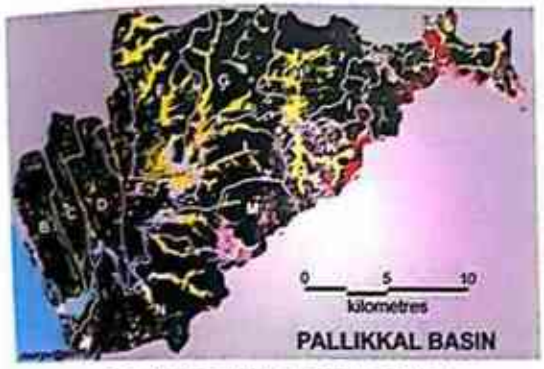


Fig. 02-23 Pallikkal basin: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Panni

In general, coastal Kollam was a water logged area with heavy siltation. Many places have become land in historical times itself. Much land reclamation has taken place in recent times. The railway line traverses across the lake through bridges in narrow parts. The Ashtamudi Kayal is about 60 km^2 in extend. It has an amoeboid shape with arms extending inland. The exit to the sea is at Neendakara, now developed as a fishing harbour.

Fig. 02-24 Lakes of Kollam District

The region between the Ashtamudi lake and areas falling within 20m contour is a vast flood plain. Due to land reclamation, water connection has been lost and several individual lakes have resulted. Kanjirakottu Kayal on the left side and Sasthamkotta Lake on the right side of Kallada River are examples. Even after isolation, occasional floods used to fill up the lakes, but now with the construction of Thenmala dam, floods are a rare phenomenon.

Two southern arms of the Ashtamudi Kayal are Kandanchira Kayal and Kuripuzha Kayal. A perennial stream from extensive paddy fields flows into the Kandanchira Kayal. These lakes surround the Thrikkadavoor Panchayat on almost all sides. A large number of People depend on fishing and coir retting for livelihood. Water transport is the main means of communication with the outside world. People use Chinese fishing masts and local fishing methods. Fish species are mostly estuarine. There are factories related to coir, fishing, prawns and cashew nuts in areas near the lake. Kollam Corporation is on the southern side of the lakes described. The town area is mostly built up, western side of the lake has mixed dry land cultivation and small amount of paddy cultivation. Two water bodies in this region are remarkable, The Vatta Kayal (17.75 ha as per topo sheet) and the Kottakkal Kayal (13.35 ha).

Occasionally water carnivals including boat races are held in Vatta Kayal. The kayal drains surrounding urban areas and reclamation of lake is reported. Satellite image shows large blobs of water discoloration in some parts. Kotttakkal Kayal is an elongated water body which receive water from the Vatta Kayal. This Kayal also receives flow from surrounding areas and drain into the Ashtamudi Lake.

Fig. 02-25 Ashtamudi Kayal

Sasthamkotta Kayal: The region between the Ashtamudi lake and areas falling within 20m contour is a vast flood plain. Due to reclamation, water connection has been lost and several individual lakes such as Sasthamkotta formed. Even

after isolation, occasional floods used to fill up the lakes, but now with the construction of Thenmala dam, floods are a rare phenomenon. Water level of Sasthamkotta Lake which is the source of drinking water for Kollam town is on the decrease, and augmenting water from Kallada River to the lake is the only way of reducing shrinkage of its water area. Panayam, Perinad, Perayam, East Kallada are on the banks of Kanjikkote kayal and Kumbalathu Kayal.

Sasthamkotta and West Kallada panchayats are situated adjacent to the Sasthamkotta Lake. Further water bodies in the district are in the Pallickal Basin. Kallada River empties into the sea near Kollam. The distributaries form a vast belt of swamps. The fact that the river gets flooded in monsoon and the fact that catchment area is prone to landslides bring much sediments to the low lands. Secondary lakes such as Sasthamkotta Lake have been formed due to the filling up of connecting regions to the river.

Fig. 02-26 Sasthamkotta lake©prejith@kfri.org

Kayamkulam Kayal: Kayamkulam Kayal has two parts, southern part and northern part, about 10 km, connected through a chain of narrow lakes. These lakes unlike the link at south (Chavara) do not seem to be manmade. Panchayats of Karunagappally, Kulasekhara Puram, Clappana and Alappad fall on either side of these lakes.

Nadayara, Paravur and Edava Kayals: These are situated in the boundary of Thiruvananthapuram and Kollam Districts. It is about 2.38 km² in extend. Nadayara Kayal continues as Kilimukkam Kayal eastwards, there is no western outlet to the sea. A land corridor of about 0.75 km separates it from sea. Two branches of the Airur River join near the eastern part. There is some amount of paddy cultivation near the confluence; otherwise the lake is surrounded by dry land with cultivation of coconut, mango, jack, plantain, etc. Topo sheet shows a lake of about 10 ha between the arms of the Ayroor River. Now this has mostly been filled up and only a remnant water body remains. The national highway and railway line pass along the left side of the lake.

Fig. 02-27 Lakes of Kollam District

Kilimukkam Kayal is situated to the north of Nadayara Kayal in continuation with it. Kilimukkam Kayal is about 1.09 km² in extend. Paravur Kayal is situated to the west of these two lakes, the railway line passes between Paravur Kayal and Kilimukkam Kayal. A narrow gap and railway bridge separate the lakes now. Paravur Kayal is about 1.2 km² in extend. Two small streams join it at the apex, a canal, Maniyamkulam Canal, possibly man made links it to another set of kayals situated few km north. Edava Kayal, 0.19 km² in area, is the southward extension of these lakes. It is a narrow canal like structure. The exit to the sea is at the end. Now there is a bridge at the junction of Edava Kayal and Paravur Kayal. Many parts of Edava Kayal are being filled, and the exit to the sea is somewhat diffused. This could affect the salinity of the entire system. Even small man made canals can bring changes in hydrology.

Paravur Kayal (N) and Iravipuram Kayal are situated to the north of the lakes described canal

passes through Kollam town. In spite of so much water availability there is not much paddy cultivation around the lakes. There are some water logged areas. The exit of these lakes to the sea is interesting. There is possibility of water entering sea at the junction of the lakes, but the original exit has been modified by fixing a sluice control and exit canal. This is possibly for salinity and water level control.

Paravur (N) and Iravipuram Kayals are joined at Mukkam through a narrow gap. Ithikkara River joins the lake at the eastern side. A long canal, possibly manmade, connects these lakes to the Ashtamudi Kayal. Vattakayal is about 16 ha in extend. Vattakkayal is becoming an increasingly popular tourism spot. About 30 fishermen families are reported to make a living through the lake. There was a massive fish kill in the month of May 2010 possibly due to pollutants and salt water entering the lake.

Fig. 02-28 Vattakkayal.

High concentration of heavy metals in sediments is reported near Chavara Industrial area. The public sector industry KMML is charged with polluting the lake. Making of burned bricks also reported from the area. The lake is rich in fish fauna; about 30 species of fish are reported. Large number of birds visits the lake. Paddy is cultivated in areas around the lake.

Other lakes: These are situated in the boundary of Thiruvananthapuram and Kollam Districts. It is about 2.38 km^2 in extend. Nadayara Lake continues as Kilimukkam Lake Eastwards, there is no western outlet to the sea. A land corridor of about 0.75 km separates it from sea. Two branches of the Aiyur River join near the eastern part. There is some amount of paddy cultivation near the confluence; otherwise, the lake is surrounded by dry land cultivation of coconut, mango, jack, plantain, etc. Topo sheet shows a lake of about 10 ha between the arms of the Ayroor River. Now this has mostly been filled up and only a remnant water body remains. The national highway and railway line pass along the left side of the lake.

Kilimukkam Lake is situated to the north of Nadayara Lake in continuation with it. Kilimukkam Kayal is about 1.09 km^2 in extend.

Paravur Lake is situated to the west of these two lakes, the railway line passed between Paravur Lake and Kilimukkam Lake. A narrow gap and railway bridge separate the lakes now. Paravur lake is about 1.2 km2 in extend. Two small streams join it at the apex, a canal, Maniyamkulam canal, possibly man made links it to another set of kayals situated few km north. Edava Kayal, 0.19 km2 in area, is the southward extension of these lakes. It is a narrow canal like structure. The exit to the sea is at the end. Now there is a bridge at the junction of Edava Kayal and Paravur Kayal. The real situation at field level seems to be quite different. Many parts of Edava Lake are being filled, and the exit to the sea is somewhat undefined. This could affect the salinity of the entire system. Even small man made canals can bring changes in hydrology.

Paravur Kayal (N) and Iravipuram Kayal are situated to the north of the lakes described above. Paravur (N) and Iravipuram Kayals are joined at Mukkam through a narrow gap. Ithikkara River joins the lake at the eastern side. A long canal, possibly manmade, connects these lakes to the Ashtamudi Lake. This canal passes through Kollam town. In spite of so much water availability there is not much paddy cultivation around the lakes. There are some water logged areas. The exit of these lakes to the sea is interesting. There is possibility of water entering sea at the junction of the lakes, but the original exit has been modified by fixing a sluice control and exit canal. This is possibly for salinity and water level control.

Kollam Port (Thankasseri) is the second largest port in Kerala after Cochin port Trust as per the current status (2010). The port is undergoing infrastructural development. The port is located almost near to the heart of Kollam city.

Drinking water supply to Kollam Town: The main source of drinking water for Kollam town is the

Sasthamkotta Lake. There are several schemes for augmenting the water supply to the panchayat regions. There was a proposal to bring water from the Thenmala reservoir.

Wetlands in blocks and panchayats

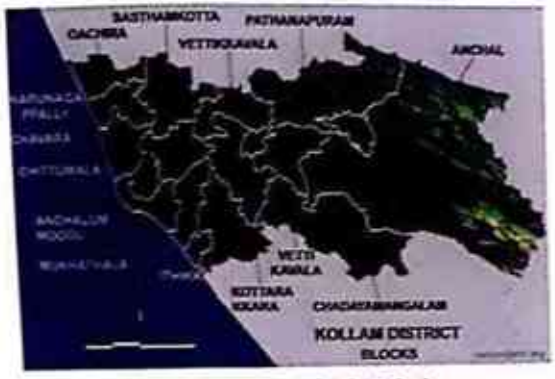


Fig. 02-29 Kollam District: Blocks

Fig 02-30 Ponds and tanks in Kollam District

Block	Ponds Count	Area (ha)
Pathanapuram	2	0.61
Punalur MCP	3	1.24
Anchalummoodu	1	1.57
(blank)	3	1.76
Chadayamangalam	3	1.90
Karunagapally	8	2.50
Anchal	8	2.83
Oachira	8	3.18
Kottarakkara	14	3.74
Mukhathala	5	6.57
Vettikkavala	21	13.61
Chittumala	9	14.28
Chavara	18	16.97
Kollam Corp.	17	33.67
Ittikkara	15	38.41
Sasthamkotta	28	452.62
Grand Total	163	595.46

As per Panfish (2002) data, private ponds come to about 205 ha, irrigation tanks 150 ha, quarry ponds 138 ha and panchayat ponds 63 ha. The data lacks map support and has measurement unit errors. Survey of India topo sheets show major ponds. A total of 19 ponds are shown with an area of 406.82 ha in the district. This includes lakes as well. Block wise breakup follow.

NREDB (2008) mapping includes smaller ponds as well. Block wise area of ponds is shown below. Most of the area is occupied by Sasthamkotta Lake.

There is only one dam and reservoir in the district. This is the Thenmala dam on Kallada River. It is an irrigation dam. The Thenmala reservoir is the longest reservoir in the state, and it is the second largest irrigation project. The water from the reservoir is also used for power generation. The irrigation system is not fully functioning, but the dam and surroundings have become an ecotourism center.

Oachira Block: This is the northern most block in Kollam district. There are four panchayats in Oachira Block. It is situated few kilometres from coast, coastal panchayat being Alappad panchayat. The national high way and railway line pass through this block. Oachira temple is very famous. There are 8 ponds with a total area of 3.18 ha. Most of the area is contributed by one pond in Kulasekharam Panchayat (1.3ha) and another pond in Thazhava Panchayat (0.76 ha). Both these ponds are not present in the topo sheets.

Fig. 02-31 Oachira Block

Major land use is mixed crops and paddy. Vattakayal is a water body in this block (there are two water bodies with this name). There were several sovereign areas before unification into Travancore. Oachira town is on the northern part, beside the national high way.

Fig. 02-32 Oachira Block: Land use

Karunagapally Block: There are four panchayats in this block. This is a low elevation area, altitude being less than 20m. Lists two water bodies of 107 ha, probably lakes. Eight Ponds are estimated to occupy an area of 2.5 ha. Half of these ponds are larger than 0.3 ha. They are distributed in different panchayats in the block. At Karunagappalli main activities are retting coir fibre and fishing. There are cashew factories also. Alappad Panchayat is a very narrow stretch between lake and sea. CoastalAlzppad panchayat is a northern extension in the map, contains a long water body.

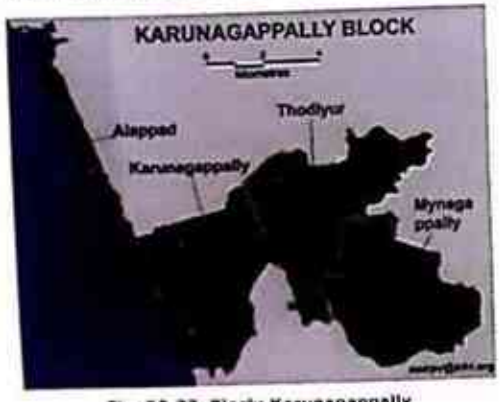


Fig. 02-33 Block: Karunagappally

Major land use is mixed crops and paddy. There are water bodies and built-up areas. Alappad Panchayat is a narrow stretch of land between the sea and fresh water lakes (TS canal). After the 2004 pstunami, new bridges were built.

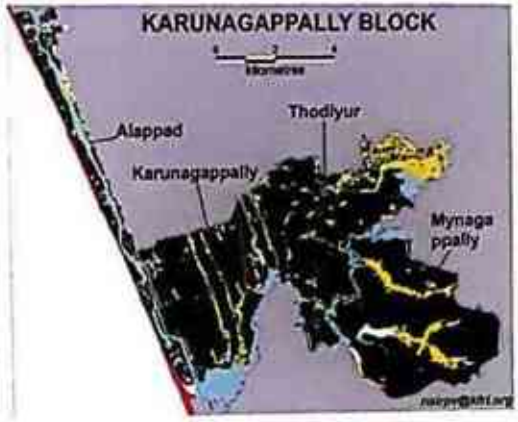
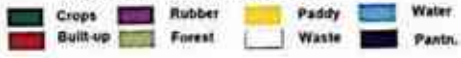


Fig. 02-34 Karunagappally: Land use



Sasthamkotta Block: There are six panchayats in this block. Kallada River forms the southern boundary. Lists 28 ponds with a total area of 452.62 ha. Out of these eight water bodies (includes Sasthamkotta lake) are larger than 1.0 ha in extend, and possibly are remnants of marshy areas in the flood plain of Kallada river. One Chira of 4.2 ha in Sooranadu South Panchayat is present in imageries. This is located west of Chakkuvally junction. Locally it is called as the Chakkuvally Lake. NREDB (2008) classifies area surrounding this area as industrial waste land.

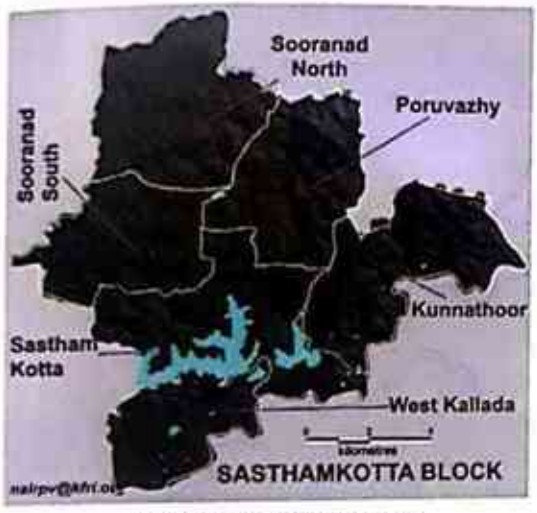


Fig. 02-35 Sasthamkotta Block

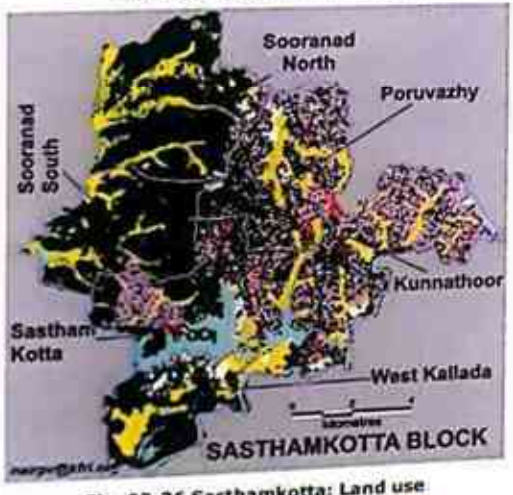


Fig. 02-36 Sasthamkotta: Land use

Crops, Built-up, Rubber, Forest, Paddy, Waste, Water, Pantn.

Vettikkavala Block: There are six panchayats in this block. Historically, it was an independent kingdom. MC Road pass through this block. It was an Lists 21 ponds with a total area of 13.61 ha. This block is situated on the left side of Kallada River. Kulakkada Panchayat has 11 ponds having a total area of 6.17 ha. One water body is particularly large, of 3.65 ha. Another pond of 0.92 ha is also beside the lake. Topo sheet does not show these ponds.

Fig. 02-37 Vettikkavala Block

Major land use is rubber cultivation. There is considerable amount of paddy fields, dry land crops and built-up areas.

Fig. 02-38 Vettikkavala :Luse

Crops, Built-up, Rubber, Forest, Paddy, Waste, Water, Pantn.

Satellite image shows the first pond, clearly, on close examination it is made of two parts, the second one has partitions. Two more ponds are more than 0.3 ha in extend, they are also not seen in the topo sheet. There are five ponds in Pavithreswaram Panchayat, three of them greater than one ha. This panchayat also is on the left side of Kallada River. These ponds are shown as paddy field in topo sheet but are visible as water body in satellite image. Other ponds in the block are smaller ones.

Pathanapuram Block: There are six panchayats in this block. Two ponds with a total area of 0.61 ha. This block has four small ponds of individual area less than 0.3 ha.

Fig. 02-39 Pathanapuram Block

Main land use is rubber cultivation and forest areas. There is considerable amount of paddy fields and built up areas.

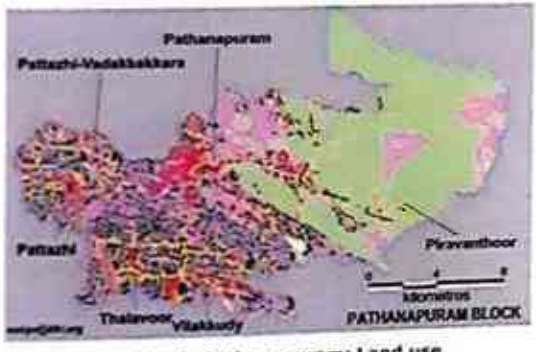


Fig. 02-40 Pathanapuram: Land use

MCP Punalur: List 3 ponds with total area 1.24 ha. Two ponds are of 0.44 ha and 0.64 ha area. Kollam Corporation: Reports 17 water bodies with a total area of 33.67 ha. Out of these, 6 water bodies are larger than 0.5 ha. Vattakayal is 18 ha in area. Kayamkulam MCP: Kayamkulam MCP has only small ponds.

Anchal Block: There are eight panchayats in this block. The Sendurney reservoir is in this block. The eastern regions are forest. The inter state highway and railway line pass through this block. Reed based industry functioned for decades. Anchal block has 8 ponds occupying a total area of 2.83 ha. The larger ponds are about 0.9 ha, but are not shown in topo sheets. The terrain is highly undulating and the Kallada River and its tributaries drain the area. The kallada Irrigation project is in this area.

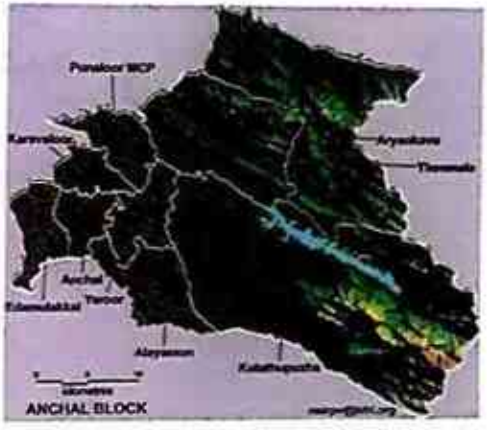


Fig. 02-41 Anchal Block

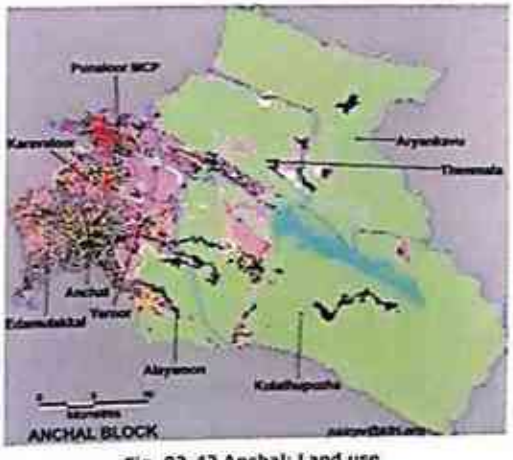


Fig. 02-42 Anchal: Land use

Kottarakkara Block: Lists 14 ponds with 3.74 ha. Palliman Ar, which joins Ithikkara River, drains this area. Ponds mapped are small, less than one ha each, and do not appear in topo sheets.

Fig. 02-43 Kottarakkara Block

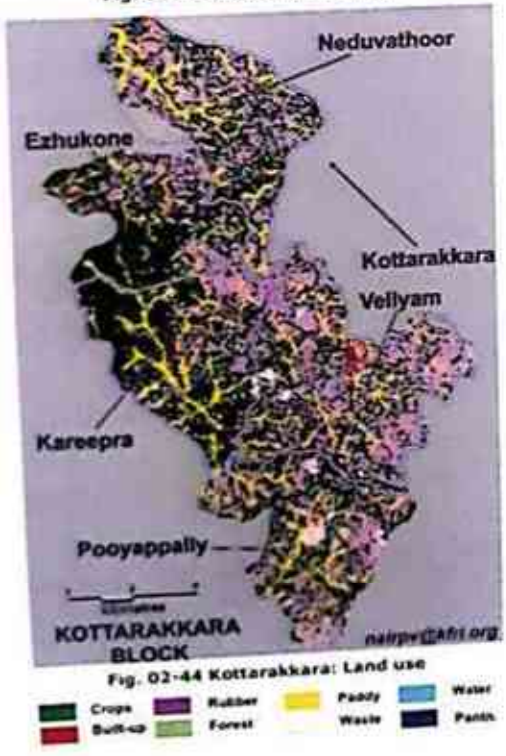


Fig. 02-44 Kottarakkara: Land use

Chittumala Block: This block is low land with many lakes, situated on the left side of Kallada river as it enters the lakes. NREDB (2008) maps 9 ponds with a total area of 14.28 ha, the ponds are mostly extensions of lakes or irrigation ponds beside paddy fields.

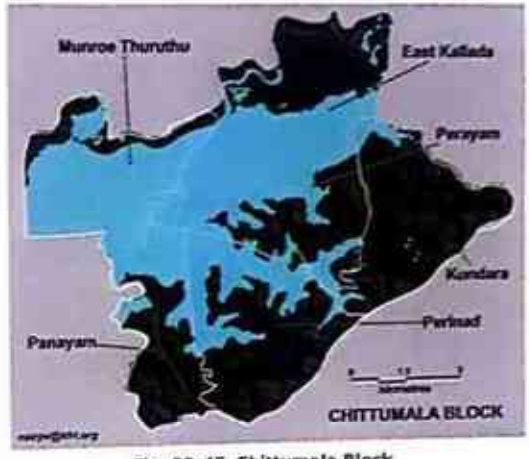


Fig. 02-45 Chittumala Block

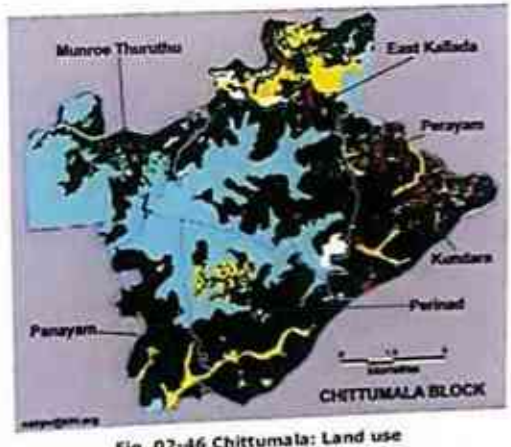


Fig. 02-46 Chittumala: Land use

Chavara Block: NREDB (2008) maps 18 ponds with a total area of 16.97 ha. This is a low land coastal block, where the prominent water bodies are fresh water lakes. Ponds are found as extension of these lakes along paddy fields. Because of this reason they are not marked in topo sheets.

Neendakara Panchayat has 11 ponds with a total area of 6.96 ha.

Fig. 02-47 Chavara Block

Neendakara estuary has a northern extension by name Thekkum Bhagam, Nadu Bhagam and Vadakkum Bhagam. There is a small land corridor at Pavambal, passage of water through this could affect salinity to some extent. Thekkumbhagam Panchayat is on the northern side of the Neendakara estuary and is surrounded by water on almost all sides Munro Thuruthu is another panchayat on the shores of Ashtamudi Lake. An island, is slowly getting connected with nearby road and rail. Main crop is coconut, the panchayat is reputed for its coir industry...

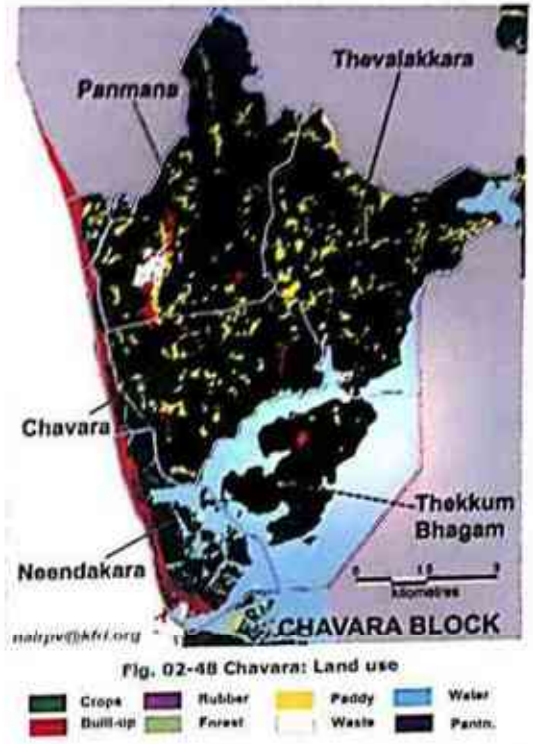


Fig. 02-48 Chavara: Land use

The coastal Neendakara Panchayat has many narrow waterways. This panchayat has sea on the western side and estuary on the eastern side. Due to salt water intrusion paddy is no more cultivated. Main occupation of people are fishing and coir industry. Panmana and Chavara Panchayats have three ponds each, many of which are large ponds. Near Chavara bridge there is a large factory. This area was paddy field in topo sheet.

Anchalummoodu Block: The block consists of small strips of land in Ashtamudi lake. Only one pond of 1.57 ha mapped. Thrikkaruva Panchayat on the southern side of Neendakara estuary has water on most sides. Topo sheet shows paddy cultivation, satellite image shows reduction. Coconut and tapioca replaced paddy. Due to the transport facility through water, merchant ships from China used to visit this place in historical times. Panchayat web site reports 24 ponds and several streams. Almost all methods of fishing techniques are employed here, Chinese masts, dragnet, dropnet, etc. Both fresh water and estuarine species of fishes are reported. Maps are shown with Kollam.

Mukhathala Block

Fig. 02-49 NAME

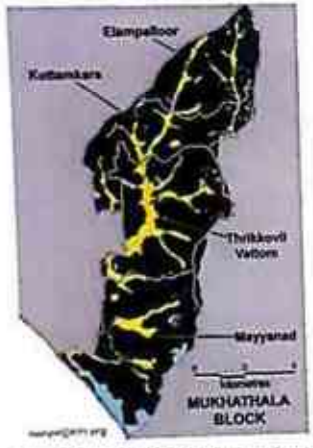


Fig. 02-50 Mukhathala: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Paints

List five ponds with a total area of 6.57 ha. Topo sheet shows extensive paddy cultivation, especially in the southern Mayyanad Panchayat. The mapping missed a chira, visible satellite image, of about 4.58 ha, present in the topo sheet. This chira is situated to the north of Kannanallur. There is a chira of 4.03 ha at Chimney.

Ithikkara Block: Lakes Ithikkara block together with Paravoor Municipality receive the Ithikkara River. There are five panchayats. NH 47 pas through the block. There are 15 ponds with a total area of 38.41 ha. There are two large ponds in Adichanallur. Area of one of them has shrunk drastically, compared to the topo sheet. This seems to be a classification error. Large water body in Nedumpana panchayat can be considered as fresh water lake. Large pond near Kottiyam has shrunk. Two water bodies, covered with weeds were missed in NREDB (2008) mapping. Pola Chira, error NREDB (2008), shows as paddy field. The Paravur Municipality and western parts of Poothakulam Panchayat area coastal. Ithikkara river joins Ithikkara lake and then the sea through a sand bar. Maniyamkulam canal links Paravur Kayal south wards to Parvur Kayal. Polachira is another water body that drains to Ithikkara River. It is home for many species of fish and migratory birds. There is a camp for domestic elephants nearby. There is paddy cultivation in the water body.

Fig. 02-51 Ithikkara Block

Fig. 02-53 Polachira

Fig. 02-52 Ithikkara: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Pantn.

Chadayamangalam Block: This is the southern blaock in Kollam District. Altitude range from 40-170m. There are eight panchayats in this Block. The area is drained by tributaries of Ithikkara River. Three ponds having a total area of 1.9 ha mapped. One large pond in Kadakkal Panchayat is 1.46 ha in area. MC road passes throught this area. Other parts of the block are poorly connected.

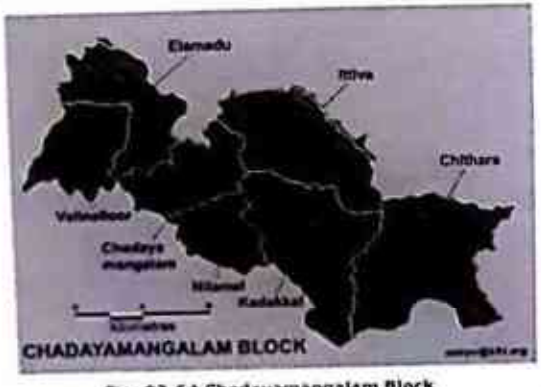


Fig. 02-54 Chadayamangalam Block

Mainland use is rubber cultivation. There are small amount of paddy fields, dry land crops and built up areas.

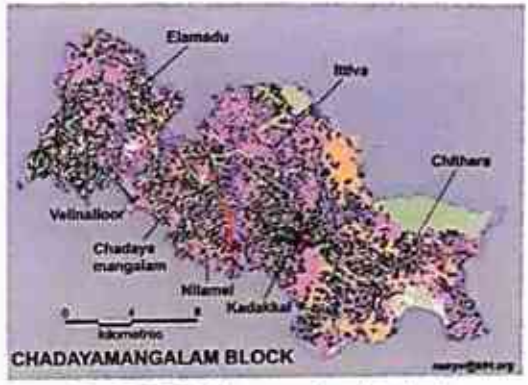


Fig. 02-55 Chadayamangalam: Land use

Kollam Corporation:

Historically, Kollam is the most well known town in Kerala. Its marshy lagoons permitted approach to ships and trade in pepper and spices flourished in the past. Anchalum mood Block with its two panchayats are considered as group.

Fig. 02-56 NAME

Main land use is dry land crops, paddy and built-up areas. Nearly 50 percent of the area is water bodies, Ashtamudi Kayal and other water bodies. Ashtamudi Kayal is connected south wards to Paravur kayal through a canal which flows along the middle of town. Vattakayal, another large water

body is connected to the Ashtamuidi Kayal and estuary through narrow Kattakkal Kayal. Vattakayal came into news following plans to fly sea planes from it. There are plans for cleaning up this stretch.

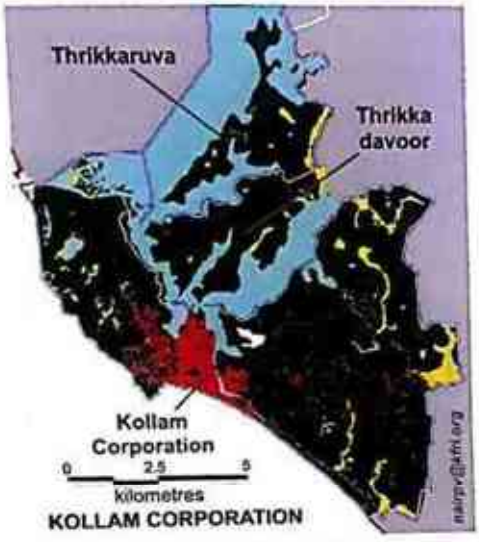


Fig. 02-57 Kollam: Land use

Fig. 02-58 Kayamkulam Thermal Plant ©nattinpuram.com

There have been committees that went into problems of Ashtamudi lake, Sasthamkotta Lake, Vattakayal, Vembanad Lake and Kuttanad. There has been a drastic decline in paddy cultivation in the state. The reasons for this are many.

Tourism: The Thiruvananthapuram-Shornur canal, which forms a part of the Thiruvananthapuram-Hosdurg system, runs a distance of about 62 km. The other canal systems include the Paravur Kayal, Kollam canal and Chavara canal.

Environmental issues

Environmental issues: The coastal sands are rich in minerals. There have been many schemes to exploit the same. A government owned factory extracts rare minerals. The tsunami that hit Kollam coast in 2004 caused much damage in Alappad Panchayat of Karunagapally Taluk. KMML and other factories in the region polluting water bodies reported. Mining for black sand is another activity in the Pallikkal coastal areas.

There has been much concern on protecting the ecology and biodiversity of wetlands. Land grabbers and illegal construction gangs are also active to acquire water fronts. Natural consequence of these has been involvement of environmental activists and creation of expert committees. The committees almost always put a list of dos and don'ts in which stopping degradation and conservation of biodiversity always top. Very often the land ownership, implementing agencies and plan of action is overlooked.

There is a canal linking Ashtamudi Kayal and Kayamkulam Kayal. It starts from Nadubhagam, Pass through Chavara region and end at Panmana. Most of this canal falls in Chavara Panchayat, which is almost the only water body in this panchayat. The public sector companies like KMML (Kerala Minerals and Metals Ltd) and IRE (Indian Rare Earths Ltd) are located in Kerala. These areas have well developed mining industry, boat building, fishing industry and coir industry. There is a small scale port also at Chavara. Sasthamkotta fresh water pipe line to Kollam pass through this area, but there is still acute drinking water shortage at Chavara.

Pallickal River joins Vattakayal, which is only 1.5 m deep, described as having potential to drain for paddy cultivation. Floods in Pallickal River described as damaging paddy cultivation. Kannatta dam would benefit Thazhava and Sooranad Panchayats. Another bund proposed in Thodiyur. There are tile factories and cashew factories. Mats from *Pandanus* on stream sides is a major activity in Thazhava area.

Pallickal basin and associated water bodies are interesting. It forms a link in the TS Canals system. There is wide spread paddy cultivation. Kayamkulam Kayal continues into Kozhikottu Kayal. There is another Vattakayal and Vilamel Punja here. After the low lands major water body is Shendurney reservoir. This is relative dry tract in which MCP such as Punalur fall. Some parts of Kallada basin fall in Alappuzha and Pathanamthitta Districts, but there are no major water bodies there.

Fig. 02-59 Chittazheekkal Karimanal near Karunagappalli. Sand after processing

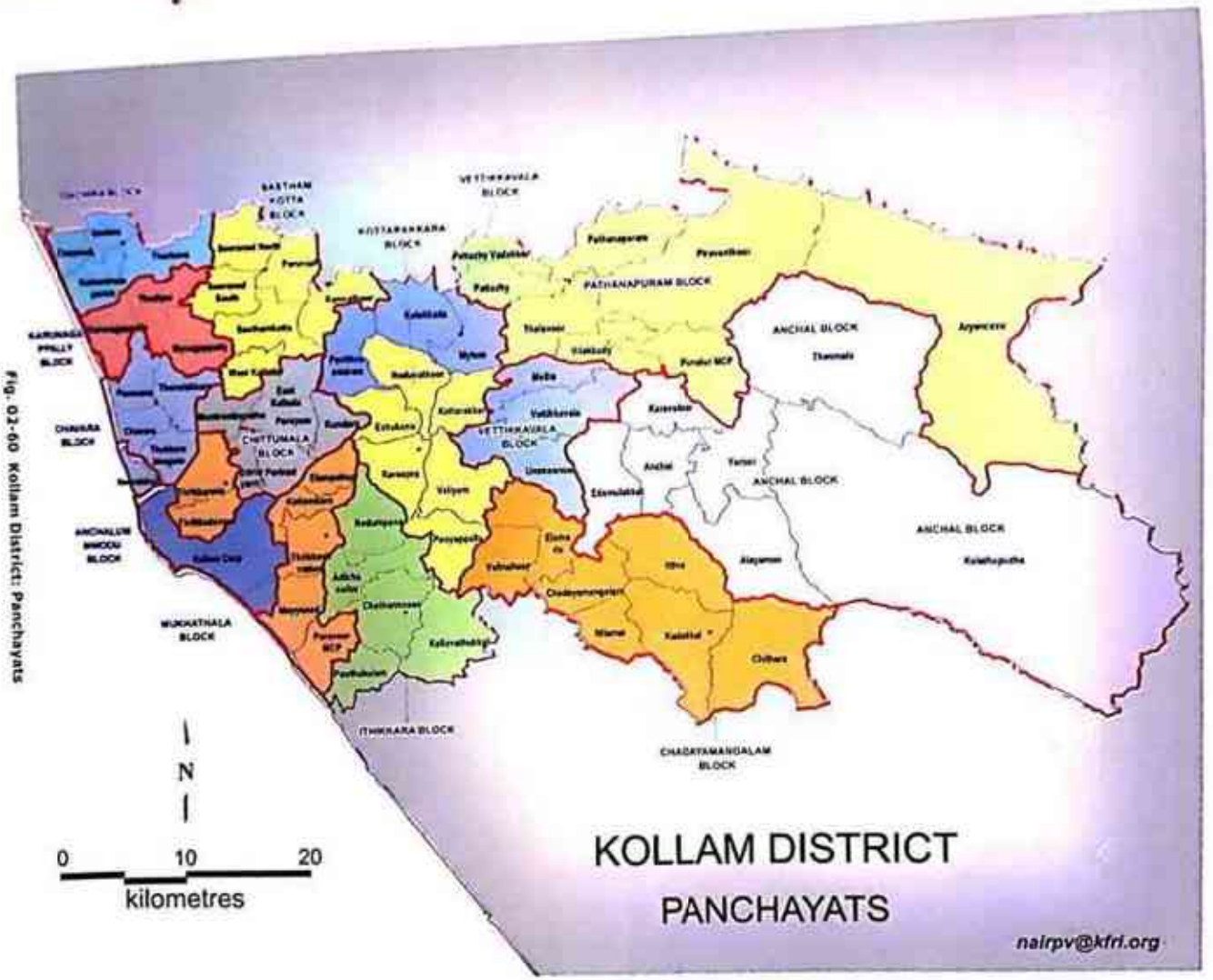


Fig. 02-60 Kollam District: Panchayats

02-22a

PATHANAMTHITTA DISTRICT

troduction

Pathanamthitta is a landlocked district, spanning er an area of 2,637 km². The district is bordered the districts Kottayam and Idukki in the north, apuzha in the west and Kollam in the south. To east, it has border with the Tamil Nadu State. e district can be divided into three natural ographical regions: the highland, the midland d the lowland. The highland stretches through e Western Ghats, where the hills are tall and vered with thick forests. It descends to smaller is of midland in the centre and finally to the wland. The lowland with its abundance of coconut ees, lies along the borders of Alapuzha.

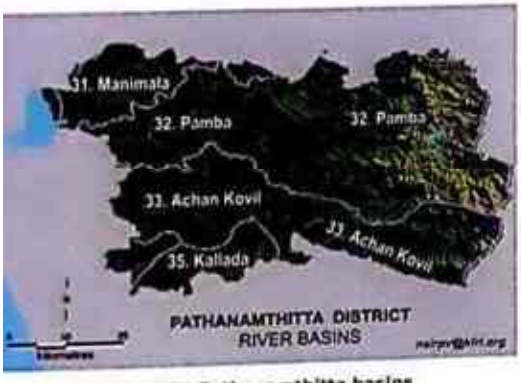


Fig. 03-01 Pathanamthitta basins

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

Pathanamthitta District has a reserve forest ea of 1,385.27 km². This is approximately 50% of e total area. The forest area can broadly be assified as evergreen, semi-evergreen and moist sciduous. Paddy is the most important crop ltivated in the wetlands. Tapioca and pulses are e important dry land crops. Other major crops re coconut, banana, pepper and ginger. In certain reas, cashew, pineapple, sugarcane, cocoa and ee spices are cultivated. The land available for ultivation is less since sizeable area of the district reserve forest. Three important rivers flow hrough the district. These rivers originate from arious hills of the Western Ghats mountain range. The Pampa (176 km) which is the third longest River in Kerala has its origin in Pulachimala.

The Achenkovil 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. Pampa and Achankovil Rivers together drain more than 70% of the total area of Pathanamthitta.

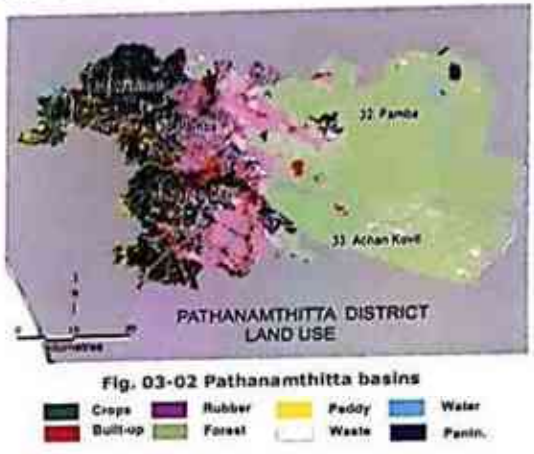


Fig. 03-02 Pathanamthitta basins

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. The district outputs only 20% of dry land cultivation when compared to state average. Rubber plantation is around 5% more than the state average.

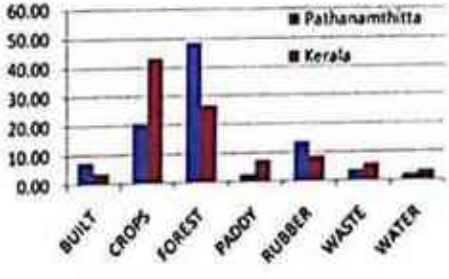


Fig. 03-03 Land use comparison

Next comes forest areas, which is 20% more than the state average. The district outputs only 20% of dry land 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 (1992) data there are a large number of ponds in the district. Achankovil and Pampa are the two major rivers in this district.

Achankovil Basin

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

Fig. 03-04 Achankovil Basin

Achankovil River flows in east-west direction and has about 50% of the basin under forest. There are no major dams in this river. Achankovil 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 of the river. Achankovil River also flows through relatively plain areas. The river is called as Kallar in these regions. KSLUB (2000) divides the basin into 47 micro water sheds, from 9A1 to 9A47. 9A refers to the 9th river in Kerala, Achankovil. We have divided the water sheds into 7 sub basins on the basis of similarity.

Fig. 03-05 Achankovil River

Sub basin A, Achan Kovil (7A/A/21..30) : This is the group where Achankovil River originates. There are a large number of streams and small rivers in this area. The region is forested. The river originates here, left and right sides of the river are included. Altitude ranges from 200m to 1500m at the top of the hills. Some of the streams are Pekkuli Thodu, Arampu Thodu, Chittar, Kal Ar, Kanal Ar, Managala Ar, Toval Thodu, Achankovil River proper, etc. Almost every stream joining the main river has name in the topo sheet. The entire basin is in forest area. The area is covered by KSLUB (2000) water sheds 9A26 to 9A30 with their subdivisions. Area falls in Aruvappulam Panchayat.

Fig. 03-06 Achankovil Basin: Land use

Sub basin B, Naduvathumoozhy (7A/A/17..25) : sub basin consist of streams draining from hills on the northern side of the river. Some of the rivers draining to the main river from the northern side are Chembala Thodu, kaduvapara Thodu, Naduvathumoozhy Thodu, etc. Altitude ranges from 40m to 1000m.This sub basin is also forested, the exception being parts of western edge near Konni where the land use is mixed crops and built up areas. The area is covered by KSLUB (2000) water sheds 9A17 to 9A25.

Sub basin C, Konni (7A/A/31..36) :The area is drained by streams such as Aruvappalam, Kalleli, Kadiyattu Thodu, Mannarappara Thodu, Chempanaruvi, Palakkappara, etc. Altitude ranges from 40m to 500m. This basin group is also forested, the exception being parts western edge near Konni where the land use is mixed crops and built up areas. The area is covered by KSLUB (2000) water sheds 9A31 to 9A36 with their subdivisions. Panchayats such as Kalanjoor, Pathanapuram and Piravanthoor are nearby.

Sub basin D, Pathanamthitta-Kulanada (7A/A/9..13): This sub basin is further downstream, on the right side of the river. Several streams from northern side flow to the main river, some of these are Nambikkal Thodu, Polachira, etc.

Altitude is 20 to 160 m. There is not much rubber cultivation in this group, major landuse is mixed crops, paddy fields and built up areas. The area is covered by KSLUB (2000) water sheds 9A9to 9A13 with their subdivisions. A large number of panchayats cover the area, Mezhuveli, Pathanmthitta MCP, Chenneerkkara, Kulanada, Malayalapuzha, etc

Sub basin E, Pandalam (7A/A/37..42) :This sub basin is further downstream, on the left side of the river. Major streams are Chandanappally Thodu, Perum Thodu, Karingalil Chal, etc.

Altitude is from 20m to 200m. There is not much rubber cultivation in this group, major land use is mixed crops, paddy fields and built-up areas. The area is covered by KSLUB (2000) water sheds 9A37 to 9A42 with their subdivisions. A large number of panchayats cover the area, Vallikodu, Pramadam, Kodumon, Pandalam, Adoor MCP, etc.

Sub basin F Venmani-Aala (7A/A/1..7) : The river joins the wetlands. There are few tanks and ponds. Few small streams flow to the main river. Land is only few meters above sea level. Major land use is dry land agriculture followed by paddy fields. The area is covered by KSLUB (2000) water sheds 9A1 to 9A7 with their subdivisions. Large number of panchayats covers the area; Puliyur, Venmani, Aala, Cheeriyanadu, Budhanoor, etc are some of them.

Sub basin G, Mavelikkara (7A/A/43..46): The river joins the wetlands. There are few tanks and ponds. There are many perennial streams. Altitude goes up to 20m from MSL. Major land use is dry land agriculture followed by paddy fields. The area is covered by KSLUB (2000) watersheds 9A43 to 9A46 with their subdivisions. Large number of panchayats covers the area, Mavelikkara MCP, Thazhakkaa, Thekkekkara, Chettikulangara, etc are some of them.

Pampa Basin

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

The Pampa basin is quite complicated to describe. On a broad level, the Pampa basin can be divided into sub basins A to Q. The upper reaches of Pampa River form sub basins A to H. Moozhiyar Reservoir is inside this. Chinnamelmala River joins Pampa; Kakki River joins it at the holy bathing ghat. Few streams join the river downstream also. Sub basin J is Azhutha River which joins Pampa at the Sangamam.

Fig. 03-07 Sub basins of Pampa basin

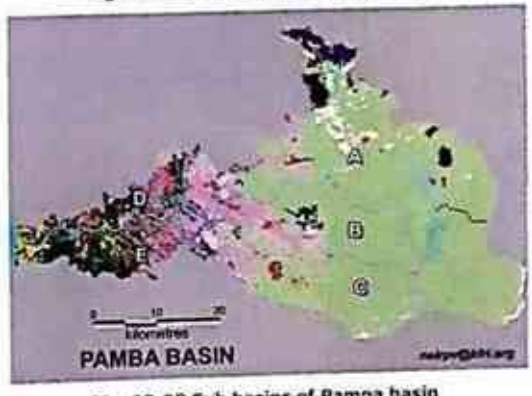


Fig. 03-08 Sub basins of Pampa basin

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Panth.

Sub basin K is the Kakkad River, which joins Pampa downstream of Sangamam at Perinad. Kakkad River itself is a large River with a vast catchment area. At Moozhiar, it receives the tail race water from the power project. Sub basin L is Kallar which also is a large river which joins Pampa further downstream at Vadasserikkara. Sub basins N to Q are further remaining portion of Pampa before it joins Vembanad Lake, The region is centered at Ranni. Detailed descriptions at more detail follow.

Sub basin A, Kakki origin (10P/A/38..42): This is the origin of the Kakki River. 10 P refers to 10th river in Kerala, Pampa. The lower end of the region

is Kakki reservoir at about 1000m. The ridge is at about 1700m. The eastern side of the area is steep drop to the plains of Tamil Nadu. This is one of the most inaccessible forests of Kerala. KSLUB (2000) micro watersheds 10P38 to 42 with their subdivisions make this area. This region falls in Ranni Block.

Sub basin B, Kakki reservoir (10P/B/32..35) : is the right side of the Kakki river including the reservoir. Ana Thodu, one of the main streams joins the reservoir. The region is fully forested. The lower end of the region is Kakki reservoir at about 1000m. The ridge is at about 1800m at Sundar Mala. The eastern side of the area is Periyar Tiger Reserve. This is also one of the most inaccessible forests of Kerala. There is some grass lands also. KSLUB (2000) micro watersheds 10P32 and 10P35 make this area. This region falls in Ranni Block.

Sub basin C, Left bank (10P/C/43..45) is the steep forest on the left side of the Kakki River immediately below the dam. KSLUB (2000) micro watersheds 10P43 to 45 with their subdivisions make this area. At the lower edge, the river is at about 500m. This region falls in Ranni Block.

Sub basin D, Right bank (10P/D/42..43) is the steep forest on the right side of the Kakki River immediately below the dam. KSLUB (2000) micro watersheds 10P42 to 43 (part) with their subdivisions make this area. At the lower edge, the river is at about 500m. This region falls in Ranni Block.

Sub basin E, Pampa(10P/E/42..43)is the where Pampa river originates. The Pampa reservoir is inside this. Elevation at the lower edge is about 300m, the ridge is the Pampa-Periyar, and grass covered hills at about 1500m. The sacred Pampa bathing stretch is at the lower portion. KSLUB (2000) micro watersheds 10P29 with its subdivisions make this area. This region falls in Ranni Block.

Sub basins F and G, Azhutha Junction [10P/F,G/25..27,46..47] are downstream from the holy area till the junction of Azhutha River, on either side of the river. Altitude range would be about to 100m. KSLUB (2000) micro watersheds 10P25 to 27 and 46 to 47 with its subdivisions make this area. Of these the micro watershed 10P28a is particularly notable as it drains the Sabarimala Temple and surrounding areas. The river is still at around 300m elevation.

Sub basins H and I, Perinad (10P/H, I/22..23, 48..51) are further downstream and the end of forested basins along Pampa. at the lower edge there is built area and cultivation. Lower edge is at about 180m. KSLUB (2000) micro watersheds 10P22 to 23 and 48 to 51 with its subdivisions make this area. Panchayats Narangamoozhi, Chittar, Pazhayangaid, Ranni Perinad come in this group.

Sub basin J Azhutha (10P/F, G/24) is a large basin that extends from Pampa Sangamam to Peerumed region. The top regions are grass lands at an elevation of around 1000m. KSLUB (2000) micro watersheds 10P24 with its subdivisions make this area. The region is forested, except few patches of human occupation. Panchayats Peermed, Vandiperiyar, Peruvanthanam, Mundakkayam, Erumeli, Kumily, etc fall in this group.

Sub basin K, Kakkad (10P/K/52) is a large basin situated parallel to the main Pampa River, on the south. The Kakkad River joins Pampa at Perinad. The area is forested except at the lower edge where the land use is rubber cultivation and built-up areas. There is much forest plantations also. The Kakki reservoir is on the east side of this basin. KSLUB (2000) micro watersheds 10P52 with its subdivisions make this area. Altitude ranges from 100m to 1000m. Panchayats Chittar, Ranni-Perinadu and Vadasserikkara fall in this group. This region falls mostly in Ranni Block.

Sub basin L, Kallar (10P/L/53) : This is yet another basin lying parallel to Pampa River and situated south of Kakkad River. Kallar River joins Pampa at Vadasserikkara where the altitude is about 20m. At Konni the river is at about 100m altitude. The ridge of the basin is at about 1200m. KSLUB (2000) micro watersheds 10P53 with its subdivisions make this area. The area is forested except at the lower edge where the land use is rubber cultivation and built-up areas. Panchayats Thannithodu, Malayalapuzha, Vadasserikkara and Ranni fall in this group. The area falls mostly in Konni Block.

Sub basins M to Q, Plains (10P/M..Q/21,17,55,12,61): The group consists of sub basins in the plains after all the major tributaries have joined the main river. The western edge is the wetlands which is almost at sea level.

Fig. 03-09 Pampa as it enters Alapuzha District

There is rubber cultivation at the eastern edge, as one comes down stream, mixed land crops, paddy fields and built-up areas are the land use. KSLUB (2000) equivalent for sub basin M (Ranni) is 10P21, 10P17 for Sub basin N (Aiyrur) , 10P55 for sub basin O (Aranmula-Kozhancheri), 10P12 for sub basin P and 10P61 for sub basin R (Chengannur). There are water bodies in sub basins P and Q. Panchayat wise, Koipram, Kuttoor and Thiruvandoor are in sub basin P; Pandanadu and Chengannur MCP are in sub basin Q; Koipram, Thottupuzhassery, Ayroor are in sub basin N; Kozhanchery, Mallapuzhasseri, Naranganam, Cherukol and Elanthur are in sub basin O; Ranni , Angadi, Vechoochira, Ranni-Pazhavangadi fall in sub basin M.

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

Fig. 03-10 Kakki Reservoir

Pampa originates at Pulachimalai hill in the Peerumedu plateau in the Western Ghats at an altitude of 1650m 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 Pampa River. The Pampa 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. KSLUB (200) divides the basin into 70 micro watersheds, from 10PA1 to 10P70.

Fig. 03-11 Pilgrims taking holy dip in Pampa

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 Pampayar dam and the Kakkiyar dam are constructed on the banks of Pampa River.

Fig. 03-12 Vembanad Lake

It divides into several tributaries and finally merges into the Vembanad Lake. The annual rainfall in the middle part of the basin is around 4600 mm. Pampa River joins the Vembanad Lake. Aranmula boat race: Aranmula, a suburb of Kozhenchery is famous for its Parthasarathi Temple. This is the venue of the annual snake boat race on the Pampa, a water theme festival bringing in palliyodams (snake boats) from all over the state, to which thousands of tourists are attracted every year. The Aranmula boat race takes place at Aranmula, near a temple dedicated to Lord Krishna and Arjuna. Thousands of people gather on the banks of the river Pampa to watch the snake boat races. Nearly 30 snake boats or "chundan vallams" participate in the festival. The oarsmen sing traditional boat songs and wear white dhotis and turbans. The golden lace at the head of the boat, the flag and the ornamental umbrella at the center make it a show of pageantry too. Each snake boat belongs to a village along the banks of the river Pampa. Every year the boats are oiled mainly with fish oil, coconut shell, and carbon, mixed with eggs to keep the wood strong and the boat slippery in the water. The village carpenter carries out annual repairs and people take pride in their boat, which is named after and represents their village.

Fig. 03-13 Aranmula boat race @Arun Sinha

Wetlands in Blocks and Panchayats

The eastern portion of the district is occupied by two blocks, Ranni and Konni. Two panchayats, Seethathode in Ranni Block and Aruvappulam in Konni Block occupy the forest areas.

Fig. 03-14 Pathanamthitta District: Panchayats

Mallappally Block: This block drains to Manimala River on the southern border. Area has mostly mixed dry land cultivation. There are no major ponds or lakes in this block. Topo sheet does not show ponds. NREDB (2008) mapping shows a water body of 7.57 ha and another of 2.91 ha. These are water bodies associated with paddy lands. The smaller pond appears to be an artifact in classification, the larger pond is a new man made structure of importance. As per Panfish (1992) data, there are three ponds of about 2 ha area each.

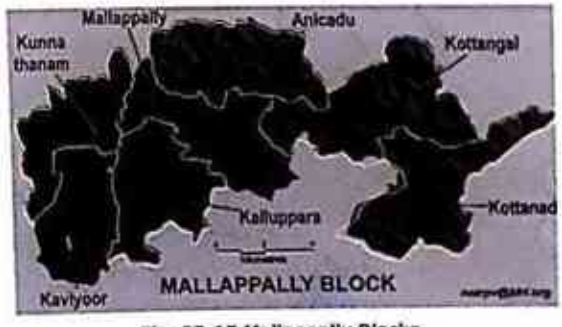


Fig. 03-15 Mallappally Blocks

There are much paddy areas, but whether they are in actual cultivation could not be checked.

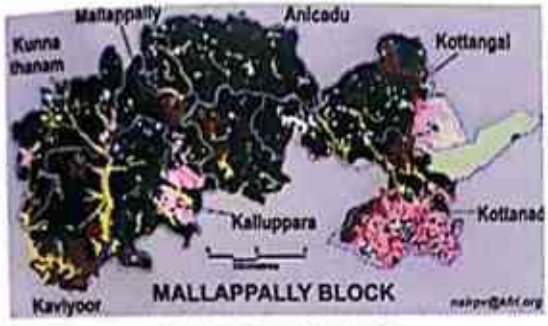


Fig. 03-16 Mallappally: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Panin.

Pulikeezhu Block: There are five panchayats in this block. Manimala River flows through the southern boundary. Peringara and Nedumbram Panchayats fall in Upper Kuttanad and get inundated in rainy season.

Fig. 03-17 Pulikeezh Block

Pulikeezh Block is situated on the north west corner of district. Peringara has low lying areas, paddy fields with large interconnecting canals and streams. Thiruvalla Muncipality falls inside this region.

Panfish (1992) reports several water bodies, probably associated with the upper Kuttanad region. Toposheet does show ponds. NREDB (2008) show many inundated paddy fields, part of upper Kuttanad system. Main crops are paddy, sugarcane, coconut, etc. First sugar factory in the state was established here. This is the land of boat races. There is shortage of drinking water in many areas.

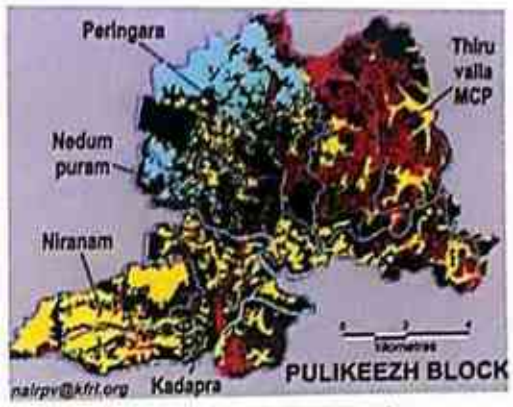


Fig. 03-18 Pulikeezh Block: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Panin.

There are several temple ponds in the block.

Fig. 03-19 Peringara Panchazhiyidathu chira temple pond

Fig. 03-20 Sree Vallabha temple pond

Kolpram Block: This block cover further downstream of Pampa River. There are six panchayats in this block. Pampa flows along the southern portion of this block. This block has mostly mixed dry land cultivation. Two large water bodies are visible in the topo sheet (more than 10 ha each) , one in Kolpram Panchayat and another in Eraviperoor Panchayat.

Fig. 03-20a Koipram Block

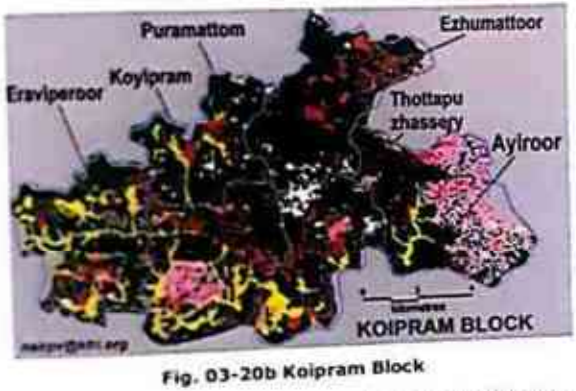


Fig. 03-20b Koipram Block

A stream from the first pond drains to Pampa. There is a small stream originating from the second pond and it joins the Manimala River. NREDB (2008) also show these ponds. Maramon convention, a religious congregation occurs on banks of Pampa. There is sugar cane cultivation in some parts. Aruvikkuzhi water fall has potential for tourism development.

Fig. 03-21 Koipram panchayat, Cleaning Nellikkal chira

Elandur (Elanthoor) Block: There are seven panchayats in Elandur Block. This block is between rivers Achankoil and Pampa. Cherukol, Kozhenchery and Mallappuzhassery are on the left side of Pampa River. Some areas are under rubber.

There is a large water body in Mallappuzhassery-Pannivelichira (about 18 ha as per topo sheet, now about 9.5 ha was overlooked in NREDB (2008) . Naranganam, Elandur and Chenneerkara have mostly low hills and dry land cultivation. Chenneerkara and Omalloor are situated on the right side of the Achenkovil River. There are paddy fields, marshes and waterlogged areas in this Panchayat. There was a proposal for constructing an airport in the wetlands of this block. This was given up following environmental considerations.

Fig. 03-22 Elandur block and Pathanamthitta MCP

Most of the block is under rubber cultivation. There are considerable amount of paddy fields, dry land crops and built-up areas.

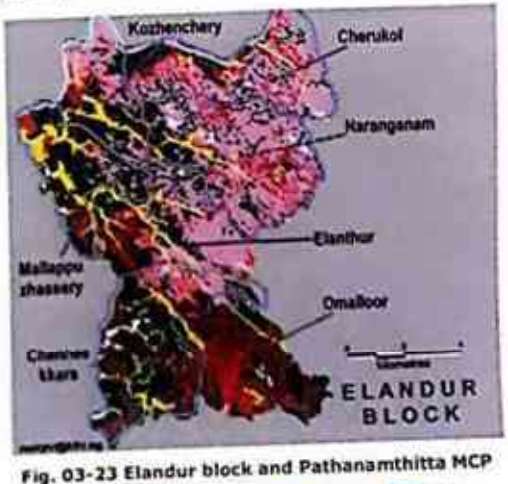


Fig. 03-23 Elandur block and Pathanamthitta MCP

Crops Rubber Paddy Water
Built-up Forest Waste Panth.

The Kozhancheri Maramon convention is in this area. Famous Aranmula temple is in this block.

Fig. 03-24 Aranmaula Airport site.

Fig. 03-25 Bridge in Pampa at kozhenchery Maramaon

Ranni Block: Ranni Block has nine panchayats. Out of these, seven panchayats are on the western non forest area. Excepting parts in the western region entire block is forested area. Pampa River originates almost fully inside this block. The two major tributaries of Pampa and Kakki, with their associated dams have already been described. Sabarimala temple is also situated on the right side of the Pampa River. The whole area is forested and there are hardly any water bodies till the Pampa and Kakki Rivers join, inside Seethathode Panchayat. Chittar Panchayat on the western side of Seethathode Panchayat is bounded by Pampa River on the north and Kakkad River, a tributary of Pampa on the south. Chittar Panchayat is also mostly forest and there is much Teak and Eucalyptus plantations in the forest area. There are no major ponds or lake inside this area. Ranni Pennadu Panchayat is situated between the Pampa River and the Kakkad River. Topo does not show any ponds. Vadasserikara Panchayat is situated between Kakkad River and Kallar (third and fourth tributaries of Pampa). Vadasserikara Panchayat is remarkable as several major rivers flow through it. The fourth tributary, Kallar joins Pampa in this panchayat. Eastern portions are forested.

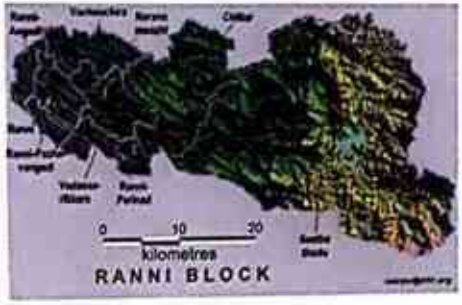


Fig. 03-26 Ranni Block

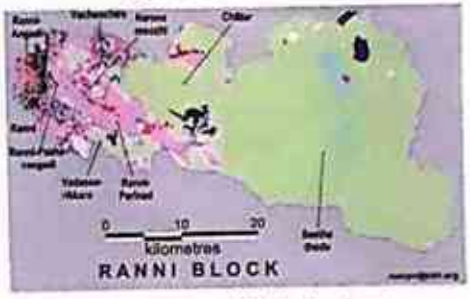


Fig. 03-27 Ranni Block: Land use

The remaining panchayats Vechoochira, Ranni Angadi, Ranni Pazhavangadi, Naranammoozhy, Ranni Perinad, Ranni and Vadasseri-kkara have low hills. Pampa passes through three of the southern panchayats. Topo-sheets do not show any ponds. There is a pond of 0.75 ha in topo sheet near Ponnambalamedu. NREDB (2008) maps a vast forested marshy region downstream of Kakki reservoir. Perinad and Vadasserikkara are two important river junctions. Vechuchira, a British made water body us near Pathanmthitta.

Konni Block: Konni Block has seven panchayats. Aruvappulam Panchayat is the eastern most, which is almost fully forested. Chittar River and Kallar River originate in this panchayat which eventually join the Achenkovil River which is the southern boundary of this block. Thannithode Panchayat situated at the western side is also forested. The southern portion of this panchayat is drained by Achenkovil River where as the northern portion is drained by the fourth tributary of Pampa River. Panfish 1992) reports few ponds from this block. Topo does not show ponds or lakes. Forest has teak plantations. Thannithode and

Thekkuthode are two enclaves inside the forest. Konni Panchayat is almost outside the forest area. Achenkovil River flows through this panchayat. There is much rubber plantations. Adjoining Malayalappuzha Panchayat also has much rubber plantations. Pramadom Panchayat also has rubber plantations. Vallikkode Panchayat is northern boundary is Achenkovil River. There is a small dam or bund on the river. Topo does not show ponds or lakes in Pathanamthitta MCP. Konni has paddy fields and marshes.

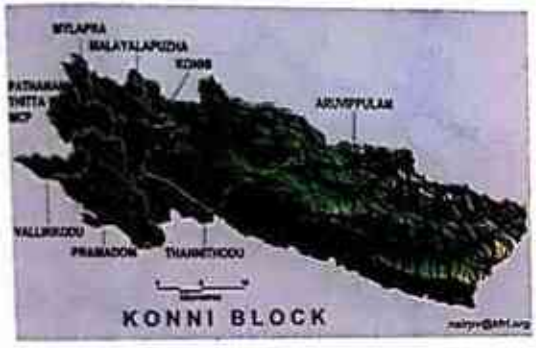


Fig. 03-28 Konni Block

More than half of the block is forest. Rubber cultivation is the main land use in t he midland. There is small quantity of paddy cultivation and dry land crops.

Fig. 03-29 Konni Block: Land use

Pandalam Block: Pandalam Block has three panchayats. They are on the left side of the Achenkovil River. In general, these panchayats have dry land cultivation mixed with paddy. On the western boundary of Pandalam Panchayat is a large water body called Karingali Chal. Surrounding this there are paddy fields. Most of the water body comes inside Nooranadu Panchayat.

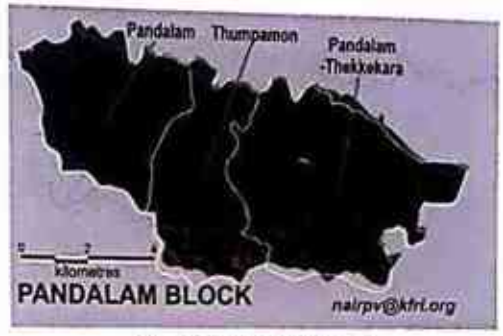


Fig. 03-30 Pandalam Block

Pandalam is historically well known. A branch Pandya Dynasty established here. Main land use is dry land crops followed by paddy fields. Pandalam Block is situated between Achan Kovil River on hte northern side and a tributary of it on the southern side. MC Road passes through the middle of the block. Pandalam town is on the northern side of the block.

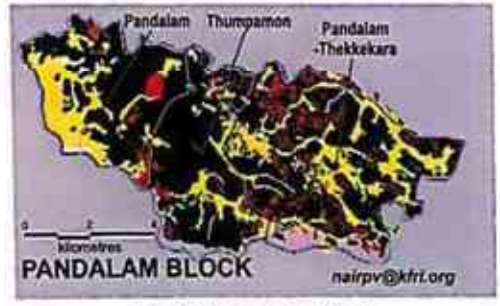


Fig. 03-31 Pandalam Block

Parakkode Block: This block has seven panchayats. Eastern part of Kalanjoor Panchayat is forested. Most of the area is under rubber. Panchayats, Ezhamkulam and Enadimangalam are also under rubber. In panchayats Kadambanadu, Pallikkal and Enathu there is dry land cultivation and paddy fields. Panfish (1992) lists several ponds. There is a large water body in NREDB (2008) images.

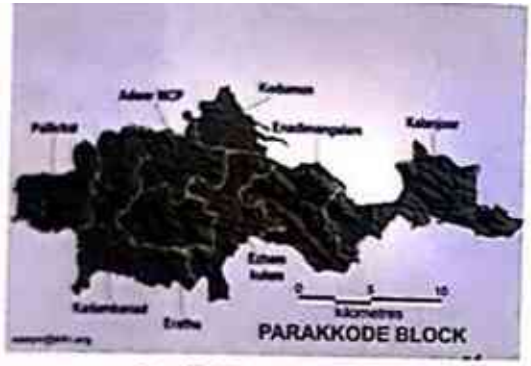


Fig. 03-32 Parakode Block

Middle part of the block is rubber estates. There is dry land crops, paddy fields, built-up areas and forest. Parakkode block falls in three basins, Achan Kovil, Pallickal and Kallada. Adoor Muncipality also falls within this area. MC Road pass through the area.

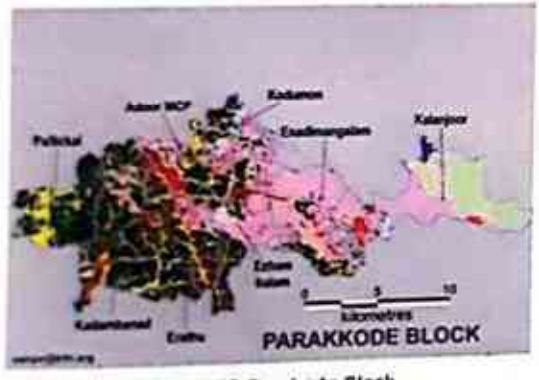


Fig. 03-33 Parakode Block

Kulanada Block: Kulanada Block has three panchayats. This block is situated between Pampa River and Achankovil River. Aranmula Panchayat is on the left side of Pampa River.

Mezhuveli and Kulanada Panchayats are on the right side of Achenkovil River. Land use is mostly dry land cultivation. There is a large pond – Pulachira in Kulanada Panchayat. A large water body, not found in the topo sheet is seen in satellite imageries, to the west of Kulanada.

Fig. 03-34 Kulanada Block

Land use is dry land crops, paddy fields and built-up areas.

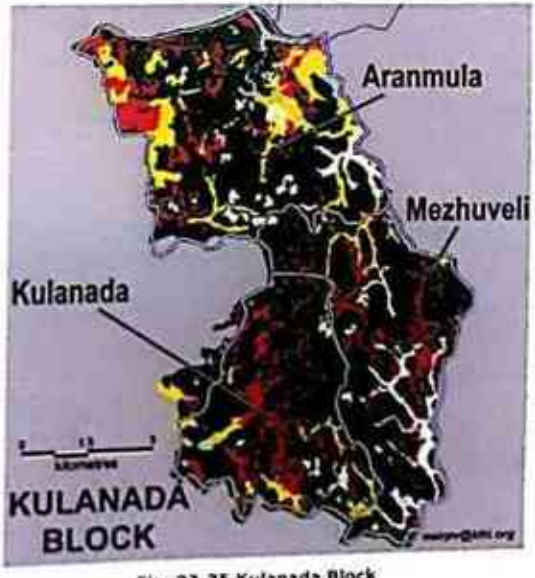


Fig. 03-35 Kulanada Block

Fig. 03-37 Pathanamthitta: Panchayats

ALAPPUZHA DISTRICT

Introduction

Alappuzha is a stretch of land between the Arabian Sea and delta of a network of rivers flowing into it. Alappuzha 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 and Kottayam and Pathanamthitta Districts in the east.

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 Chengannur Blocks in the eastern portion. Cherthala, Ambalappuzha, Kuttanad and Karthikappally lie in lowland region. There is no forest area in this district.

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

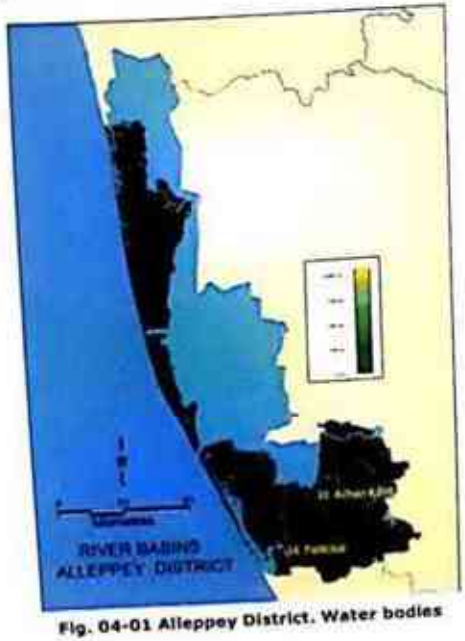


Fig. 04-01 Alleppey District. Water bodies

Fig. 04-02 Boat race

More than 50% of the land is occupied by dry land 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.

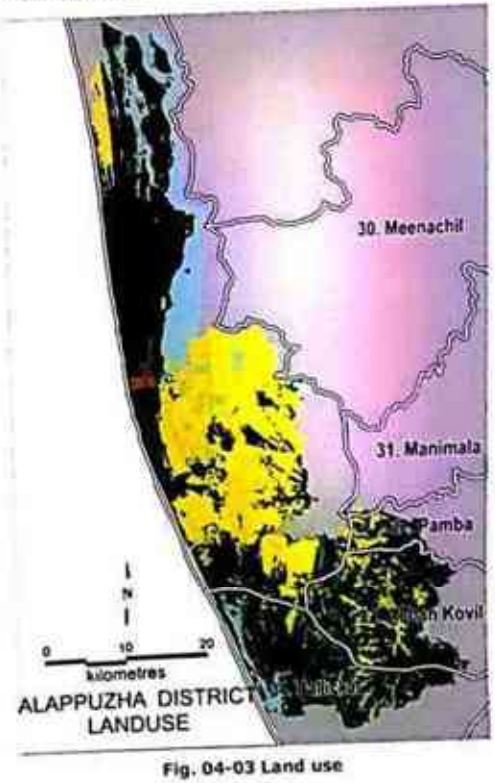


Fig. 04-03 Land use

Rivers of Kuttanad

Pampa: The Pampa is the third largest river in Kerala and is considered holy. It originates from Thamarakotta of Peermade Plateau. Kuttenkavu 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.

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

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.

Achenkovil: Several streams of Ramakkal Teri and Rishi Malai join to form this River. Pandalam, Mavelikkara and Haripad 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, Chalakudy and Vaikom are the towns on the banks of this river.The river empties into the Periyar and flows towards the northern portion of Kuttanad wetlands

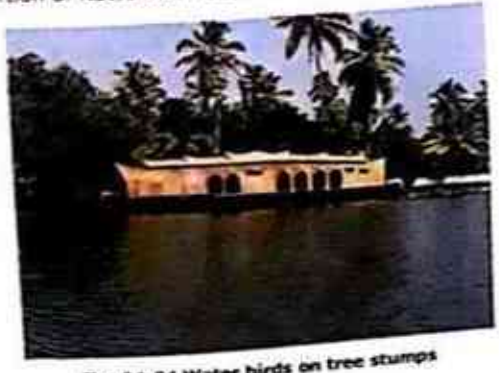


Fig. 04-04 Water birds on tree stumps

Periyar: 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 in Varappuzha.

Chalakudy: This 130 km long river and it originates from Anamala hills of Western Ghats.

Wetlands in birds and percherers

Alappuzha District consists of three parts. A northern narrow region of about 10 km width, middle region of about 20 km width and southern region of about 30 km. The southern part of Alappuzha District consist of Muhukulam, Bharanikkavu Mavelikkara, Chengannur and Haripad. The middle portion of Alappuzha District consist of three blocks running as three bands in north south direction. Ambalapuzha Block is the western most, facing the sea, Chambakulam Block in the middle and Veliyanad block on the east. The narrow northern region consist of blocks Pattanakkad, Thycattusseri, Kanjikuzhy and Aryad Blocks.

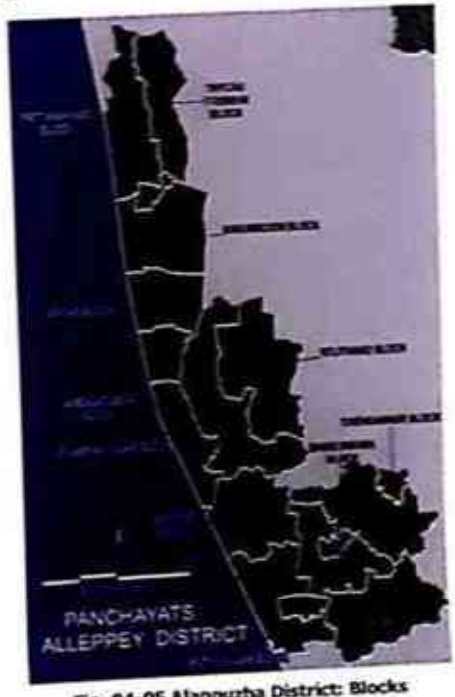


Fig. 04-05 Alappuzha District: Blocks

Thaikkattussery Block: This block is almost a long strip of land surrounded by arms of the Vembanad Kayal. The bays of the lake comes inside the land often and there are a large number of small ponds as swell.

Fig. 04-05 Thuravoor preparing for prawn cultivation

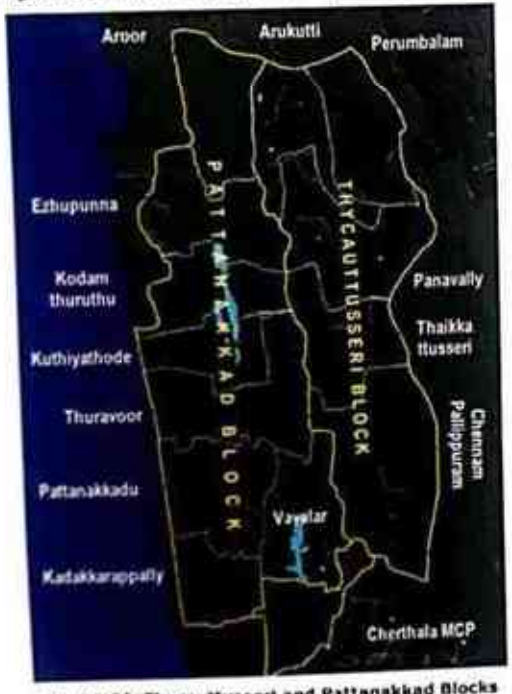


Fig. 04-06 Thycauttusseri and Pattanakkad Blocks

Pattanakkad Block: The extreme top region of the district is split into two blocks vertically, Pattanakkad and Thykkauttussery. There is narrow arm of the lake also along the boundary. There is another line of lakes on the western side. The topography is very peculiar with many arms of the lake coming into the land. This is possibly due to draining out an extensive swamp in the past. Panfish reports a large number of water bodies. NREDB (2008) maps few large water bodies.

Cherthala MCP: There is a pond of about 0.63 ha near town. Alappuzha-Cherthala canal enters the Kayal at Cherthala. Mosquito born disease, brugian filariasis was common in the past, is reported to be on the decline.

Fig. 04-07 Vayalar temple pond

Kanjikuzhy block: The narrow northern region consist of blocks Pattanakkad, Thykkattusseri, Kanjikuzhy and Aryad blocks. NH is the water divide. Small streams drain the western side to the sea. Other streams drain the eastern side to Vembabanad Lake. Alappuzha-Cherthala canal and Pathiramanal island, is in the block. Pathiramanal is a small island of much scenic beauty, is home to many rare varieties of migratory birds from different parts of the world.

Fig. 04-08 Thanneermukkam bund

Aryad block: Aryad block is one of the blocks situated at the bottom of the northern tip of Alleppey District. Alappuzha-Cherthala canal pass through this block. National Highway is the water divide. Small streams drain the western side to the

sea. Other streams drain the eastern side to Vembabanad lake.

Fig. 04-09 Kanjikuzhy

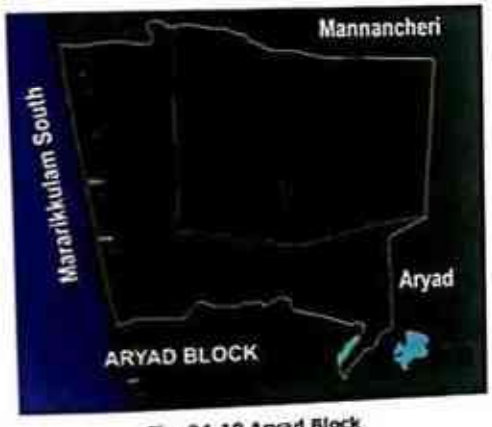


Fig. 04-10 Aryad Block

The middle portion of Alappuzha District consist of Alappuzha Municipality and three blocks running as three bands in north south direction. Ambalapuzha block is the western most, facing the sea, Chambakulam block in the middle and Veliyanad block on the east.

Alappuzha MCP: Vattakayal is a large lake coming under Alappuzha Municipality. Canals from this reach up to the sea. River Pampa flows on the eastern side, flood plain is shown as paddy areas. There are a large number of canals. Water from coastal areas drain to sea through small streams. There are few ponds of about one ha area. Nehru Trophy boat race location is in this area. The Alappuzha Drinking Water Project, conceived in 2007 to ensure pure water to the Alappuzha Municipality and eight surrounding panchayats of Purakkad, Alappuzha South, Alappuzha North, Punnapra South, Punnapra North, Aryad, Mararikulam South and Mannancherry as part of the Centre's Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) at an initial cost estimate of Rs.151.94 crore, is to have an intake well and pump house at Cyclemukku, Kadapra in Pathanamthitta, from where water is to be taken to a treatment plant at Karumadi in Alappuzha.

Fig. 04-11 Thottappally spillway

Only the Karumadi treatment plant has been completed. Niranam was originally earmarked as the site for the intake well and pumping station, people are demanding the land back. Pipeline laying work from Kadapra and Karumadi has been approved. The project envisages water from Kadapra in Pathanamthitta coming via a treatment plant at Karumadi near Ambalapuzha to Alappuzha municipality and the eight surrounding panchayats. The digging of roads to lay pipelines had faced opposition from the National Highways Authority of India, and this required urgent intervention by the government. A similar drinking water project at Cherthala, implemented with financial assistance from the Japan International Cooperation Agency should have been completed in 2003 but was completed only in 2012.

Ambalapuzha Block: The middle portion of Alappuzha District consist of three blocks running as three bands in north south direction. Ambalapuzha block is the western most, facing the sea, Chambakulam Block in the middle and Veliyanad Block on the east. Ambalapuzha Block is an elongate stretch of land along the coast. There do not seem to be lakes, but there is paddy cultivation. Pampa River form the estern boundary of this block. The river floods a vast area on the

back, where paddy cultivation is shown. There are large ponds near Ambalapuzha.

Chambakulam Block: The middle portion of Alappuzha District consist of three blocks running as three bands in north south direction. Ambalapuzha Block is the western most, facing the sea, Chambakulam Block is in the middle and Veliyanad Block is on the east. There are six panchayats. Typical Kuttanad, mostly under water, land bridge connect regions. In spite of being water logged, there are deeper Kayals, few lakes known as Vatta Kayal are particularly notable. One can say that Chambakulam Block is situated between the distributary arms of Pampa River.

Fig. 04-12 Sand mining in Pampa Ar

Fig. 04-13 Ambalapuzha, Champakulam and Veliyanad blocks

Veliyanad Block: The middle portion of Alappuzha District consist of three blocks running as three bands in north south direction. Ambalapuzha Bock is the western most, facing the sea, Chambakulam Block is in the middle and Veliyanad Block is on the east. Veliyanad Block is typical Kuttanad with most of the area covered with water, land is in the form of connecting links, reclaimed from the marsh. In spite of this there are few water bodies designated as ponds as well. The marsh is divided into kuttanad blocks, with names such as Arayiram, Irupathinalayiram, Ramankari, Kavalam, etc. The canals are possibly on raised bunds, in typical kole style. These are what is popularly called as the granary of Kerala State because of extensive rice cultivation. Water transport is the main mode of communication. Floods affect lives in many ways.

Manimala River and Pampa River pass through the block. The rivers now flow through raised bunds. In prehistoric times they must have entered at the edge of a vast swamp, there is no evidence of a river course. This is to be expected as most of the area was occupied by sea. The southern part of Alappuzha District consist of Muthukulam, Bharanikkavu Mavelikkara, Chengannur and Harippad.

Chengannur Block: The southern part of Alappuzha District consist of Muthukulam, Bharanikkavu Mavelikkara, Chengannur and Harippad. Chengannur Block is situated between two major rivers, Achankovil Ar and Pampa. There is large river link, possibly between the two. Streams drain to either river. Western parts are part of Kuttanad. In land use map there is marsh and much paddy field. Panfish and Topo show few ponds of about one ha. NREDB (2008) map shows marshy areas near River Pampa.

Fig. 04-14 Chengannur and Mavelikkara Blocks

Harippad Block: The southern part of Alappuzha District consist of Muthukulam, Bharanikkavu

Mavelikkara, Chengannur [illegible] a coastal block. But unlike [illegible] has no fresh water lakes. There is a long canal, linking Arattupuzha Kayal to Vembanad Kayal. This canal seems to be manmade. Pampa and Achankovil Rivers flow into this block. Northern parts, especially Karuvatta Panchayat is part of Upper Kuttanad.

Panfish reports a large number of water bodies. Topo sheet shows two ponds near Harippad of about one ha each. NREDB (2008) maps three water bodies larger than one ha. There is reduction in paddy fields, compared to topo sheet.

Fig. 04-15 Ducks. Thandapra-Achancoil-Pampa junction

Fig. 04-16 Lotus in ponds

The connecting link canal is called Thrikkunna Puzha. There is a net work of canal connecting to this. This makes one to think that the region, a vast marshy area was drained for cultivation.

Mavelikkara Block and Municipality: The southern part of Alappuzha District consist of Muthukulam, Bharanikkavu Mavelikkara, Chengannur and Harippad. This region lies on the left side of Achankovil River and is drained by streams joining it. Most of the area is below 10m MSL. There are few small factories (chemicals, glass, match box, etc) in the area. Panfish and NREDB (2008) reports few ponds of about one ha [illegible] paddy fields show much reduction [illegible] topo sheet.

Fig. 04-17 Haripad Block

Bharanikkavu Block: The southern part of Alappuzha District consist of Muthukulam, Bharanikkavu Mavelikkara, Chengannur and Harippad. Puduchira is in Bharanikkavu block,at the boundary of Vallikkunnu and Thamaakkulam panchayats.

Fig. 04-18 Puduchira Lake

Panfish(2002) reports a large number of water bodies in this block. Topo sheet shows three large water bodies of 123.43 ha (Karingali Chal) , 36.71 ha (Vlankara Chira) 11.18 ha (Pudu Chira) and 5.52 ha (Vallikunnathu Chira). Puvathur Chira shown in topo sheet is 0.75 ha. The last four Chira are interesting in that they are situated on a stream, which down stream has two major Chira (Vettakayal) and Valumel Punja and join Kozhikottu Kayal. Vlayankara chira is in Thamarakkulam

Mavelikkara, Che[illegible] and Harippad. Harippad is a coastal block. [illegible] similar coastal blocks, it has no fresh water lakes. There is a long canal, linking Arattupuzha Kayal to Vembanad Kayal. This canal seems to be manmade. Pampa and Achankovil Rivers flow into this block. Northern parts, especially Karuvatta Panchayat is part of Upper Kuttanad.

Panfish reports a large number of water bodies. Topo sheet shows two ponds near Harippad of about one ha each. NREDB (2008) maps three water bodies larger than one ha. There is reduction in paddy fields, compared to topo sheet.

Fig. 04-15 Ducks. Thandapra-Achancoil-Pampa junction

Fig. 04-16 Lotus in ponds

The connecting link canal is called Thrikkunna Puzha. There is a net work of canal connecting to this. This makes one to think that the region, a vast marshy area was drained for cultivation.

Mavelikkara Block and Municipality: The southern part of Alappuzha District consist of Muthukulam, Bharanikkavu Mavelikkara, Chengannur and Harippad. This region lies on the left side of Achankovil River and is drained by streams joining it. Most of the area is below 10m MSL. There are few small factories (chemicals, glass, match box, etc) in the area. Panfish and NREDB (2008) reports few ponds of about one ha area each. Paddy fields show much reduction compared to topo sheet.

Fig. 04-17 Haripad Block

Bharanikkavu Block: The southern part of Alappuzha District consist of Muthukulam, Bharanikkavu Mavelikkara, Chengannur and Harippad. Puduchira is in Bharanikkavu block,at the boundary of Vallikkunnu and Thamaakkulam panchayats.

Fig. 04-18 Puduchira Lake

Panfish(2002) reports a large number of water bodies in this block. Topo sheet shows three large water bodies of 123.43 ha (Karingali Chal) , 36.71 ha (Viankara Chira) 11.18 ha (Pudu Chira) and 5.52 ha (Vallikunnathu Chira). Puvathur Chira shown in topo sheet is 0.75 ha. The last four Chira are interesting in that they are situated on a stream, which down stream has two major Chira (Vattakayal) and Valumel Punja and join Kozhikottu Kayal. Vlayankara chira is in Thamarakkulam

Panchayat, Vallikuni
Panchayat.

Fig. 04-20 Vallikkunnam chira. Filled part

Fig. 04-19 Vallikkunnam Chira. Filled area

In fact this system drains about half of the block. The other block is drained by streams that flow northwards and join Achankovil River. Karingal Chal mentioned above is part of this system. NREDB (2008) maps more or less in the same way.

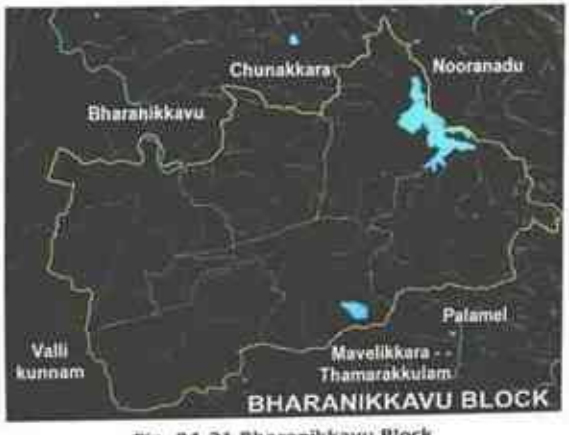


Fig. 04-21 Bharanikkavu Block

Muthukulam Block and Kayamkulam MCP:

The southern part of Alappuzha District consists of Muthukulam, Bharanikkavu, Mavelikkara, Chennamam and Harippad. One of the notable features of the block as per toposheet is extensive paddy fields. This is true of the NREDB (2008) mapping also.

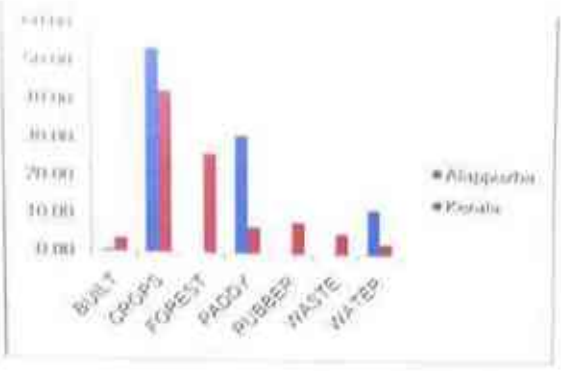
Fig. 04-22 Temple pond Pathiyoor Alleppey

Fig. 04-23 Chennithala Chala temple pond.

Kayamkulam-Arattupuzha Kayal run the entire length of this block. There is a very narrow stretch of land between the sea and the lakes. On the southern end the land is connection itself is doubtful. The land is between 0 and 3 m from sea level. Muthukulam Block consists of seven grama panchayats. Kayamkulam Thermal plant. The estuary continuation of Kayamkulam Kayal. Southern distributary of Achankovil River, Krishnapuram River flow into the Arattupuzha-Kayamkulam Kayal. It has connection southwards to Kayamkulam Kayal in the south.

Alathupuzha Panchayat is between the Lake and sea. The panchayat had recently become the centre of media attraction following a proposal by a private group to mine mineral sand from the area and the opposition raised against it by ecological groups.

Fig. 04-24 Muthukulam Block and Kayamkulam Municipality



Other aspects

Since the whole area is water logged, sub basins on river level is hardly possible. The status of wetlands were described on the basis of block panchayat boundaries.

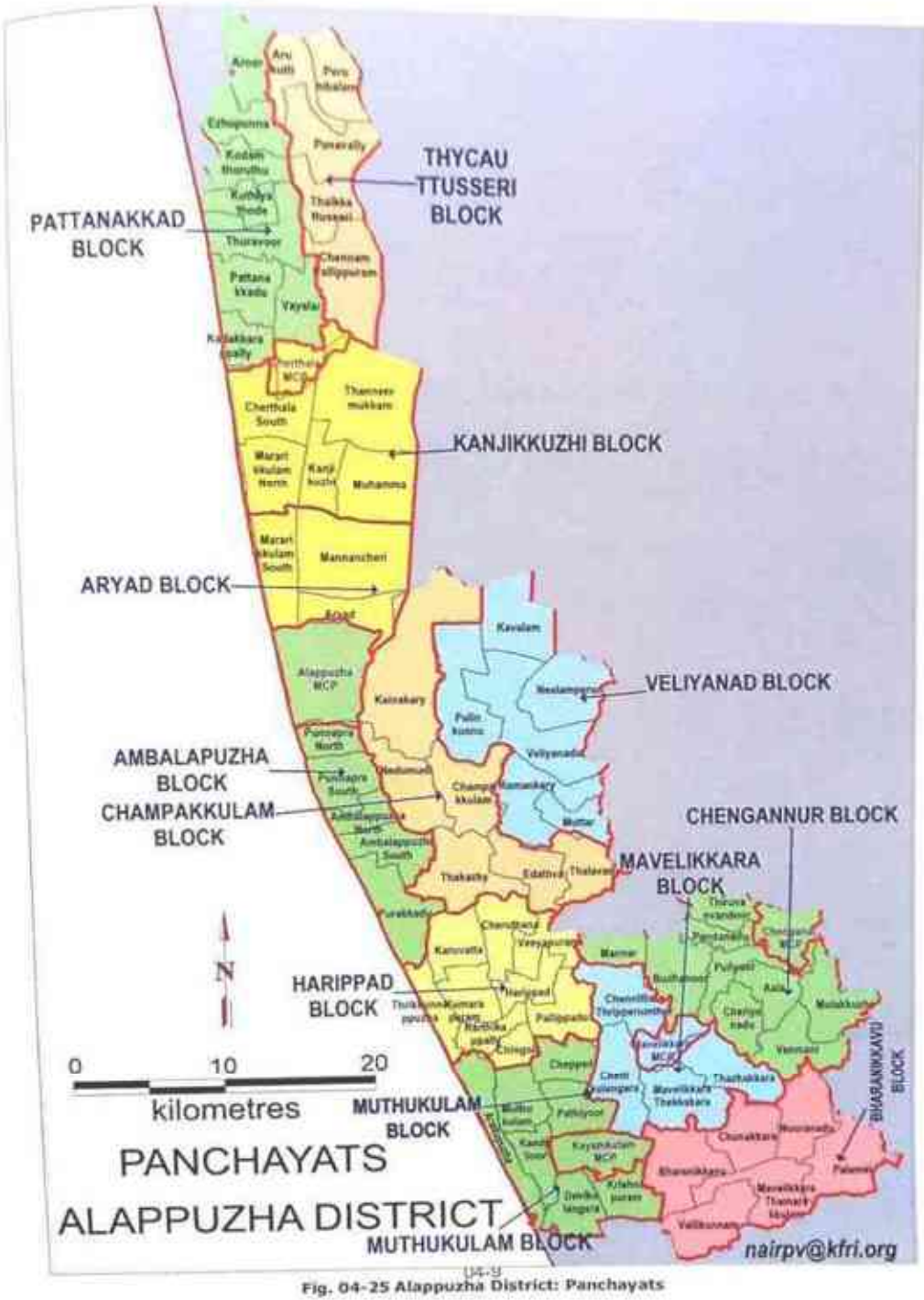


Fig. 04-25 Alappuzha District: Panchayats

KOTTAYAM DISTRICT

Introduction

Kottayam District has a total area of 2,208 km^2. 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 can be divided into highland, midland and lowland, the bulk being constituted by the midland region. Meenachil and Kanjirappally Taluks have highland and midland areas while Kottayam, Changanassery and Vaikkom Taluks have midland and lowland areas.

Fig. 05-01 Kottayam District. Topography and basins

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 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. October to December forms the north east monsoon. Rain cease early in January. The district normally gets an annual average rainfall of 3130 mm. The important rivers of the district are the Meenachil, Muvattupuzha and Manimala. There are no major reservoirs in these 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.

About 35% of the area is under mixed crops. Rubber occupies 31.5%, wetlands, 14.58% and built-up area 10.39%. Area occupied by rubber is much higher than state average. Consequently crop area is less than state average.

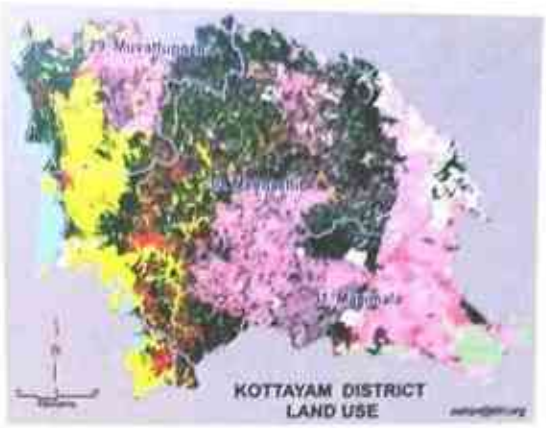


Fig. 05-01a Kottayam District. Topography and basins

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.

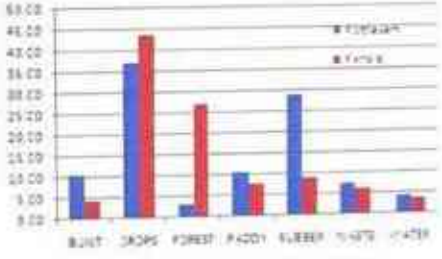


Fig. 05-02 Comparison of land use

Manimala River Basin

The river passes through the districts of Kottayam, Pathanamthitta and finally joins the Pampa River at Muttar in Alappuzha District. The main tributaries of this river are Kokayar, Valiya thodu, Makkani thodu, Arikka thodu, etc. 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 1,272 km^2.

Manimala basin is situated north of Pampa basin. This is another river that originates in the midland area. Tributaries flow in a north-south direction, in fishbone pattern and join the main river. Manimala River flows through Kanjirapally

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

Fig. 05-04 **View of Manimala River**

More than 25% of the district 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.

Fig. 05-03 Manimala River: Sub basins

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 (2002) data there are large number of ponds in the district. KSLUB (2000) divides the Manimala basin into 55 micro watersheds from 11M1 to 11M55. We have grouped these into 11 sub basins. Individual sub basins are not described.

Meenachil River Basin

Meenachil River is another river that originates from the edge of the Idukki Plateau. The 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.

The Meenachil River is formed by several streams originating from the Western Ghats. The general elevation ranges from 77m to 1,156m in the highlands and less than 2m in the lowlands and 8 to 68m in the midlands. The river has 38 tributaries including major and minor ones. The Meenachil River has four main tributaries, namely Kadapuzha, Minadamar, Punjar, Trikovil, etc. Average annual rainfall of the basin is 3000 mm. 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.

Fig. 05-05 Meenachil River: Sub basins

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.

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. KSLUB (2000) divides the Meenchil basin into 39 micro watersheds. We have grouped these into seven sub basins.

Sub basin A (Pala) : This sub basin consists of the tributaries at the origin of the river on the right side. The northern and eastern sides are hilly where the altitude reaches up to 1,000 m. The lower portion at Pala is at about 40m. The streams are Payyappalli Thodu, Parayil Thodu, Kaiattur Kadavu Ar, Kadapuzha, Kollappalli Thodu, etc. KSLUB (2000) basins are 12M21 to 12M25. Panchayats coming in this group are Pala MCP, Ramapuram, Kadanad, Melukavu, Melanganam, Moonnilavu, Teekoy, Thalappalam, Bharanganam, Erattupetta, etc. Higher areas have rubber cultivation and lower areas have mixed crops.

Sub basin 2 (Erattupetta) : This sub basin is on the left side of the river, opposite group 1. There are hills on the eastern side which reach up to 1000m. Several streams join the Meennachil River. They are Meenachil River proper, Chittar, Ponnozhukum Thodu and Mannani Thodu. Panchayats are Erattupetta, Meenachil, Thidanadu, Poonjar and Elikulam. KSLUB (2000) basins are 12M27 to 12M33. Higher area have rubber cultivation and other areas mixed crops.

Sub basin 3 (Ettumanoor) : Several streams flowing to the main river downstream on the right side are included in this. KSLUB (2000) basins are 12M14 to 12M20. panchayats in the group are Ettumanoor, Kidangoor, Kadaplamattam, Mangattupally, Karoor, etc. Kottachira Thodu is the main stream.

Sub basin 4 (Akalakunnam) : Several streams flowing to the main river downstream on the left side are included in this. KSLUB (2000) basins are 12M34 to 12M37. Panchayats in the area are Ayarkunnam, Akalakunnam, Kozhuvanal, Mutholi, pallikkathode, etc. Pannagan Thodu is the main stream. Altitude is from 40 to 200m.

Sub basin 5 (Adirampuzha): is a small basin near the confluence of the river with wet lands. The railway line pass through this. Altitude is about 20-40m. parts of Athirampuzha, Kumaranalloor and Arpookara come in this basin. Land use is mixed crops and built up areas. KSLUB (2000) basins are 12M1 to 12M14.

Sub basin 6 (Kottayam): This sub basin is on the left side of the river as it approaches the wetlands. Kottayam MCP is at the downstream edge of this basin. Vellur Thodu and its tributaries drain the entire area. Altitude is 20 to 140m. Panchayts in the group include Kottayam MCP, Vijayapuram, Kooroppada, etc. Land use is mixed crops and built up areas, the higher areas on the east are almost fully under rubber cultivation. KSLUB (2000) basins are 12M 38.

Sub basin 7 (Pam[illegible]) [illegible] stream. Valiya Thodu [illegible] to the [illegible]. KSLUB (2000) basins are [illegible] with several sub divisions. Panchayats are Pampady, Puthuppally, Meenadom, Vakathanam, Madappally, etc. Altitude is up to about [illegible]m. Some of the portion on the north and east have rubber cultivation, lower areas have mixed crops and built up areas. There are some paddy fields also.

Muvattupuzha basin

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 and Muvattupuzha. The shape and direction of tributaries are different from Kallada River or Achankovil River. The hills run in an east west direction in the catchment area and many of the tributaries also follow same direction. KSLUB (2000) divide the basin into 10 [illegible] watersheds, 13M1 to 13M10[illegible]. We divide the area into [illegible] sub basins. The river basin is situated to west of the Idukki plateau, the main tributaries originating from the western edge of the plateau.

Sub basin 1 (Koorampara Thodu): [illegible] 13M 38) on the north eastern part of the basin, a major tributary. An independent stream from Malayur area also join the Muvattupuzhayar slightly down stream. The elevation range is from about 50m to 20m. Few of the first order streams at the eastern edge originate at about 600m. The area is under forest, rubber and dry land crops. There are few small scale water impoundments on the stream. The area comes under KSLUB (2000) water sheds 13M38a to 13Mz to 13Mag. Panchayats: Nellikuzhy, Varapetty, Kottappady, Keerampara, Kothamangalam MCP, Kavalangad and Varappuram.

Sub basin 2 (Muvattupuzha origin): One can say that the Muvattupuzha river originates in the basin and the tributaries at the origin are called Vadar Puzha, Kaliyar Puzha, Kannadiyar, etc. Thodupuzhayar is another large tributary which joins Muvattupuzha river in this group. Altitude range from 20 to 200 to 1000m. The basin extends from Muvattupuzha to the extreme eastern hills. KSLUB (2000) includes the microwater sheds under sub divisions of 13M 38 which is a gross error. Panchayats: Muvattupuzha MCP, Ayavana, Pallarimangalam, Paithara Kad, Kallorkad, Paingottoor, Kadikkulam, Kanmannoor and Alampallanoor.

Fig. 05-06 Moovattupuzha: Sub basins

Sub basin 3 (Thodupuzha) : This group is made of the Thodupuzha river and tributaries. Altitude would range from 20 m at Muvattupuzha to 100 m at Thodupuzha and Moolamattom to 1000m at the level of first order streams. Inter basin transfer of water from Idukki project at Moolamattom has altered the water level and hydrology of the whole region. A dam was recently constructed downstream of Moolamattom at Malankara. This has resulted in a reservoir of about 4.0 km². The region has some forest at the eastern edge, but the majority of area is under rubber plantations. Panchayats, Marady, Arakkuzha, Manakkad, Thodupuzha MCP, Manjallur, Kumaramangalam, Edavetti, Alakode, Muttam, Velliyamattom, Kudayathoor and Arakulam. A large number of microwatersheds of KSLUB (2000) from 13M 139 to 13M 155 fall in this.

Sub basin 4 (Valiya Thodu-Karamattom Thodu-Kutthattukulam Thodu) : This is a stream running parallel to the Thodupuzhayar on the southern side and joining Muvattupuzha River. Altitude range from about 20m to 150m. Landuse is mixed dry land crops, built up areas and rubber. Panchayats are Pampakuda, Thirumarady, Koothattukulam and Veliyannoor.

Fig. 05-08 Block and Grama Panchayats

Vaikom Block: In general the whole block is low land, barely a few meters from sea level. There are six panchayats and Vaikom Municipality. Panchayats of Vaikom Block is elongated in east-west direction and they all have Vembanad Lake on the western side. There is a road in the middle. The area is traversed by canals and rivers. Chempu Panchayat has a network of canals and water bodies. These are the distributaries of Muvattupuzha River.

Fig. 05-07 Vaikom Block

Maravanthuruthu has few canals. Udayanapuram also has paddy pockets in the middle and south East. Vaikom MCP has much built up area. Thalayazham is water logged on the Eastern side also, there are paddy areas. Distributaries of Meenachil River form a net work that extends up to this panchayat. TV Puram has lake on both sides, as one arm of the lake extends north wards.

Kaduthuruthy Block: Kaduthuruthy is an area, east of Vembanad lake, but little inland. Central distributaries of Muvattupuzha and Meenachil River. There are seven panchayats in this block. Southern portions are water logged areas. Northern regions have much rubber. Muvattupuzha River flows through this block. Mulakkulam Panchayat has rubber and paddy cultivation. Paddies drain to Muvattupuzha River. Muvattupuzha River divides the Velloor Panchayat into two. There is dry land cultivation, rubber and paddy cultivation in this Panchayat. There are two ponds near the southern edge. Thalayolaparambu has low areas under paddy, rubber cultivation, built up areas and dry land crops. Kaduthuruthy has low areas under paddy, rubber cultivation, built up areas and dry land crops. There are canal as in Manjoor. Kallara Panchayat is mostly water logged areas and there are canals also.

Ettumanoor Block:

Fig. 05-09 Ettumanoor and Pallam Blocks

There are six panchayats in this block. Western Panchayats are water logged areas. There are few ponds associated with streams in the southern part in Ettumanoor Panchayat. There is a pond at Ettumanoor also. Topo shows a small pond in Athirampuzha also. There are canals in

Kumaranalloor. Arpookkara, Aymanam and Neendoor are water logged areas.

Uzhavoor Block: This block is a relatively dry area with almost no ponds, tanks or lakes. Panfish (2002) reports few ponds 0.25 to 1.0 ha. Topo sheet shows a large pond of 6.74 ha near Kidangur beside Meenachil River. This water body is visible in satellite images, but seems to have been converted to paddy fields, leaving only a small portion in the middle. A large water body of 9.32 ha shown in NREDB (2008) mapping is possibly a classification error. This block has eight panchayats. Meenachil River flows through Kidangoor Panchayat. Most of the southern regions of the block drain to this river. The northern parts drain to Valiya Thodu which eventually join one of the distributaries of Muvattupuzha River. Payappara Thodu, which is a tributary of Meenachil River, flows through Ramapuram Panchayat. Kottachira Thodu, which is a tributary of Meenachil River, flows through Kidangoor, Kanakari and Kuravilangadu Panchayats. Areas near this tributary get flooded during rainy season. Most of the areas are under mixed crop cultivation. There is Paddy cultivation in some areas. Topo sheet does not show any ponds or lakes.

Lalam Block: Meenachil River is in the center, most of the area is drained by it. This block has six panchayats and Pala MCP. Meenachil River flows through Pala MCP and Mutholi Panchayat and it forms the Southern boundary of Bharananganam Panchayat. Payappara Thodu which is a tributary of Meenachil River flows through Pala MCP and Karoor Panchayat. Mannani Thodu, which is a tributary of Meenachil River, makes boundaries of Kozhuvanal and Meenachil panchayats. Most of the areas in Kadanadu and Bharananganam Panchayats are under rubber. Some portions of other panchayats are also under rubber. There is mixed crop cultivation. Panfish (2002) reports few ponds, from 0.5 ha to 3.09 ha. Topo sheet does not show any ponds. NREDB (2008) also do not show any ponds. In general the area is quite dry, considering the altitude also.

Erattupetta Block: Meenachil River and its tributaries drain the block. Topo sheet shows one pond of about 0.8 ha. This surprisingly is at the top of a hill top, at Kurissumala Ashramam. Satellite image also shows a water body here.

Fig. 05-10 Erattupetta Block

Fig. 05-11 Uzhavoor and Lalam Blocks

Pampady Block: This is a relatively dry block. A tributary of Meenachil River, the Pannagan Thodu drains the area. This block has six panchayats. Most of the areas are under rubber. Topo does not show ponds. Almost whole block is covered with rubber cultivation.

Fig. 05-12 Pampadi Block

Pallam Block: This block is mostly drained by tributaries of Meenachil River which forms the northern boundary for this block. Southern regions are drained by an independent stream which eventually joins one of the distributaries of Meenachil River. There are nine panchayats and Kottayam MCP. Western portion is wetlands. Kurichi Thiruvarppu and Kumarakam are water logged areas.Vembanad Lake lies at the western portion of Kumarakam Panchayat.

Fig. 05-13 Kumarakom Sanctuary

Fig. 05-14 Backwaters of Kumarakom

There is a small pond in Panachikkad Panchayat (Mn Chira). There are two ponds, one is near Arumanna and another one is near Kongadur in Ayarkunnam Panchayat. Four small ponds were seen in Puthuchira Thodu at Ayarkunnam Panchayat. There is built up area dry land crops and paddy fields. Topo sheet shows three ponds, the largest one, Mn Chira is 4.62 ha in area, and situated to the east of Chingavanam (east of railway track). There are few ponds near Nirikkad, on left side of Meenachil River. These are probably check dams on streams. One of the tributaries of Meenachil, Minadam Ar is notable, there are extensive paddy fields in its basin.

Madappally Block: There are seven panchayats and Changanassery MCP. Eastern portions of the block have built up area and dry land crops. The two panchayats in the western portion consist of Kuttanad water bodies. Panfish(2002) reports several ponds of small and medium size. Topo sheet shows three ponds of 2.26, 2.5 and 4.62 ha each. The largest, Ennakka Chira is located east of Kurichi near the road. Another pond is near Vakathanam. Paippad and Vazhappally are typical Kuttanad areas. There is a pond in Thrikodithanam Panchayat (near the road). Changanassery MCP has a small pond near Perunnayil and another at city centre and a large pond at Kizhakkumbhagom. Fourth one is at south end.

Kanjirappally Block: This block has six panchayats. Manimala River flows through the Western boundary of Mundakkayam, Erumeli and Manimala Panchayats . Most of the areas in this block is under rubber. Some part of Erumeli Panchayat is forested. This panchayat is situated between Rivers Pampa and Manimala. Some part of this panchayat is under mixed crop cultivation. Topo does not show any pond or lake in this panchayat. Manimala River flows through the western boundary of Manimala Panchayat. Eastern portion is forested. There is a teak plantation on the eastern boundary.

Fig. 05-15 Kanjirappalli Block

Most of the area is under mixed crop cultivation. Topo does not show any ponds or lakes in this panchayats. Mundakkayam Panchayat is situated between Rivers Pampa and Manimala. Most of the area is under rubber. There is a teak plantation on the northern boundary. Eastern portion is forested. There is mixed crop cultivation. Topo does not show ponds or lakes. Manimala River and its tributaries make southern and western boundaries of Kanjirappally Panchayat.

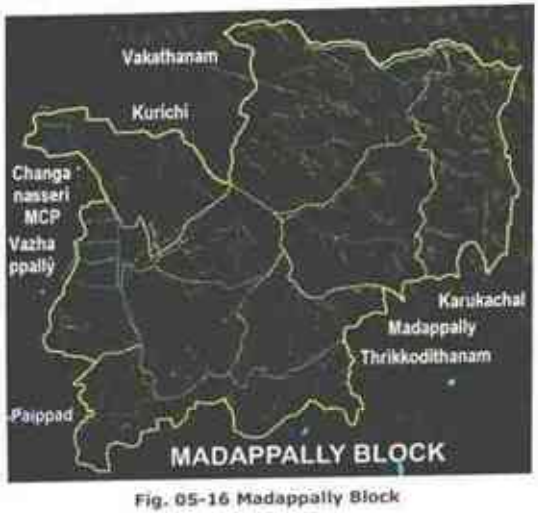


Fig. 05-16 Madappally Block

A tributary, Parathodu flows through the panchayat. Most of the area is under rubber. There is mixed crop cultivation. Topo shows two small ponds in the Paingana Thodu in Parathode Panchayat which is a tributary of Manimala River. Most of the areas in Parathode and Koottickal Panchayats are under rubber.

Kottayam MCP: Regions within Kottayam Municipality has been described with Pallam Block.

Fig. 05-17 Vazhoor Block

Vazhoor Block: There are five panchayats. Manimala River forms the southern boundary of this block. Topo does not show ponds. Nedunkunnam and Vazhoor have much rubber. Other panchayats have rubber to a lesser extent.

Drinking water schemes: Work at the Kariyar Spillway, a drinking water project using water from Vembanad Lake has been initiated. Rs. 8-crore drinking water distribution system, envisages a massive water purification complex and then pumping the purified water to the existing system. This is expected to find a lasting solution to the drinking water problems of the western areas of Changanassery, Kumarakom and Vaikom. A sum of Rs. 20 lakhs has been earmarked for the initial stage.

The Kariyar Spillway project is aimed to protect nearly 45,000 hectares of paddy field from brackish water intrusion during dry season. Vaikom, Kaduthuruthy, Ettumanur and Pallom areas will benefit from the project. A sum of Rs. 15 lakhs has been set apart for the project. The panchayats Kumarakom, Aymanom and Thiruvarpu have serious drinking water problems. Panchayats in

Kottayam Kanjirappally and Changanassery [illegible] which are the worst hit by drinking water [illegible] are supplied with drinking water from [illegible]. There are reports of sand mining affecting drinking water sources.

The situation at Kottayam Medical College continues to remain grim as the source for water distribution system catering to the hospital has dried up owing to indiscriminate sand mining. The water in the Meenachil River is below the [illegible] level. There are ongoing repairs of drinking water supply pipe lines in panchayats, Puthuppally, Mutholi, Kozhuvanal and Akalakunnam Kooroppada Panchayats. Drinking water scheme in Meenadom Panchayat would be strengthened by linking it to the Kottayam Augmentation Scheme. A new drinking water scheme at a cost Rs.3.75 crore is on the anvil in Mannarcadu Panchayat, the press note said. A proposed drinking water supply scheme will benefit the panchayats within the limits of the Kottayam municipality, including Kumaranalloor and Nattakom that were recently merged with the municipality.

Inter Basin Projects

Meenachil River Valley Project (MRVP): A proposal to divert surplus water from Malankara dam in Moovattupuzha basin to Meenachil basin was studied earlier, but not found economical due to the 9 km of tunnelling. Hence a proposal for a storage reservoir to meet the water requirement in Meenachil basin was studied and report prepared in 1983. This project is not feasible due to the public protest against acquisition of land for the reservoir. Government constituted an expert committee for studying and finding out different options for restructuring the MRVP. The committee has suggested a series of check dams in the upstream of Meenachil river along its tributaries. Meenachil basin has an irrigable area of 9489 Ha. In the present proposal, check dams with higher capacity is recommended to meet the Irrigation requirement in Meenachil basin.

The Kerala State Electricity Board has constructed two tunnels near Wagamon to divert the water from the Meenachil River to the Idukki Dam. One is from the Vazhikkadavu check dam to Karinthiri and the other from Koottiyar to Kappakkanam. The Kerala Government has recently (2006) accorded high priority to the [illegible] Meenachil River Valley [illegible] water [illegible] Meenachil River [illegible] tunnel from [illegible] the project will help in increasing the availability of water in the area.

There are a few serious issues affecting the environment of the Meenachil River basin. Some of them are: Water pollution due to disposal of urban and domestic waste into the river and through the banks of the river especially at urban centres like [illegible], Pala, Ettumanoor and Kottayam. Uncontrolled legal and illegal mining of river sand is leading to depletion of water table. Illegal construction of numerous check dams has affected the river flow. Diversion of upstream water to Idukki dam has affected areas downstream.

Vazhikkadavu Mini Dam: Illegal fishing is destroying marine life. Excavation of clay and sand from paddy fields for the brick and construction industries is also doing harm.

Fig. 05-18 Removing water weed

Fig. 05-19 Vegetatioin Kumarakom Bird Sanctuary

Fig. 05-20 Puthanthodu Kodimatha, *Eichornia*

Fig. 05-21 Paddy being transported by boat

Sand mining from almost all the rivers in Kerala goes on unabated despite the restrictions and controls imposed by the State Government. It has not only deepened the river beds to below the sea level but threatens the existence of several road bridges across these rivers, according to N.K. Sukumaran Nair, Vice-President of the Aluva-based Kera a River Protection Council. "It is the violation of the law passed by the Kerala Legislature unanimously on December 6, 2001," he told *Business Line*. He alleged that the controls envisaged in the law are not being enforced.

Fig. 05-23 Kottayam District: Panchayats

IDUKKI DISTRICT

Introduction

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.

Fig. 06-01 Topography

Idukki has many unique topographical and geographical characteristics. Idukki is the largest district of Kerala with an area of 5,105.22 km². 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.

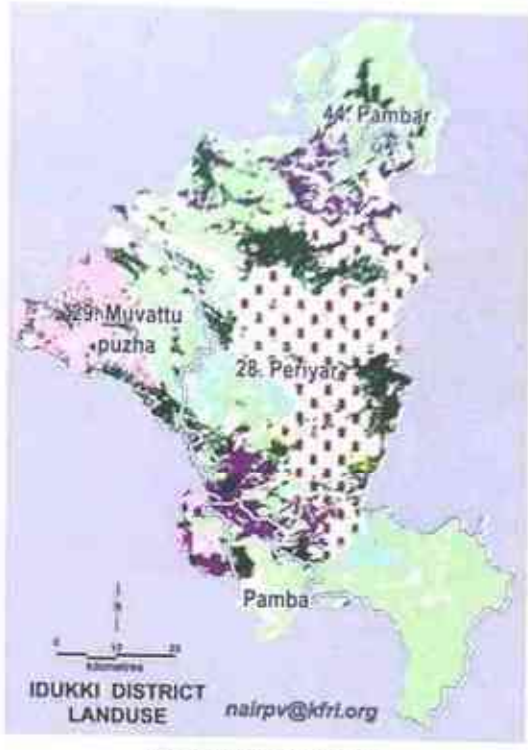


Fig. 06-02 Topography

Brown dots are cardamom plantation

There are 14 peaks in the district which exceed in height of 2,000 m above MSL. They are Anamala, Eravimala, Tathumala, Chenthavara, Kumarickal, Karimkulam, Devimala, Perumal, Ghudoor, Kabhula, Devikulam, Anchanad, Sabarimala and Karimala. Anamudi (Anamala) the highest peak south of Himalayas is in the 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 277 km 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.

Fig. 06-03 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. As per Panfish(1992) data, there are a large number of ponds in Idukki District.

Fig. 06-04 Ponds in Idukki District. Panfish(1992)

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 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.

Periyar River Basin

Length of Periyar River is 244 km and the basin area covers around 5398 km2. Average annual rainfall of the basin is 3,200 mm. Periyar is one of the largest rivers in Kerala, some of the tributaries are larger than medium sized rivers. The basin consists of more than 183 watersheds. To describe all these basins would take much space. We have divided the basin into 10 Sub basins to bring out the salient features. Periyar River emerges from Udamala near Periyar Wild Life Santuary at an elevation of 1,593 m. After flowing for about 48 km, the Periyar is joined by 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, Neriya-mangalam and Lower Periyar are the other hydro electric projects in Periyar River. Mullaperiyar, Bhuthathankettu, Mattupetty, Munnar, Idukki, Cheruthoni, Kulamavu, Irattayar, Lower Periyar, Idamalayar, Chenkulam, Anayirangal and Ponmudi are the important dams across this river.

Fig. 06-02 Topography

The important tributaries of Periyar are Muthirapuzha, Mullayar, Cheruthoni, Perinjankutty and Idamalayar. On its way to Arabian Sea, the river [illegible] with water of minor tributaries like Muthayar, Perunthuraiar, Chinnar, Cheruthony,

Kattappanayar and Idamalayar at different locations; upper region of the basin is covered with forest, agricultural land, waste land and water bodies.

Fig. 06-05 Idukki dam

Periyar basin covers 88 villages and is spread over 102 panchayats, 21 blocks and three districts. Periyar watershed is divided into 183 sub-watersheds and 448 micro watersheds (KSLUB, 2002).

Fig. 06-06 Periyar Basin. Sub basins. (1234=ABCD)

Sub basin A (Mullaperiyar) :Sub basin covers the Mullaperiyar dam and the catchment area of Mullayar and Periyar. Few streams also flow into the Mullaperiyar reservoir. Kumily is at the lower end of this group. Altitude range from about 1000m at reservoir level to about 1750m at the ridge. There are hill ridges on three sides. The whole region is protected forest area, comprising evergreen forests and grass lands. This is one of the largest continuous stretches of forest in Kerala. The region receives rains from both monsoons. The water from the reservoir irrigates dry plains in Tamil Nadu. The region falls under the Kumily Panchayat. KSLUB (2000) watersheds 14P 64 to 100 covers the area. Periyar is a huge river, the engineers had to face the fury of the flood waters at the time of constructing the Mullaperiyar dam.

Sub basin B (Between Idukki and Mullaperiyar Reservoirs):This sub basin occupies region between the Idukki reservoir and Mullaperiyar reservoirs. The stream bed is generally dry and the land use on either side is tea cultivation. Several streams drain from both sides to the main river. Flow of these is the main source of water for the Idukki reservoir. Vandiperiyar is a small town almost at the middle of this drainage group. Ayyappan Kovil is a small village near the lower end. There is a main arch dam and a gravity dam at Idukki creating a reservoir of nearly 70 km^2.

Fig. 06-07 Sub basin A (1234=ABCD)

Altitude range from about 900m at reservoir level to about 1350m at the ridge. Land use is mainly tea and cardamom cultivation.

This stretch has received much attention in recent times in connection with the safety of the 100 year old Mullaperiyar dam. The flood waters, in case of a dam break would flow through the deep valleys up to the Idukki reservoir. The area is thinly populated except for the Vandiperiyar region.

Idukki reservoir gets filled fully only occasionally, there is additional capacity for water intake almost all the time. Periyar enters one of the secondary arms of the Idukki Reservoir, generation of a shock wave towards the main dam is not very likely.

Several panchayats such as Vandiperiayr, Peeurmedu, Ayyappan Kovil, Upputhara and Elappara fall in this drainage group. KSLUB (2000) water sheds 14P51 to 60 and 14P100 to 112 fall in this area.

Sub basin C (Idukki reservoir): This group includes the Idukki reservoir, and little area downstream on either side of the river. Idukki town is situated immediately below the main dam. Minor places such as Chelachuvadu, Karimpan and Kirithodu come inside this. Kattappana town is on the eastern arm of the reservoir. Kulamavu dam and village is on the western arm of the reservoir. Altitude range from 700m to 800m. There are plantations of cardamom in vast areas. The region is mostly forested, with rocky areas. Panchayats include Kanchiyar, Vazhathoppe, Kattappana, Kamakshi, Vathikudi, Idukki and Kanjikuzhi. KSLUB (2000) watersheds include 14P42 to 48 and 14P119 to 130.

Sub basin D (Chinnar Thodu):

This is a tributary of Periyar, Chinnar Thodu that joins the main river at Kirithodu. The river flows through a narrow valley. Locations such as Chempakappara, Perinjakutty, Tukkupalam, Nedumkandam, Irattayar, Vandanmedu, etc are inside. The river branches into two, Kallar and Irattayar.

There are feeder dams in the river. Altitude goes up to 1200m on the ridges. Landuse mainly is cardamom plantations with patches of rubber and paddy and mixed crops. Panchayats are Nedumkandam, Irattayar, Pampadumpara, Karunapuram, Kamakshi and Vandanmedu.

As per KSLUB (2000) 14P41 is the watershed.

Sub basin E (Muthirapuzha): Muthirapuzha with a large number of small dams constitute this group. There are reservoirs at Kallarkutty, Ponmudi, Mattupatti, etc. Major places are Rajakkad, Munnar, etc. Upper reaches of streams go as high as 1800 m. Landuse consist of plantations of cardamom and tea and some amount of mixed cultivation. Panchayats are Munnar, Chinnakanal, Pallivasal, Adimali, Vellathuval, Bson Valley, Rajakumar, Santhanpara, Konnathadi, Udumbanchola, Senapathi, etc. The group is equivalent to KSLUB (2000) watershed 14P40.

Sub basin F (Bhutanthakettu-Neriya mangalam): Areas downstream from Pazhayeri Thodu junction, on either side of the Periyar River. It is a narrow gorge. There is a small tributary, Devi Ar inside the group which flows parallel to the main river, separated by a ridge. Major places en route are Neriyamangalam, Maniyanpara, Chempankuzhi, Neendapara, Kari Manni, Tattakanni, etc. Altitude range from 40m to 200m. The region has steep rocky ledges, forest areas and mixed cultivation. panchayats are Pindimana, Keerampara, Adimali and Idukki Kanjikuzhi. KSLUB (2000) micro watersheds 14P31 to 39 and 14P131 to 137 fall in this area.

Sub basin G (Idamalayar-Pooyamkutty): This group consists fo the Idamalayar and Pooyamkutty river systems. It is bigger than many medium sized basins in Kerala. Most of the tributaries have names. There is a dam at Idamalayar. Proposal for several dams in Pooyakutty basin has now been shelved on the basis of adverse ecological grounds. The region is mostly forested with reed areas. Some of the hill tops are occupied by forest dwelling tribal, the Muduvas. Ridges are more than 1300m in altitude. Major places en route are Kollathirumedu, Pooyamkutty, Kuttampuzha, Penavur, Puttukudi, etc. Most of the area falls in Kuttampuzha and Mankulam Panchayats. KSLUB (2000) micro watershed 14P30 is equivalent to this drainage group. The tributaries can be described only at further subdivisions.

Sub basin H (Periyar):This is Periyar in the plains. Several streams flow into the main river from both sides. The river often branches and the branches unite afterwards. Pulliyampalli Thodu is one instance. The river stretch extends from Bhoothathankettu to the wetlands near Aluva. The stretch is navigable, and prone to salt water intrusion. Locations such as Kaladi, Malayattur are en route. Altitude range is from 20 to 40m. Landuse is mixed dry land crops and paddy fields. There are some amount of rubber cultivation in the upper areas. Being thickly populated areas, about two dozen panchayats belonging to Angamali, Koovappadi and Parakkadavu blocks fall in the

area. KSLUB (2000) watersheds 149 to 152 and 14P140 to 147 fall in this group.

Sub basin I (Angamali). This area, centered around Angamali is drained by a perennial stream that joins the wetlands. Landuse is mixed crops, built-up areas and paddy fields. Areas of Kumbalam, Nedumbassen, Angamali MCP, Parakkadavu, Karukutty, Mukkannoor come in this group. KSLUB (2000) watersheds 14P21 is equivalent to this drainage group.

Sub basin J (Varapuzha Cheranalloor): This region shown as flooded consist of bodies of water and land bridges. Several panchayats belonging to Paravur, Alangadi and Edappally blocks fall in this group. KSLUB (2000) watersheds 149 to 182 except 155,182,179 and 177 belong to this group.

Sub basin J and K (Coast): These are two coastal stretches of land situated between the sea and the fresh water lakes. KSLUB (2000) watersheds 155,182,179 and 177 cover the area. Panchayats Pallippuram, Kuzhippully, Edavanakkad, Nayarambalam, Njarakkal and Elamkunnapuzha cover the area.

Chinnar Basin

Chinnar is one of the east flowing rivers in Kerala. There are no dams in Kerala, but there is a dam after the river enters Tamil Nadu which irrigates large area. The catchment area is mostly forests, peculiar topography and climate. The western side of the hills have high rainfall and evergreen forest, where as the eastern side has dry forest and very little rain fall. The river, flowing through dry tract become a virtual lifeline, there are wooded forest along the river course. The grizzled giant squirrel, one of the most endangered squirrels live in these trees in the Chinnar Wildlife Sanctuary.

Kundala Dam, Mattupetty Dam, Munnar head works, Ponmudi Dam and 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. There are about 9 blocks and several MCPs. Being a high elevation area, there are only few ponds and tanks in Idukki district.

The Mulla Periyar Dam

A masonry dam was constructed across Mullaperiyar in 1895 creating a lake of about 27 km. With the technology available at that time, there were enormous difficulties in putting a dam across a steep fast flowing river with rocky bed. The reservoir could irrigate large dry tract in Tamil Nadu and several districts depend upon it for irrigation. The Mullaperiyar dam tamed the river in one sense, reducing flood occurrence down stream. It reduced water availability for the Idukki project constructed later. It is feared that much of the lime used in the Mullaperiyar dam has been leached away over the years and underwater photography has revealed damages in the part on under water. A dam break would possibly do minimum damage up to the Idukki region as the region is hilly and thinly populated. Probably the Idukki reservoir can contain the resulting flood waters, as the river enters it at an oblique angle in one of the arms, but a failure of Idukki dam can cause heavy damage to towns downstream. The situation has led to much dispute and litigation. It is a fact that the dam may not remain intact for the next 800 years till which time Kerala was forced to sign an agreement before formation of the Indian Union. A new dam little below the present dam is proposed, but whether to retain or dismantle the old arm is a challenging issue. A grass land has developed around the fringes of the lake, which has done good to the visibility and probably feeding of animals. Environmentalists argue the loss of this grassland in the newly stabilized ecosystem due to rise in water level to be inadmissible. In spite of all these, the Mullaperiyar catchment remain one of the largest continuous forest tract, probably in the whole of India and a rich source of rain water.

Idukki project

Idukki project make use of narrow region in the river to construct a dam and large drop near by to generate a huge quantity of electricity. The region around the reservoir is mostly degraded grass lands and has been declared as a wildlife sanctuary. There was much human infiltration into the forests during the prolonged construction of the dam and the forest nearby has become highly fragmented. The project has resulted in much inter basin transfer of water, increased water availability in Muvattupuzha and has probably raised water table downstream. Periyar got totally depleted and

there is much salt water intrusion from the sea. Transfer of water from Idamalayar project has mitigated this partially, but not adequately. The Pooyamkutty project , was not taken up, one of the reasons, depriving lively hood of reed cutters.

Wetland features in Blocks

Fig. 06-14 Blockss

Adimali Block: There are five panchayats. Ponmudi Lake falls in Konnathadi Panchayat. Kallarkutty Dam is in Vellathooval Panchayat. Anachal Dam is also in this panchayat. Bison Valley, Adimali has no ponds as per topo sheets.

Devikulam Block: There are six panchayats. There is much forest interspersed with forest under revenue control. Chinnakanal Panchayat has Anayirankal Dam. A small pond is shown above the dam. Munnar Panchayat has several reservoirs. Small dam below Mattuppetty, new water bodies near Devikulam estate. There is a small reservoir left of Lekshmi Tea estate.

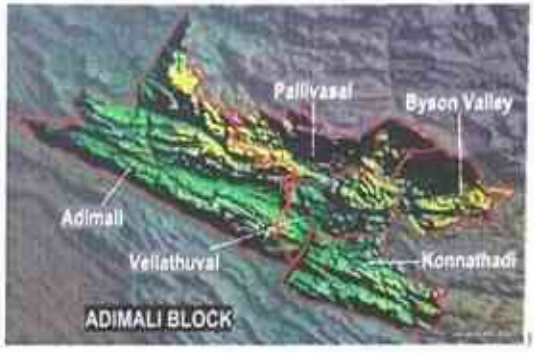


Fig. 06-15 Adimali Block

There is a small water body in Gokanathapuram in Kanthalloor Panchayat. No ponds as per topo sheets in Mankulam, Vattavada and Marayoor Panchayats.

Fig. 06-16 Devikulam Block

Nedumkandam Block: There are eight panchayats. There are no ponds in Santhanpara, Rajakumari, Senapathi, Udumpanchola, Nedunkandam, Karunapuram and Pampadumpara Panchayats. Ponmudi Lake falls in Rajakkad Panchayat.

Fig. 06-17 Nedungandam Block

Elamdesam Block:No ponds in Vannapuaram, Kodikkulam, Karimannoor, Alacode, Velliyamattom, Udumbannoor.

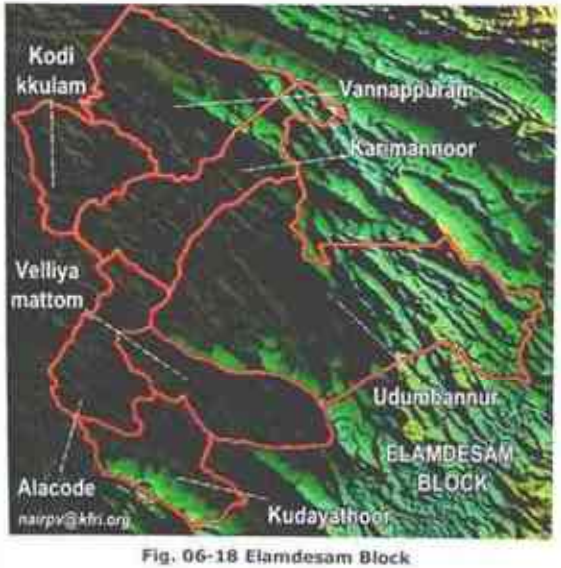


Fig. 06-18 Elamdesam Block

Idukki Block: No ponds in Kanjikkuzhy, Vathikkudi, Mayapuram, Arakulam Panchayats. Parts of Idukki reservoir come in Kamakshi and Vazhathope.

Fig. 06-19 Idukki Block

Kattappana Block: Erattayar, Kattappana, Kanchiyar Panchayats have parts of Idukki reservoir. No ponds in Upputhara, Ayyappankovil, Chandanmedu, Kupallam Panchayats. Thodupuzha Block: No ponds in Kumaramangalam, Thodupuzha, Edavetti, Karimkulam, Muttam, Purappuzha and Mannakkad.

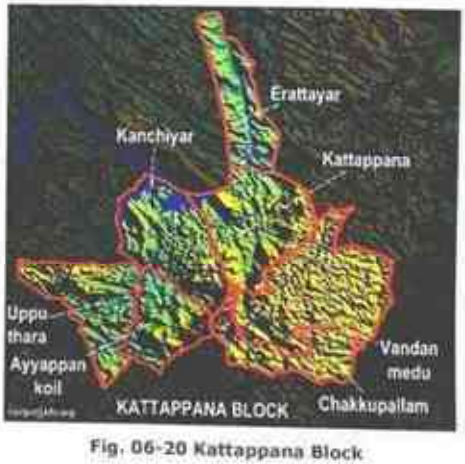


Fig. 06-20 Kattappana Block

Azhutha block: Azhutha Block is the southern most block in Idukki. It is a large block, more than half is forest. Kumily, Vandiperiyar, Peermedu Panchayats have forest. Kumuly Panchayat alone covers about 800 km^2. Mullaperiyar dam falls inside. There is a dry pond near Kumily. Periyar, after the dam flows through Kumily Panchayat. There are few ponds. No ponds in topo in Peruvanthanam, Munda-kkayam,Erumeli, Manimala panchayats , one pond in Elappara Panchayat at Uppukulam. One samall pond at the eastern edge in Kokkayar Panchayat. No pond in Koottikkal, Parathode and Kanjirappally Panchayats.

Fig. 06-21 Todupuzha Block

Fig. 06-22 Azhutha Block

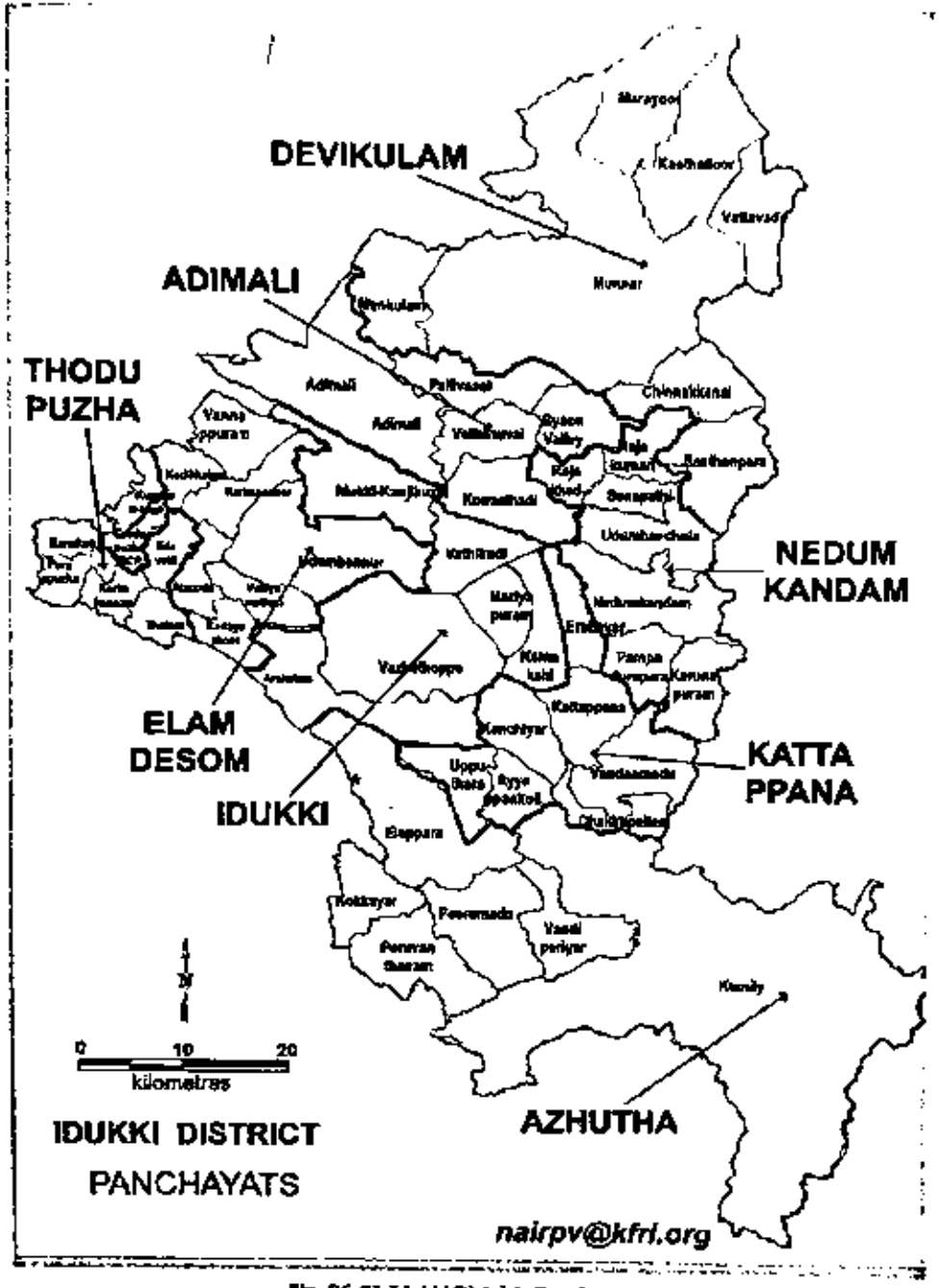


Fig. 06-01 Idukki District: Panchayats

Fig. 06-01 Idukki District: Panchayats

ERNAKULAM DISTRICT

Topography

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 300m. 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 in the district 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.

Fig. 07-01 Ernakulam District: Basins

The Parur Taluk which lies in the flat delta region of the Periyar River is cut by several canals, which have resulted in the formation of many islands. 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. Twenty percent of the total area is lowland region.

Hilly regions of Malayattoor, north and north eastern tip of Muvattupzha and Kothamangalm Taluks form the forest area of the district. Area under forest is 81.23 km². Area under water bodies is 127 km².

Fig. 07-01 Ernakulam District: Basins

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 these 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 Kothamangalam Rivers. Thodupuzha originates from Tangakkanam Hills; Kaliyar 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 3,100 mm. 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 micro and 202 first order 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 Thanneermukkam 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. Muvattupuzha River receives water diverted from the Periyar basin which has increased the water availability.It is not feasible to divide the area into sub basins as the rivers empty into the Vembanad Lake. Status of wetlands in blocks follows.

Paravur Block with Paravur MCP: Paravur Block and Paravur Municipality form one contiguous unit. Altitude is from sea level to 15 m. Periyar River form the northern boundary of this unit. Lake from Chattanad extend up to Periyar along the western edge. Vadakkekkara and Chittattukara Panchayats are criss-crossed by a net work of canals connected to the lake. There is a large pond of about 0.5ha near Paravur. NREDB (2008) show a pond of about 6 ha near Peringattoor. There are paddy fields in Southern region especially in Ezhikkara and Kottuvally Panchayats. Other areas have mostly dry land cultivation.

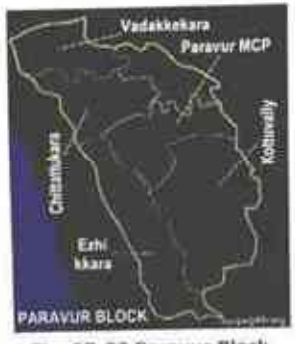


Fig. 07-02 Paravur Block

Alangad Block with Aluva MCP: Alangad Block is on the eastern side of Paravur Block. Aluva Municipality form a contiguous area with it. Periyar River is the northern boundary. Block is mostly dry land cultivation areas with large block of built-up areas. Compared to the topo sheet, there is much reduction in paddy fields. There are few large ponds near Turavur as per satellite images. Most of the block is situated among distributaries of Periyar River.

Fig. 07-03 Alangode Block

Angamaly Block with Angamaly MCP: Ayyampuzha Panchayat has most forest areas and areas under rubber. Manjapra Panchayat is almost fully rubber. Malayattoor, Neeleswa-ram has forest and rubber. Kalady Panchayat has dry land and paddy cultivation. There are irrigation canals. River is a boundary in Kanjoor and Sreemoolanagaram Panchayats. Topo does not show ponds in Angamali MCP, Thuravoor Panchayat and Karukutty Panchayat. Land use is dry land cultivation, paddy, rubber and built-up areas. Topo-sheet shows several large ponds. The pond near Kurisumudi is more than 20 ha in extend. A pond situated to the north of Kaladi is more than 10 ha. Most of the block is drained by streams leading to Periyar River. The block extends into the hilly regions and more than half of the block is reserve forests. Iringole Kavu and Kurusumudi attract a large number of pilgrims.

Fig. 07-04 Angamali Block

Koovappady Block with Perumbavoor MCP: Koovappady block along with Perumbavoor Municipality is on the left side of Periyar River. This block also extedns into the hill and a considerable area is forested. There are six panchayats and Perumbavoor MCP. Periyar River forms the Northern boundary of the block. There are perennial streams all over the area. Ponds are not seen as such in topo sheets.

Fig. 07-05 Alangode Block

Vazhakkulam Block: Vazhakkulam Panchayat is also on the left side of Periyar River. Northern areas are drained by streams leading to Periyar. Southern area is drained by Kadambrayar which join the lakes. There are six panchayats. There are built-up areas, dry land cultivation, paddy cultivation and rubber cultivation. There are perennial streams all over the area. Ponds are not seen as such in topo sheets. In Keezhmad Panchayat topo shows a pond at Thottumugham.

Fig. 07-06 Vazhakulam Block

Edappally Block with Kalamassery MCP and Kochi Corporation:

There are three panchayats in Edappally Block. Kalamassery MCP has perennial streams. There is a large pond of about 1.25 ha near Trikkakara. There is large pond west of Kakkanad. Kochi Corporation has many canals and lakes. Mattanchery, Wellington Island and Ernakulam town are totally built-up areas. There are three ponds around High Court in topo. Kadamakkudy Panchayat is almost completely water and paddy cultivation. Cheranalloor Panchayat has built-up areas and dryland cultivation.

Arms of Vembanad Lake extend into many areas. Depending upon the landuse, industrialization and land availability, disturbances vary.

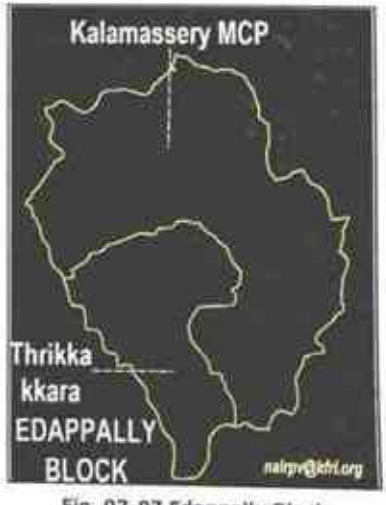


Fig. 07-07 Edappally Block

Vypin Block. Vypin Block is an elongated coastal strip consisting of seven panchayats. There is a road running in north-south direction to middle. There is built up areas along the road. Dry land cultivation is also seen around this. Paddy fields and water logged areas are on the eastern and western regions. Binck is a large island. Mulavukkad Panchayat is fragments of land surrounded by water with paddy or dry land cultivation. Pallipuram Panchayat has lake on the eastern and western sides. There is lake in Edavanakkad Panchayat also. In Nayarambalam and Njarakkal Panchayats canals are the main water bodies. Elamkunna puzha with Vypin is surrounded by water.

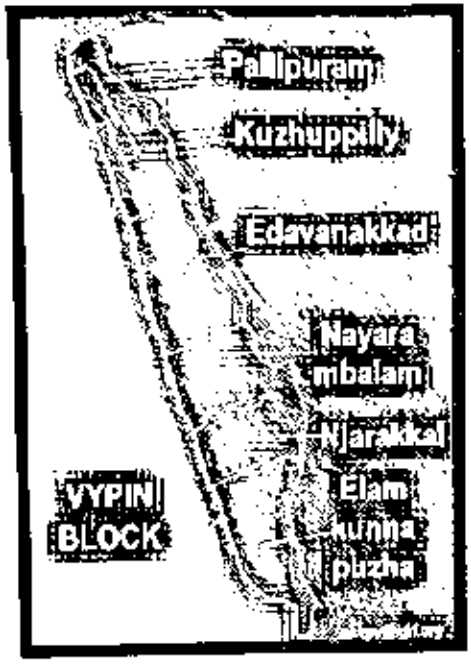


Fig. 07-08 Vipin Block

Palluruthy Block. Palluruthy Block consisting of three panchayats, has a large lake that opens into the Vembanad Kayal. Low lying area is criss-crossed by arms of lake and canals. Aroor Panchayat is almost surrounded by water on all sides except south. Kumbalangi Panchayat is almost an Island. Chellanam Panchayat has two parts. The Southern region is paddy area criss-crossed with canals. Northern part has built-up area and paddy cultivation. Roads run from all sides in north-south direction.

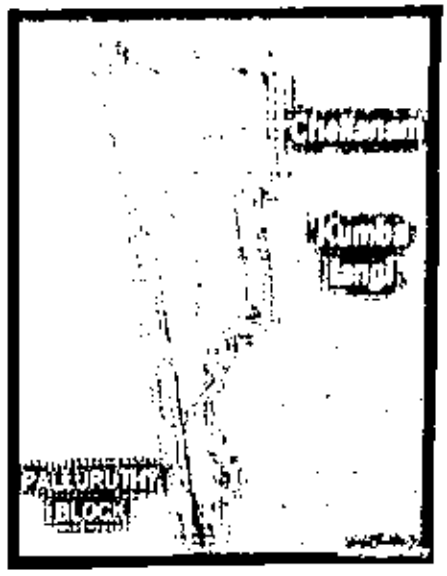


Fig. 07-09 Palluruthy Block

Vytila Block: Vytila Block consists of Kumbalam and Marad Panchayats only. There is a low lying area. Kumbalam Island is inside Kumbalam Panchayat. Most of the other regions are interspersed with arms of lake. There are drinking water problems and transport problems.

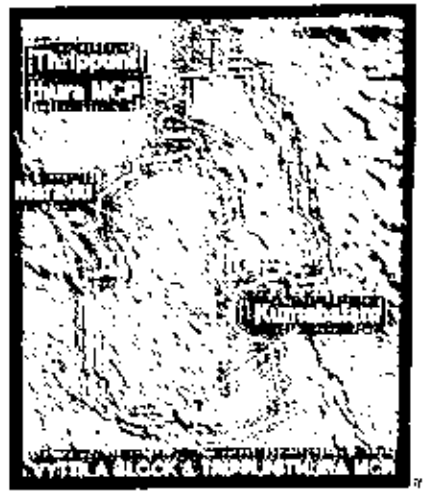


Fig. 07-10 Vytila and Thrippunithura Blocks

Mulamthuruthy Block : There are six panchayats and Thrippunithura MCP. Vembanad Lake lies on the western side of Udayamperoor Panchayat.

Vypin Block: Vypin block is an elongated coastal strip consisting of seven panchayats. There is a road running in north south direction in middle. There is built up areas along the road. Dry land cultivation is also seen around this. Paddy fields and water logged areas are on the eastern and western regions. Block is a large island. Mulavukkad Panchayat is fragments of land surrounded by water with paddy or dry land cultivation. Pallipuram Panchayat has lake on the eastern and western sides. There is lake in Edavanakkad Panchayat also. In Nayarambalam and Njarackal Panchayats canals are the main water bodies. Elamkunna puzha with Vypin is surrounded by water.

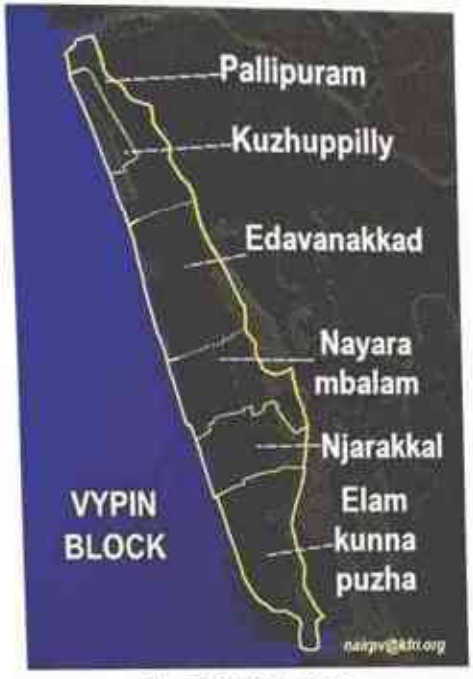


Fig. 07-08 Vipin Block

Palluruthy Block: Palluruthy Block consisting of three panchayats, has a large lake that opens into the Vembanad Kayal. Low lying area is criss-crossed by arms of lake and canals. Aroor Panchayat is almost surrounded by water on all sides except south. Kumbalangi Panchayat is almost an Island. Chellanam Panchayat has two parts. The Southern region is paddy area criss-crossed with canals. Northern part has built-up area and paddy cultivation. Roads run from all sides in north-south direction.

Fig. 07-09 Palluruthy Block

Vytila Block: Vytila Block consists of Kumbalam and Marad Panchayats only. There is a low lying area. Kumbalam Island is inside Kumbalam Panchayat. Most of the other regions are interspersed with arms of lake. There are drinking water problems and transport problems

Fig. 07-10 Vyttila and Thrippunithura Blocks

Mulamthuruthy Block : There are six panchayats and Thrippunithura MCP. Vembanad Lake lies on the western side of Udayamperoor Panchayat.

Fig. 07-11 **Mulanthuruthy Block**

Thiruvakulam, Udayamperoor, Thrippuni-thura MCP and Amballoor Panchayats are water logged areas. Topo does not show any large ponds. There is a large canal running in the north-south direction. There are paddy fields in Thrippunithura MCP.

Vaduvacode Block: The area has dry land cultivation, rubber cultivation and paddy cultivation along streams. There are few large ponds north of Sasthammukal Panchayat.

Fig. 07-12 **Vaduvacode Block**

Kothamangalam Block: There are ten panchayats and Kothamangalam MCP. Eastern portions are under forest. No ponds in Kuttampuzha Panchayat. Bhoodayar reservoir and Bhoothathankettu comes under Kuttampuzha. No ponds in Kavalangad, Pangottoor, Pothanicad, Pallarimangalam, Varapetty, Kothamangalam M.C, Nellikkuzhy, Pindimana and Kottappady Panchayats. Thattekkad Reservoir comes in Keerampara Panchayat.

Fig. 07-13 **Kothamangalam Block**

Pampakuda Block: There are eight panchayats.There are two ponds near Kodikutti Mala and another one near uramana in Ramamangalam Panchayat. Maneed, Pampakuda, Piravom, Thirumarady, Palakkuzha, Koothattukulam and Elanji do not have ponds in topo.

Fig. 07-14 **Pampakuda Block**

Prakkadavu Block: There are five panchayats. Periyar form the southern boundary for this block. Tributaries of Periyar criss - cross the area . Land use are dry land and paddy cultivation. Topo shows two ponds in Nedumbassery Panchayat. There is a pond in Parakkadavu Panchayat also.

Fig. 07-15 **Parakkadavu Block**

Muvattupuzha Block: There are eight panchayats and Muvattupuzha MCP. Kalloorkad, Manjalloor, Avolly, Arakkuzha, Marady, Ayavana, Muvattupuzha MCP and Paipra do not have ponds in topo. There is a pond in Valakam Panchayat.

Cochin Corporation

Fig. 07-16 **Muvattupuzha Block**

Fig. 07-17 **Cochin Corporation**

Kuttanad Region

Kuttanad meaning 'low lying lands' is one of the most fertile regions of the world and isspread over the district of Alappuzha, Kottayam & and Pathanamthitta. Kuttanad is crisscrossed by rivers, canals and waterways. Four major rivers namely Achenkovil, Pampa, Manimala and Meenachil originating from the High Ranges discharge their water into the Arabian sea through the Kuttanad region.

Fig. 07-18 **Kuttand. House just above water level**

Fig. 07-19 **Kuttand. Boat carryiing goods**

The Kuttanad Wetland System (KWS) inclusive of the Vembanad Lake is now receiving global attention because nature is at the peak of its beauty in this Ramsar site. The KWS comprising of 32 Panchayats of Alappuzha District, 27 Panchayats of Kottayam District and 5 Panchayats of Pathanamthitta district is a predominantly agriculture belt of Kerala where people are dependent on farming allied sectors like fishing, animal husbandry, etc for their livelihood.

This is the only part of the world where rice is cultivated below sea level and this will be of great importance in view of the projected sea level rise caused by global warming. It is a unique wetland which permits one good crop of rice and one harvest of fish and an area of thriving water tourism. Kuttanad is a biodiversity paradise. The

area is also popular [illegible] duck rearing and coir industry.

The soil is silty clay which is highly impervious facilitating paddy cultivation but is extremely acidic in reaction due to microbial oxidation of organic matter resulting in iron / aluminium toxicity. Cultivation is taken up along contiguous blocks or padasekharams or polders bounded by rivers and canals. Extent of padasekharams range from few hectares to 1000 ha, each padasekharam is owned by several cultivators and group farming is practiced.

The main season is the Punja crop (Rabi season) when sowing takes place in November / December immediately after the North East Monsoon and harvesting is done in March / April. A second crop is taken in selected areas as Viruppu crop (Kharif season) when sowing takes place in June / July immediately after the South West Monsoon and harvesting is done in September / October. Paddy fields are flooded with water to reduce the soil acidity and to control weeds and pests. This period of flooding is used for duck rearing also. Before sowing, the flooded water is pumped out through centrifugal force using engine pumps after the bunds are repaired.

After monsoon, cultivation is taken up on lands bounded by waterways by erecting bunds along the flow of water. When the flow of water increases, the bunds are breached causing floods in the paddy fields. Paddy cultivation is taken up in about 40,000 ha out of which double cropping takes place in 10,000 ha.

The Kuttanad region has been under intense and increasing anthropogenic pressure over the years, which has adversely affected its ecology as well as the livelihood of the people. This has resulted in loss of flora and aquatic fauna, particularly the fish species and population, eutrophication of water bodies promoted by nitrate and phosphate leaching from farm fields, high level of pollution with organic, inorganic and toxic material locally generated and brought in by the rivers, aggressive spread of water hyacinth, poor drainage due to choked water ways, increasing intensity of flooding, shortage of potable water and proliferation of water borne parasites and predators affecting human health.

[illegible] were facing [illegible] Based on the request of the Govt. of Kerala to address the agrarian problems faced in Kuttanad, the Union Govt. entrusted the Dr. M.S. Swaminathan Research Foundation (MSSRF) to conduct a scientific study of the region and suggest suitable measures to mitigate agrarian distress in Kuttanad. The MSSRF recommended a variety of interventions to be implemented as a package with a total cost outlay of Rs. 1,840 crore which was accepted by the Govt. of India for funding under ongoing Central Sector Schemes. Detailed Project Reports (DPRs) prepared by the State Govt. for different activities envisaged in the Package are under different stages of implementation.

On 24th July 2008, the Union Cabinet gave in-principle approval for providing financial support for implementing various programmes / interventions suggested by the M.S.Swaminathan Research Foundation by the concerned Ministries / Departments within their existing schemes of funding pattern. The Govt. of Kerala was requested to identify the activities to be undertaken, submit appropriate proposals by formulating Detailed Project Reports (DPRs) to the concerned Ministries / Departments of the Govt. of India in accordance with the guidelines / procedures for such schemes for the release of necessary funds.

The Cabinet approved the provision of need based additional financial allocations to the concerned Ministries / Departments of the Govt. of India for implementation of the programmes / interventions included in the Package. The Programmes / interventions involving financial outlay upto Rs. 50 lakhs are to be implemented by the State Govt. from their own funds under their schemes. The Cabinet also approved the constitution of the implementation mechanism consisting of the Kuttanad Prosperity Council, Coordination Committee and Task Implementation Committee.)

The Project Office, Kuttanad Package was created by the Govt. of Kerala to facilitate the implementation of the Kuttanad Package. The Project Officer was entrusted with the job of coordinating the various departments / PSUs to implement the various interventions recommended in the Study Report of the M.S. Swaminathan

earch Foundation. The Project Office is the al office for information on the Package. It ns the link between the farmers, line departments / PSUs and the Government. The progress of the project is rather slow.

#

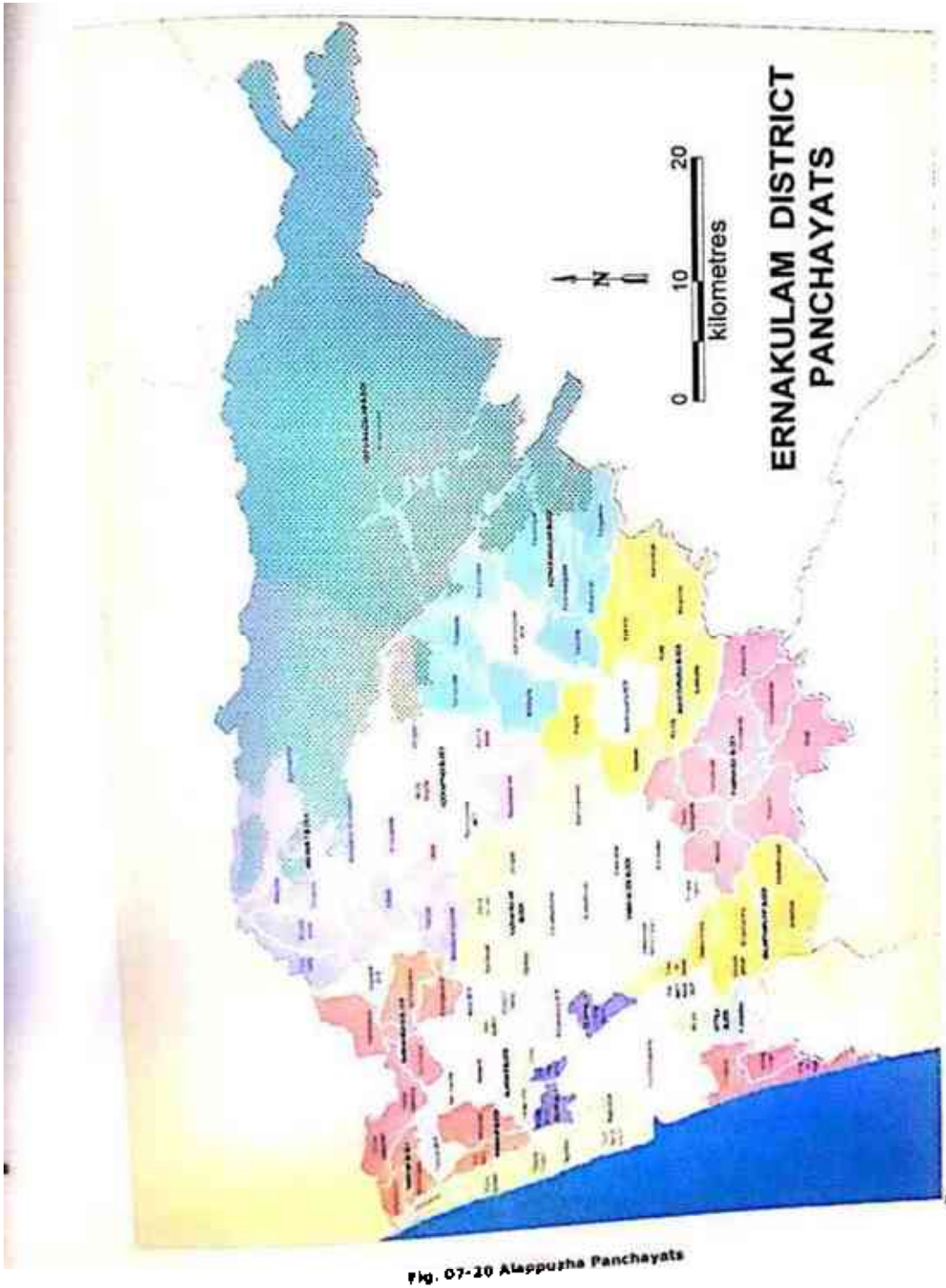


Fig. 07-20 Alappuzha Panchayats

THRISSUR DISTRICT

Introduction

Thrissur District is situated to the south of the Palakkad gap. As a result of this, the northern parts are relatively plain and the hill chains start a little to the south from the Nelliampathy. The district is drained by two rivers, Kechery and Karuvannur. Part of Chalakudy basin also falls in Thrissur District. The hilly area is a narrow band on the eastern edge, midland occupy most of the area. The lakes and Kole lands in the coastal area is notable.

Fig. 01Thrissur District. River basins

Fig. 02 Land use pattern in Thrissur

The main land use in the district is mixed dry land crops and forest These are almost on the same level as state average. Paddy cultivation is more than state average, rubber cultivation is more than state average. There are considerable quantity of wetland in the 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 dams and reservoirs in the rivers. All these rivers drain to Kole wetlands which is a unique ecosystem.

Chalakudy basin

Chalakudy River is of medium size, among rivers of Kerala with a length of about 130 km and basin area of 1704 km^2. It originates in the forested areas of Nelliyampathy and flows west wards to join the Kole wetlands. The basin includes areas with moderate and heavy rainfall. There are several dams in the river which facilitate interstate transfer of water. KSLUB (2000) divides Chalakudy basin into 38 micro water sheds. We have grouped then into 10 sub basins.

Fig. 03 Chalakudy Basin: Sub basins

Sub basin A (Tunakadavu-Parambi-kulam) : Chalakudy River originates in this region Tunakadavu River and Thekkady Ar join together to form Kuriarkutty River. This in turn joins Parambikulam River and joins with other tributaries at the lower edge of this group. The altitude ranges from 580m to about 1500m. There are dams in Tunakadavu and Parambikulam tributaries. The region is totally forested, much of the level areas are under teak plantations. There are no ponds or tanks in the area, the area being forest. KSLUB (2000) watersheds 16C23 to 16C37cover the area. This area comes under Nelliyampathy Panchayat.

Sub basin B (Karappara): Karappara River is another tributary that joins the main river at about

500m MSL. This region is also forested. The altitude ranges from 580m to about 1000m. There are several tea and coffee estates on the upper reaches. KSLUB (2000) watershed 16C22 cover the area. This area comes under Athirappally Panchayat.

Sub basin C (Sholayar): Sholayar is another tributary that joins the main river at about 580m MSL. This region is also forested. The altitude ranges from 580m to about 900m. The Sholayar dam and reservoir fall inside this area. KSLUB (2000) watershed 16C38 cover the area. This area comes under Athirappally Panchayat.

Sub basin D, E (Poringal): Several tributaries described above join at about 500m MSL, and flow downwards as Chalakudy River. The Poringal dam is in the main river. This region is also forested. The altitude ranges from 300m to about 500m. KSLUB (2000) watershed 16C18 to 21 and 16C40 to 45 cover the area. Athirappally water fall is in this sub basin. This area comes under Athirappally Panchayat.

Sub basin F (Kannan Kuzhi): A very curious phenomena, the Kannakuzhi Thodu flow from a deep valley in north - south direction and join the Chalakudy River at about 300 m MSL. This region is also forested. The altitude ranges from 300m to about 1000m. KSLUB (2000) watershed 16C18a cover the area. The Chalakudy - Vazhachal road go along the river bank. This area comes under Athirappally Panchayat.

Fig. 04 Chalakudy Basin: Land use

Sub basin G (Tumburmuzhi): This sub basin cover a large stretch of Chalakudy River, till it reaches Pariyaram, at about 50 m MSL. The Chalakudy - Vazhachal road go along the river bank. This region is only partly forested. Rubber cultivation is the main land use here. The altitude ranges from 300 m to about 50m. KSLUB (2000) watershed 16C9 to 15 and 16C 46 to 51 cover the area. Panchayats Melur and Athirappally cover this area.

Sub basin H (Kappa Thodu): This is a narrow valley running parallel to the main river. This region is only partly forested. Rubber cultivation is the main land use here. The altitude ranges from 300 m to about 50m. There are some forest areas on hill tops, middle regions are under rubber cultivation and lower areas are under mixed crops. KSLUB (2000) watershed 16C8 cover the area. Panchayats Kodasseri and Pariyaram cover this area.

Sub basin I (Chalakudy): This is the remaining portions of Chalakudy River from Chalakudy to Pariayarm area. The altitude ranges from 20m to about 50m. The region is under mixed dry land agriculture and paddy cultivation. The area is irrigated by irrigation canals. Few perennial streams drain to the main river. KSLUB (2000) watershed 16C6 to 7 and 16C51 to 54 cover the area. Panchayats Kadukutty, Koratty, Alur, Chalakudy MCP and Melur cover this area.

Sub basin J (Chalakudy Kole): This is the remaining portions of Chalakudy River from Chalakudy to the wetlands. The region is under mixed dry land agriculture and paddy cultivation. The area is irrigated by irrigation canals. KSLUB (2000) watershed 16C1 to 5 and 16C55 to 57 cover the area. Panchayats Puthan Velikkara, Kuzhur, Annamanada, and Kadukutty cover this area.

Karuvannur Basin

Karuvannur River is one of the smaller rivers of Kerala. It is about 48 km in length, basin is about 1000 km^2. It has two main parts, Manali and Kurumali. Both these rivers have dams in them. Irrigation canals from these reservoirs supply water to relatively dry areas and to the Kole wetlands. In fact the water level of Kole lands is controlled by water from these two reservoirs, the Vazhani reservoir and brakish water from sea.

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 Chimmini Puzha. All tributaries of Karuvannur River originate from Peechi and Chimmini Wildlife Sanctuaries. Peechi dam was constructed in the catchment area of Manali Puzha and Chimmini dam, in the catchment area of Chimmini Puzha. Both Manali Puzha and Kurumali Puzha join together near Arattupuzha, and flow along the middle of Kole wetlands. The River divides the Kole wetlands into two, northern Kole and southern Kole. The River joins to Conolly 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 use river water from Karuvannur. It also flushes out water to river through canals during monsoon.

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. Karuvannur basin can be divided into 8 sub basins.

Fig. 05 Karuvannur Basin. Sub basins

Sub basin A (Peechi-Manali): Manali River originates in this drainage group. Few hills are at about 1000m, most of the forested catchment is below 500m. There is hardly any forest below 50m, the Peechi dam is at about this altitude. Canals from the reservoir irrigate a large area called as Kannara Puzha in upper reaches. There are few scattered hills in the mid land. There area a large number of ponds and tanks in the lower part of the basin, probably to prolong the availability of water from the canals. Several perennial streams join the river downstream.

At Manali the national highway crosses the river, there are a large number of water bodies in this area, probably clay mine pits. Land use is mixed dry land agriculture and paddy fields. There are extensive paddy fields beside the river form Puthur onwards. Manali and Kurumali rivers join near Arattupuzha. A little distance after this the Kole wetlands start. KSLUB (2000) watershed 17K9 to 17K27 fall in this group.

Sub basin B (Chimminy-Kurumali): Chimminy River originates in a crater shaped forested area. The Chimmini dam is in the Chimmini tributary. Two other tributaries, Mupli Puzha and Pulla Thodu meet slightly down steam. Vallya Thodu joins Kurumali River further down steam. Altitude of the basin range from about 20m to 500m. After a little distance down steam, it joins Manali River. There is large belt of rubber cultivation below the forest area, which is followed by mixed dry land cultivation and paddy fields downstream. This area is 17K28 as per KSLUB (2000) classification.

Fig. 06 Karuvannur Basin. Sub basins

Sub basin C (Kodakara Thodu): A stream from Mundur areas pass through Peramangalam

and reach Chittilapppally. A perennial stream crosses national highway and railway track and enters Kole area directly. Land use is mixed dry land cultivation and paddy fields. There is another perennial stream, Kunda Thodu directly joining the Kole lands. There are a large number of water bodies here, probably clay mining pits. Kole wetlands start here. KSLUB (2000) watershed 17K31 to 17K34 fall in this group. KSLUB (2000) watersheds 18K 31, 32, 35, 36,39 also fall in this group.

Sub basin D (Poomala): These are two small streams entering the Kole directly. One stream from Athani area joins the wetlands near Muthuvara and Puzhakkal. Another stream from Pumala reservoir pass through Kolazhi-Thiroor area, cross the railway line and reach Puzhakkal. Another stream called Kallayi Thodu drain Madakkathara, Nellankara, Nettisseri areas and reach Puzhakkal. Panchayats falling in this are Thrissur Corporation, Kolazhy, Avanur, Mundathikode, Mulamkunnathukavu, Thekkumkara and Madakkathara. KSLUB (2000) watershed 18K40 covers this drainage group.

Sub basin E and F (Thrissur Muncipality): These groups cover the southern part of Thrissur MCP. There are several tanks and ponds in this area. These are two perennial streams entering the Kole area directly. KSLUB (2000) watershed 18K44 cover Sub basin 5 and 18K 45 cover Sub basin F.

Sub basin G (Thrissur Kole): This is a unique system of wetlands some parts of which are below sea level. It is described in detail separately. Panchayats Vengitangu, Arimpoor, Manaloor and Anthikkad fall in this group. KSLUB (2000) watershed 18K 37, 41, 42, 43, 46, 47, 48 and 49 fall in this group.

Sub basin H (Engandiyoor): is a narrow stretch of land between the sea and the inland fresh water lakes. NH 17 pass through this. There are two lakes inside, Chetwa Puzha and Kanjira Puzha. These are connected to the Kole wetlands on one side and to the sea at the other. Several panchayat come in the area. Thalikulam, Vadanappally, Engandiyoor, Pavaratty, Kadapuram, Orumanayoor, Thalikkad panchayats and Chavakkad and Guruvayoor municipalities come in this group. KSLUB (2000) watershed 18K 2 to 8 and 18K50 to 51 fall in this group.

Kechery Basin

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

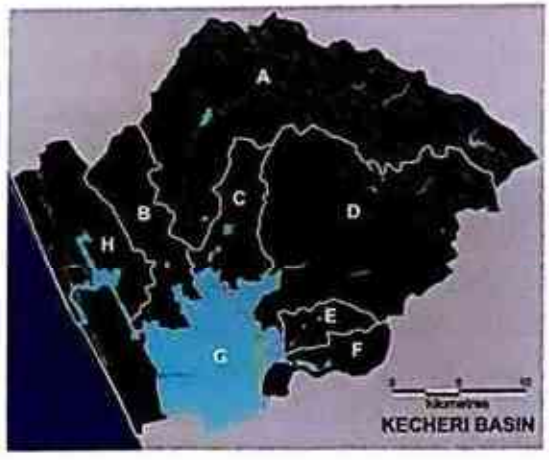


Fig. 07 Kechery basin: Sub basins

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. The project was completed during the year 1962. Kecheri basin is divided into 7 sub basins.

Sub basin A (Kechery-Vadakkanchery-Vazhani): This sub basin consists of Vazhani River and streams joining it. The catchment area upstream of Vazhani reservoir is forested. The region below has mixed dry land crops and paddy cultivation. There are occasional plantations in the higher areas. Vazhani reservoir is meant for irrigation. The river itself is the main distribution canal. There are as many as 22 check dams downstream which distribute water for paddy cultivation. Vadakkanchery is major town downstream followed by Kechery. It joins the Kole wetlands further downstream, at Chalakkal. The flood waters from Vazhani and Karuvannur rivers

used to create problems for Kole paddy cultivation. Joining up the Vazhani basin and extending it up to Engandiyoor has mitigated the floods. KSLUB (2000) watersheds 18K 11 to 31 fall in this sub basin. Panchayats in the group are Vadakkanchery, Erumapetty, Kadangode, Velur, Chowannur, Choondal and Kandanasseri.

Sub basin B (Kadavallur): KSLUB (2000) watershed 18K 8 to 9 fall in this sub basin. The sub basin falls in Kunnakulam MCP, Pookode, Guruvayoor MCP, Kanadassery, Elavally, Mullasseri and Venkitangu panchayats. The perennial stream in the sub basin joins the Kole lands. Land use is mixed dry land cultivation and paddy fields. KSLUB (2000) watersheds 18K8 and 9 fall in this sub basin.

Fig. 08 Kechery basin. Sub basins

Fig. 05 Karuvannur Basin. Sub basins

Sub basin C (Peramangalam Thodu): A stream from Mundur areas pass through Peramangalam and reach Chittilapppally. Land use is mixed dry land cultivation and paddy fields. KSLUB (2000) watersheds 18K 31, 32, 33, 34, 35,36 and 39 fall in this group.

Fig. 09 Ollukakra tank. Weed covered.

Fig. 10 Pallikkulam garbage was cleared recently.

Fig. 11 Vadakkechira, near north bus stand

Fig. 12 Vanchikulam was recently cleaned up.

KOLE WETLANDS

There is arrangement for pumping water in and out.

Fig. 13 A pump house at Pathramangalam

Fig. 14 Kole paddy

Wetlands in blocks and panchayats

Fig. 15 Blocks All

Vadakkanchery Block: This block is mainly drained by tributaries of Vazhani River. This river originates in this block. There are forests on the eastern side and on isolated hills. Small portions in extreme north drain to Bharathapuzha River. Small portions in south drain to Puzhakkal basin. There is much paddy growing areas on both sides of Vazhani River. As per Panfish (1992), there are a large number of water bodies, larger than one ha in this block. A reservoir of 27.39 ha exists at Pattazhikund. This is for irrigation. Topo sheet shows 15 water bodies, 8 of them larger than one ha in extend. Varavoor Panchayat has as many as 8 ponds. These are associated with paddy cultivation and are on streams leading to Bharathapuzha. NREDB (2008) mapping which includes ponds above 0.10 ha maps as many as 200 ponds. This indicates the importance of ponds in this block. They are distributed over the panchayats in the block.

Fig. 16 Ponds in Vadakkanchery Block

Panchayat	Count	Area (ha)
Desamangalam	19	2.69
Erumapetty	20	3.89
Kadangode	25	4.06
Mullookkara	14	9.57
Mundathikode	33	3.30
Thekkumkara	13	9.64
Vadakkanchery	14	1.68
Varavoor	19	5.16
Velur	41	5.75
Grand Total	**198**	**45.74**

Fig. 17 Vadakkanchery Block

Pazhayannur Block: Almost the entire Pazhayannur block flows into Bharathapuzha. The northern regions drain to Chelakara-Panjal stream and the eastern regions to Gayathripuzha. Panfish (1992) shows a large number of ponds and tanks, many more than one ha in extend. Toposheet shows 15 ponds, ranging in area between 0.25 and 1.32 ha. Pazhayannur Panchayat includes 10 ponds. These are associated with paddy cultivating areas and are on streams draining to Gayathripuzha. Surprisingly, NREDB (2008) mapping missed most of these ponds, shows only one of these ponds, of about 1.05 ha (near Kakachola). NREDB (2008) maps 21 ponds in the block, ranging in area between 0.30 and 0.84 ha.

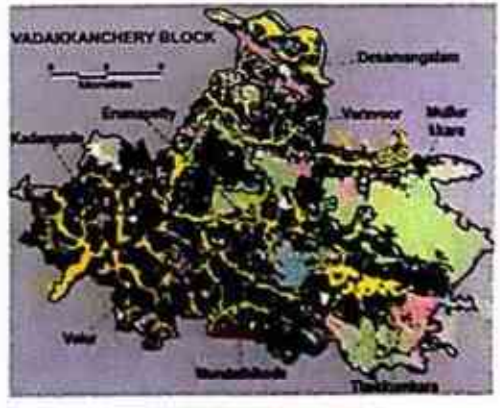


Fig. 18 Vadakkanchery Block

Fig. 19 Pazhayannur Block

Ollukkara Block: Most of the area of Ollukkara block is drained by Kurumali River. Small part on the west falls in Puzhakkal Basin. Sothern regions drain to Manali River. More than half the area is forested. There are Kole lands on the western side. Panfish (1992) reports about half a dozen ponds. Topo sheet shows four ponds. The largest pond is near Puthur, 14.89 ha in area. Other ponds are small, in Kolazhy Panchayat. NREDB (2008) map 73 ponds. Their Panchayat wise distribution is shown below

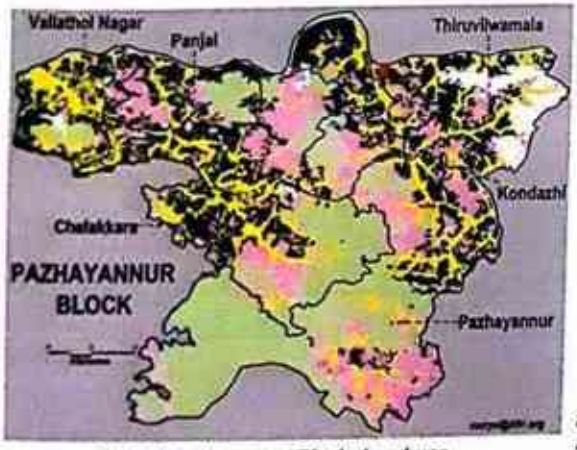


Fig. 21 Pazhayannur Block: Land use

Fig. 20 Ponds and tanks in Ollukkara Block

Panchayat	Count	Area (ha)
Kolazhy	12	2.85
Madakkathara	26	8.65
Nadathara	25	6.46
Pananchery	7	0.91
Puthur	3	0.33
Grand Total	**73**	**19.20**

Four ponds in Kolazhy Panchayat are larger than 0.25 ha, Maximum size is 0.64 ha. There are 26 ponds in Madakkathara Panchayat, nine of them are more than 0.25 ha in extend, the largest pond is 3.32 ha, others are less than one hectare. Nadathara Panchayat has 25 ponds, seven of them are larger than 0.25 ha, two of them larger than one hectare, 1.27ha and 1.4ha each. Pananchery Panchayat has seven ponds, all of them less than 0.25 ha each. Puthur Panchayat has three ponds, all less than 0.25 ha each. NREDB (2008) enumeration misclassified the large pond in Puthur Panchayat.

Detailed examination of ponds of Pananchery Panchayat show that additional 20 ponds, ranging in area between 0.06 ha and 0.5ha mostly quarry ponds could be identified by close examination of satellite images of one meter resolution.

Fig. 22 Puzhakkal, Thrissur and Ollukkara Block

Thrissur Corporation: Thrissur Corporation area is drained by a series of streams. Puzhakkal stream enters at one corner only. A stream from Poomala dam drains the north western areas. Kallayi stream drains northern areas. Kurukkanchery and Ollur areas are drained by streams by the same names. Thrissur is a planned city, where ponds situated around the Thekkinkad used to play a major in supplying water for domestic uses. With the commissioning of Peechi

Project, dependence on ponds decreased considerably. Water from Peechi project through irrigation canals affect the water table and water availability. Water from all these systems meet at the Kole fields on the western side. The Kole system in itself is an intricate system, delicately balanced by fresh water input and salt water intrusion from sea. In the hey days of transport along canals using country boats, an elaborate system of water ways existed.

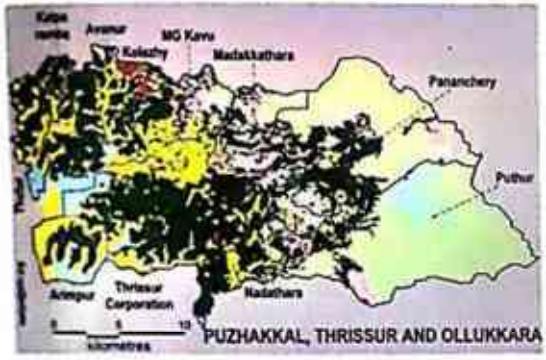


Fig. 23 Puzhakkal, Thrissur and Ollukkara: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Panfish (1992) reports six ponds from corporation area. Topo sheet maps 12 ponds. The largest of these ponds, is 2.22 ha in extend, a stream from Chelakottukara, Ollur and Sakthan areas drain into this. This is a highly polluted water body. The water body continues into the Kole canals. Another three ponds of about 0.8 ha were the main source of fresh water in the past. At a smaller size, many of the temples have ponds. NREDB (2008) has mapped 73 ponds in the area. Some of these ponds are serving as source of drinking water in summer. Pallikulam is partly filled up Some of the notable ponds in the Thrissur corporation are

Fig. 24 Ponds and tanks in Thrissur Corporation

1 Vadakke Chira
2 Padinjare Chira
3 Vanchikulam
4 [illegible]
5 Chiramanangad
6 Pallikulam highly polluted
7 [illegible]

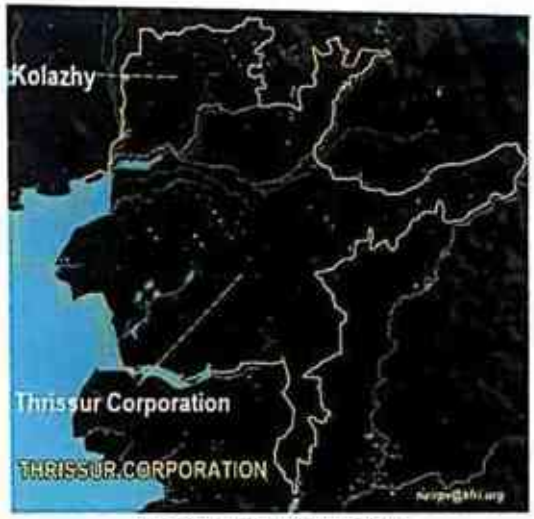


Fig. 25 Thrissur Corporation

Puzhakkal Block: Puzhakkal block is a network of Kole lands, paddy fields and strips of land. Topo-sheets show four ponds. A large water body of 9.89 ha, seen in topo-sheet near Edakkalathur is paddy fields in satellite image. In spite of being water logged, NREDB (2008) has mapped 53 ponds in the block.

There is a large pond at Mannukuzhy, formed after extraction of clay for tiles, bricks and pottery.

Fig. 26 Edakkalathur Mannukuzhy

Mullasseri Block: Mullasseri Block is situated to the east of the kayals, its eastern side is water logged Kole lands. Satellite images show a decline in paddy fields. Water balance is maintained by the Kole system. Panfish (1992) reports several large water bodies. Topo sheet shows only two ponds,

few of them larger than 1 ha.

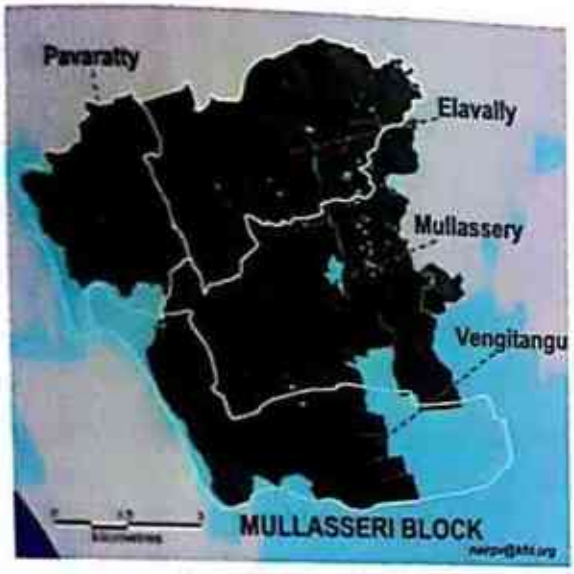


Fig. 27 Mullasseri Block

The block contains a series of low hills, Aykunnu. Most of these have been levelled for extracting soil for making bunds in the Kole lands

Fig. 28 Aykunnu. The hills being levelled.

Thalikkulam Block: This is a narrow strip of land between the sea and fresh water lakes. Panfish (1992) reports few water bodies. Topo-sheets do not show ponds. NREDB (2008) show as many as 22 ponds. These might be a god source drinking water.

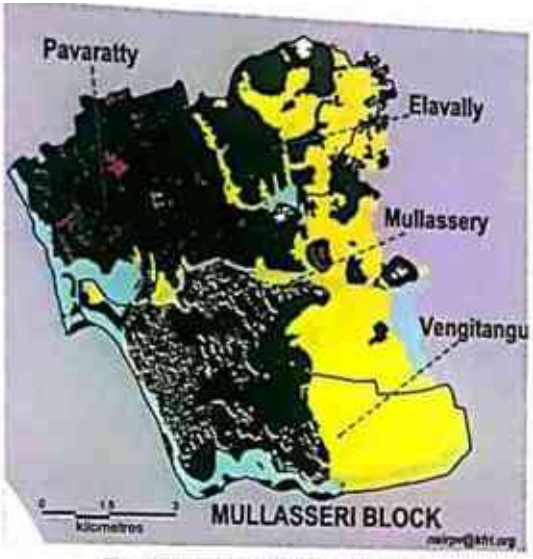


Fig. 29 Mullasseri Block: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Pantn.

Anthikkad Block: This block also has Kayal (canal) on the west and Kole paddy fields on the right. Almost every panchayat has an eastern water logged area. Panfish (1992) reports a large number of water bodies. Topo-sheet shows 5 ponds ranging in size from 0.2 to 1.2 ha. NREDB (2008) maps nearly 40 ponds, only three of them are larger than one hectare.

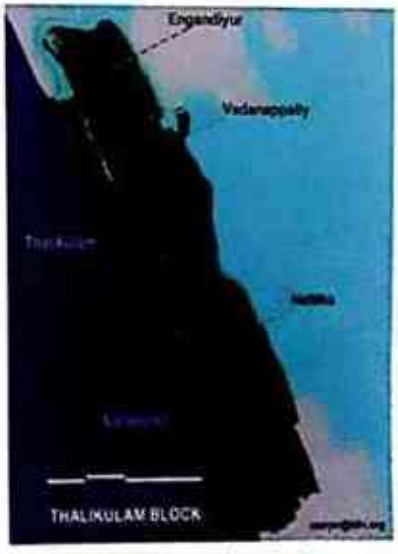


Fig. 30 Thalikulam Block

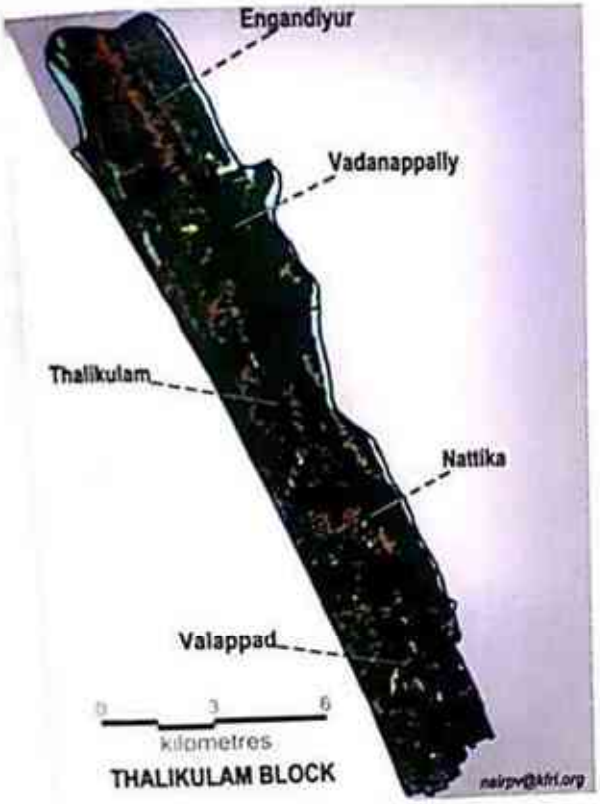


Fig. 31 Thalikulam Block: Land use

Fig. 32 Anthikkad Block

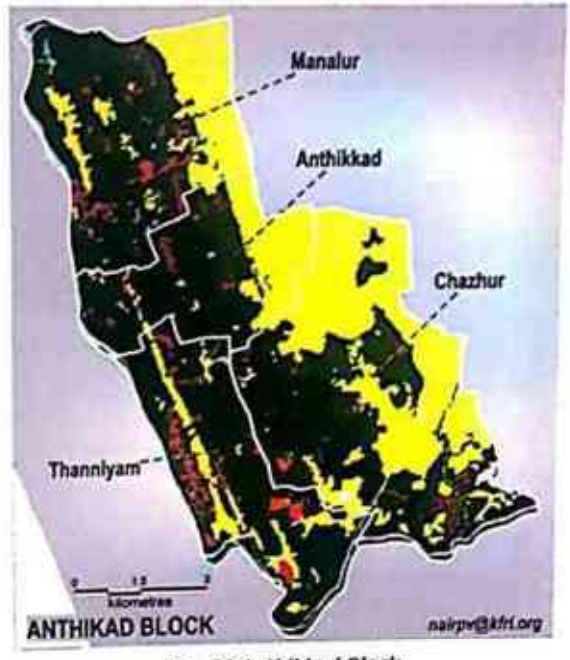


Fig. 33 Anthikkad Block

Cherpu Block: Cherpu block has Kole paddy fields on the west and strips of land on the east. Panfish (1992) reports a large number of water bodies. Topo-sheet shows 8 ponds ranging in size between 0.3 and 1.6 ha. NREDB (2008) reports 12 ponds, only one pond is larger than one hectare (1.81 ha) .

Fig. 34 Vallachira in Cherpu Block.

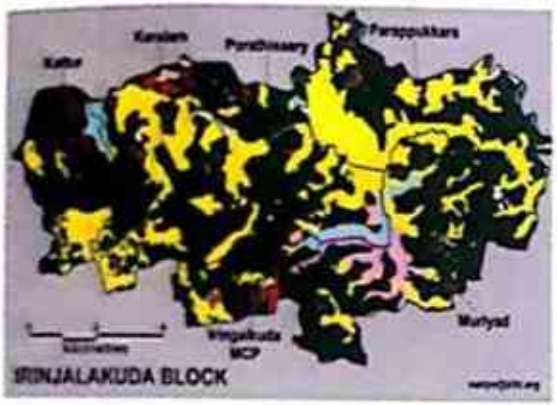


Fig. 40 Irinjalakuda Block: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Vellangallur Block: Vellangallur Block is also a water logged area interspersed with strips of land. Panfish (1992) reports 49 water bodies, topo-sheet shows two ponds of about 11 hectare each and several small ponds. The large ponds are Vayikila Chira and Pond near Nadavarambu on the road side. NREDB (2008) maps more than 40 ponds, 7 of which are more than one hectare in extend.

Fig. 41 Vellangalloor Block

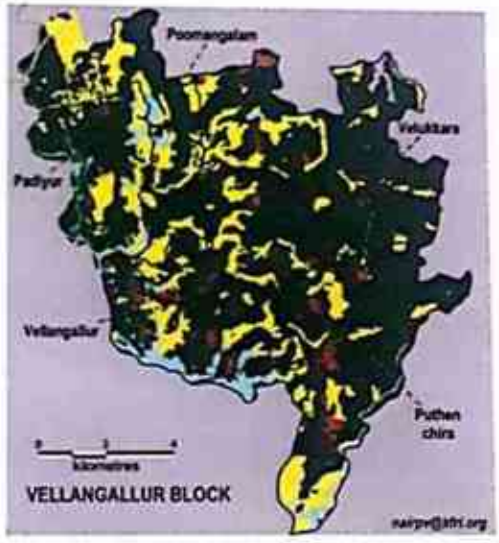


Fig. 42 Vellangalloor Block

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Mathilakam Block: Mathilakam Block is situated south of Thalikulam Block and like the later is a strip of land between the sea and water logged areas. Panfish (1992) reports 49 ponds, topo-sheet shows one major pond and NREDB (2008) maps 28 ponds, four of which are larger than one hectare.

Fig. 43 Mathilakam Block

Fig. 44 Mathilakam Block: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Pantn.

Kodungallur Block: Kodunallur Block together with Kodungalur Municipality is surrounded by water on three sides. On the west it is the Arabian sea, south Periyar and east lakes leading to Chalakudy basin. Panfish (1992) reports 35 water bodies. Satellite image shows reduction in paddy areas compared to topo-sheet. NREDB (2008) maps 38 ponds, five of them more than one hectare in extent. An arm of Periyar estuary extends north wards up to Eriyad.

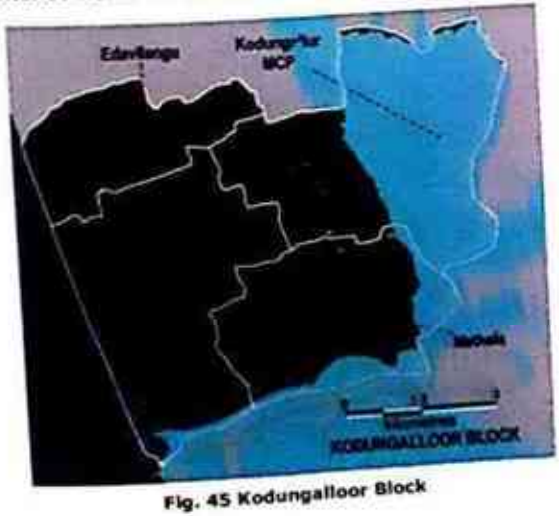


Fig. 45 Kodungallor Block

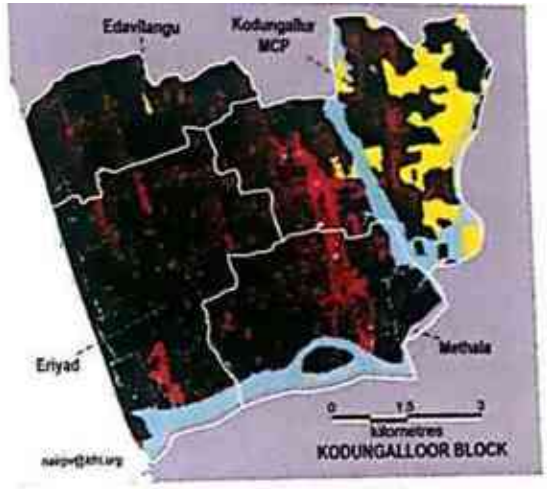


Fig. 46 Kodungallor Block

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Pantn.

Mala Block: Mala is a block with much paddy cultivations and bounded by rivers on most sides. Panfish (1992) reports 15 water bodies. Topo show three ponds of 0.58 ha to 0.81 ha and a large pond near Payyanattukara of 24.23 ha. NREDB (2008) maps 6 ponds.

Fig. 47 Mala Block

Chalakudy Block: Chalakudy Block and Municipality extend up to the ghat region, the Chalakudy River flows through the middle. Panfish (1992) reports a large number of water bodies. Topo shows three ponds, more than one hectare in extend. These ponds are situated close by one near Palappilli (mud quarry) , one near Valungamuri and Modi Chira NREDB (2008) maps three ponds. Koratty and Kadukutty panchayats are criss-crossed by a series of canals.

KOLE WETLANDS

There is arrangement for pumping water in and out.

Fig. 48 A pump huse at Pathramangalam

Fig. 49 Enamakkal, out let to sea. manmade bunds in front

Fig. 50 Kole paddy

Fig. 51 Puzhakkal

Fig. 52 Pazhayi waste land

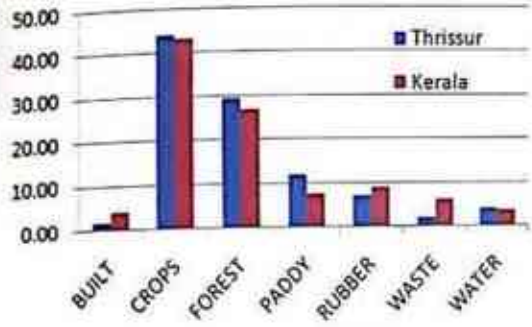


Fig. 02 Land use pattern in Thrissur

Fig. 53 Muriyad

Fig. 54 Muriyad

Fig. 55 Kole raised canal

Fig. 56 Chathanchira

Fig. 57 Munambam

Fig. 58 Thrissur District: Panchayats

PALAKKAD DISTRICT

Introduction

Palakkad District is situated in the south west region of India, bounded on the north by Malappuram District, in the east by Coimbatore District of Tamil Nadu, in the south by Thrissur District and on the west by Thrissur District. 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. The most important rainy season is during south-west monsoon which sets in the second week of June and extends up to 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 Thuthapuzha, Gayatrippuzha, Kannadippuzha, Kalpathyppuzha and Thuthappuzha. Palakkad is called the "Rice bowl of Kerala" because of extensive paddy fields. The net cultivated area of the district is 284 lakh hectares, i.e, 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 cashew nut are some of the major cash crops raised.

Palakkad District is blessed with irrigation almost all the important tributaries of Bharatha Puzha 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 Kanjirappuzha are in progress. The total ayacut of these projects is 542 km^2.

Fig. 9-01 Kannur District: Basins

Palakkad is a district with many peculiarities. Topography and terrain had played a very important factor in development of the area. The river network is shown below diagrammatically. Very broad rivers have limited road connectivity and setting up of large number of dams have altered the water flow pattern. This combined with the low rain fall nature of the region has led to the construction of thousands of tanks and ponds. This facilitated paddy cultivation till recently, till it became a non profitable task due to rise in labour cost.

Fig. 9-02 Main tributaries of Bharatha Puzha

Fig. 9-03 Bharatha Puzha: Main tributaries

Bharatha Puzha Basin

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

The river originates in the Anamalai 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, Bharatha Puzha River flows northwards till Pollachi. Kannadippuzha and Kalpathippuza, tributaries of Bharatha Puzha meet at Parli and flow in the west direction as Bharatha Puzha River. The Bharatha Puzha River enters the Arabian Sea at Ponnani. Gayathripuzha River, Kannadi Puzha River, Kalpathipuzha River and Thuthapuzha River are the main tributaries of the Bharatha Puzha. 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 Bharatha Puzha River. The tributaries of Thuthapuzha River are Kunthipuzha, Kanjirapuzha, Ambankadavu, and Thuppanadipuzha. 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.

Bhavani Basin

Fig. 9-04 Bhavani Basin.

WETLANDS IN BLOCKS AND PANCHAYATS

Thrithala block

Trithala Block is the western most block in Palakkad District. The block consists of undulating terrain, but inside this, the northern part drain to Bharatha Puzha and southern part drain to Viyyam Kayal.

Fig. 9-05 Thrithala Block: Pachayats

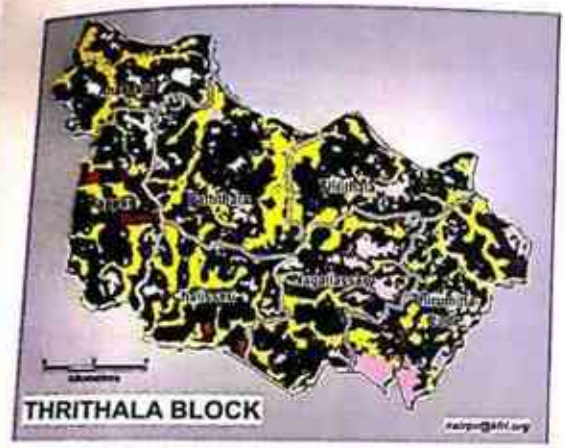


Fig. 9-06 Thrithala Block: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Pantn.

Thrithala town itself is located beside Bharatha Puzha. Tuta Puzha and Bharatha Puzha join near Kudal. Access to the place is limited to few roads from nearby blocks. Bridges at Kuttippuram and Pattambi provide connection to those towns. The rail way line goes along the right bank of Tuta Puzha up to Pattambi. There are seven panchayats in the block. Topo sheet show the whole area mostly as low lying paddy fields.

Land reforms of the past brought about a redistribution of land held by temple authorities and feudal lords. Land use is mainly dry land crops and paddy fields.

Table 9-01 Thrithala Block: Water bodies

Panchayat	W Body%	Paddy %	Topo	NREDB	Pan fish
Anakkara	0.05	28.64	1	1	3
Chalissery	0.25	23.88		1	3
Kappur	0.04	8.21		5	5
Nagalassery	0.06	16.25		7	4
Pattithara	26.01	29.22		7	5
Thirumittacode	0.05	22.21		3	3
Thrithala	0.03	10.38		1	2

Topo sheet shows one pond of 0.5 ha. NREDB (2010) and Pan fish (1992) also report a large number of ponds.

Pattambi Block

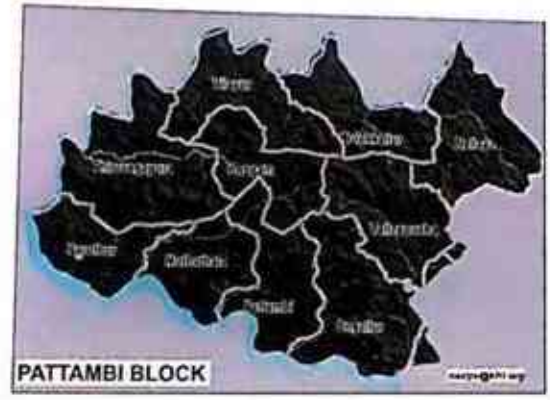


Fig. 9-07 Pattambi Block: Panchayats

Pattambi Block consists of 10 panchayats situated between Tuta Puzha and Bharatha Puzha. Terrain consists of undulating low hills, the northern part of the block drains to Tuta Puzha and southern part drains to Bharatha Puzha.

Pattambi town itself is on the banks of Bharatha Puzha, the block is well connected with towns across Tutha Puzha through bridges in the narrower Tutha Puzha. Topo sheet shows most of the area as paddy fields. There is road and rail connection to towns like Perinthalmanna. Land use is dry land cultivation, paddy fields, waste lands and built-up areas.

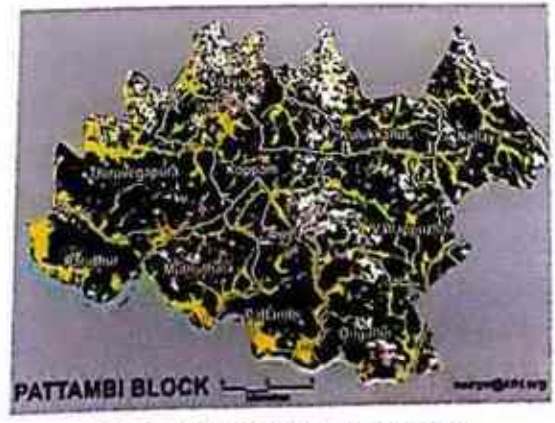


Fig. 09-08 Pattambi Block: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Pantn.

Table. 9-02 Pattambi Block

Panchayat	WBody%	Paddy %	Topo	NREDB	Pan fish
Kappur	0.28	1.50		4	4
Kulukallur	0.06	20.48		9	4
Muthuthala	0.04	15.46		2	4
Nellaya	0.10	12.87		15	3
Ongallur	3.05	31.45		9	4
Parathur	0.53	41.17	3	3	5
Pattambi	0.04	10.56		4	2
Thiruvegappura	0.09	50.82		5	4
Vallapuzha	0.05	45.03		10	2
Vilayur	2.82	20.13		7	5

Ottappalam Block

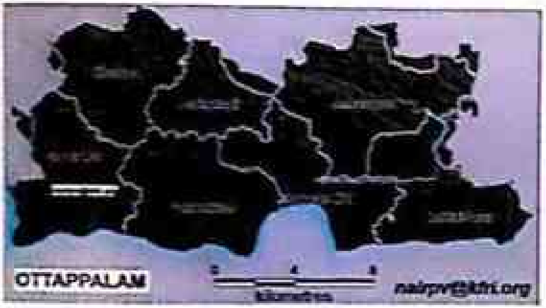


Fig. 9-10 Ottappalam Block: Panchayats

Further upstream, there are two blocks between Tuta Puzha and Bharatha Puzha. Ottappalam faces Bharatha Puzha and Sreekandapuram faces Tuta Puzha. The block consists of five panchayats and two municipalities. Terrain is undulating with drainage to Bharatha Puzha. Terrain consists of low hills; the Anangadi mala is a chain of hills about 400m in height. There was reorganization of block in 1978, before this Ottappalam Block consisted of more vast area.

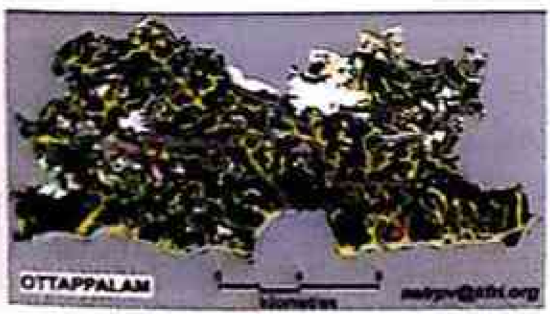


Fig. 9-11 Ottappalam Block: Land use

Crops, Rubber, Paddy, Water, Built-up, Forest, Waste, Paths

Ottappalam region had many peculiarities in political and cultural fields. Earlier feudal system changed to peasant dominated system and rise of cooperatives. Land use is dry land cultivation and paddy fields. Retardation in agriculture was recently followed by gulf boom and construction activities. Communication facility wise, the railway line from Palakkad go along Bharatha Puzha bank up to Shornur. Bharatha Puzha had been a block in road transport; there are bridges across Bharatha Puzha at Shornur, Lakkidi, Ottappalam, Mayannur, etc. Ottappalam town is situated on right bank of Bhartha Puzha.

Fig. 9-03 Ottappalam Block

Panchayat	WBody%	Paddy %	Topo	NREDB	Pan fish
Ambalappara	0.08	15.83		10	3
Ananganadi	0.27	11.96		25	4
Chalavara	0.31	0.51		38	4
Lakkidiperur	0.43	14.34		15	4
Ottappalam MCP				15	3
Vaniyamkulam	2.97	18.01		35	3

Land use consists mainly of dry land cultivation and paddy fields. Increasing rubber cultivation is also noticeable. Many panchayats have paddy cultivation to the tune of 10-20%.

Sreekrishnapuram Block

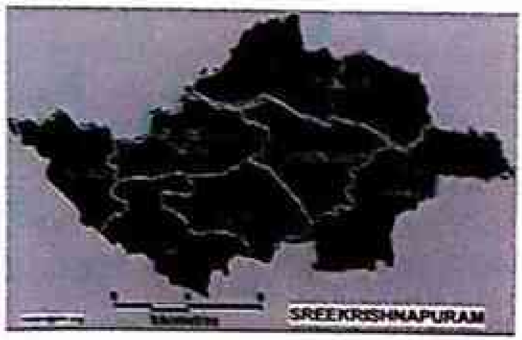


Fig. 9-12 Sreeekirshnapuram Block: Panchayats

This block, as mentioned before is situated between the two major rivers of the area. Drainage is to Tuta Puzha. The block has remained largely underdeveloped due to lack of major roads or rail. In spite of this, it was the seat of many cultural, literary and educational activities in the past. Undulating terrain combined with comparatively

seven panchayats in the block.Tuta Puzha flows through the middle of the block and receives its major tributaries at Karimpuzha. These make Tuta Puzha a perennial river. In regions upstream of Karimpuzha major land use is rubber.

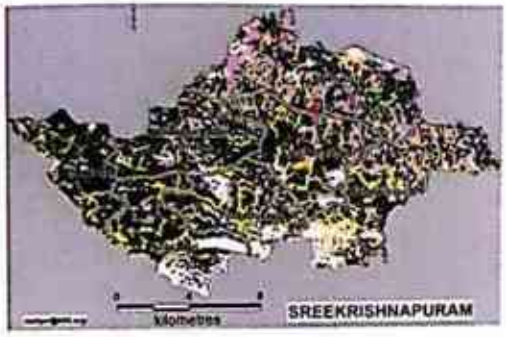


Fig. 9-13 Sreeekirshnapuram Block: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Table 9-04 Sreekrishnapuram Block

Panchayat	W Body%	Paddy %	Topo	NREDB	Pan fish
Cherpulassery	0.12	12.89		12	4
Kadampazhypuram	0.02	16.03		2	4
Karimpuzha	0.05	9.29		7	4
Pookottukavu	0.04	20.49		7	3
Sreekrishnapuram	0.05	16.53		3	4
Thrikkaderi	0.15	16.82		12	3
Vellinezhy	0.07	11.17		10	4

Mannarkad Block

There are ten panchayats in this block. Most of the panchayats are drained by streams leading to Kunthipuzha. The western region is drained by streams leading to Kadalundi Puzha. Eastern parts are drained by Kanjirapuzha in which there is an irrigation dam.

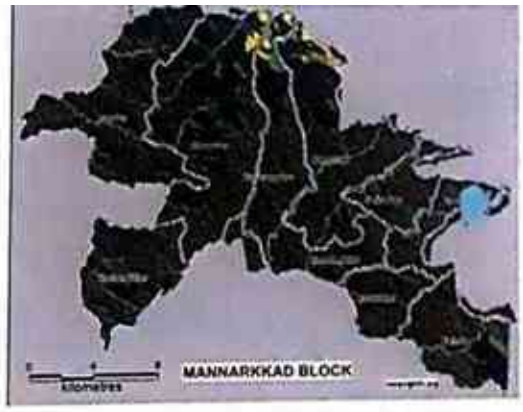


Fig. 9-14 Mannarkkad Block: Panchayats

The region has its own cultural features reflected in the local art forms and performing arts. Earlier times, stress was on imparting education. High way connecting Palakkad and Calicut pass through the block. There is road link to Coimbatore as well.

This is a more elevated regions, land use is dry land crops, paddy fields, rubber cultivation and forest. After independence, this area has been colonised by people from Travancore who introduced rubber and tapioca cultivation

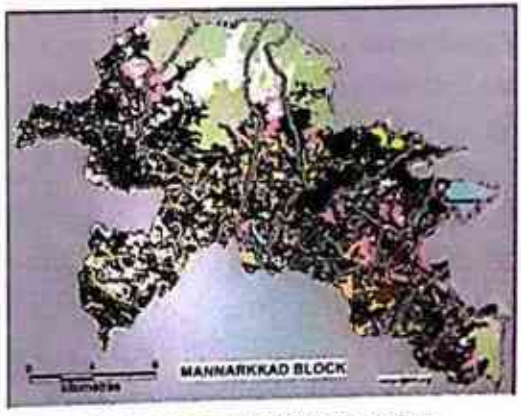


Fig. 9-15 Mannarkkad Block: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn

Panchayat	WBody%	Paddy %	Topo	NREDB	Pan fish
Alanallur	0.08	3.49		10	3
Kanjirapuzha	0.03	1.76		2	3
Karakurissi	0.02	10.61		1	3
Karimba	0.00	2.72			3
Kottapadam	0.06	6.73		17	4
Kumaramputhur	15.53	6.13			3
Mannarakkad	0.20	9.51		9	3
Thachanattukara	0.03	14.53		4	4
Thachanpara	21.71	0.00	1		3

Land use shows two large water bodies in Kumaramputhur and Thachampara panchayats.

Attappady Block

There are three panchayats in this block. Two river systems drain the block. The western and southern side are drained by tributaries of Tutha Puzha and southern regions by tributaries of Kanjira Puzha. The whole eastern side is drained by Bhavani River.

Fig. 9-16 Attappady Block: Panchayats

It is interesting to note the Bhavani River originating in the hills of the Western Ghats, flowing to south and then suddenly taking a easterly turn. The Mannarkad - Coimbatore road pass through this region. The area was ransacked by Tippu's soldiers. By the year 1860 it fell back into the hands of local chieftains.

Fig. 9-17 Attappady Block: Land use

Crops · Rubber · Paddy · Water · Built-up · Forest · Waste · Pantn.

British introduced schools in the area. Silent Valley is on the western side. Attappady is a low rainfall area, crops are cotton, chilly, ragi, etc. Much of the area is under forests. With this, we complete the Tutha basin and consider blocks in Bharatha Puzha after this.

Table 9-06 Attappady Block

Panchayat	W Body%	Paddy %	Topo	NRE DB	Pan fish
Agali	0.44	0.00			1
Pudur	1.08	0.0			1
Sholayur	1.50	0.00	2	1	3

Palakkad Block

Pattambi block, considered earlier, was situated between Tuta Puzha and Bharatha Puzha. Half the drainage was to Tuta Puzha and half to Bharatha Puzha. Upstream of this, the region was wider, Ottappalam block was draining to Bharatha Puzha and Sreekrishn-apuram Block to Tuta Puzha. From there we followed Tuata Puzha into Mannarkad Block and into Attappadi Block where it ended. Now to continue with Bharatha Puzha, after Ottappalam, it continues along boundary of Palakkad and Kuzhalmannam Blocks.

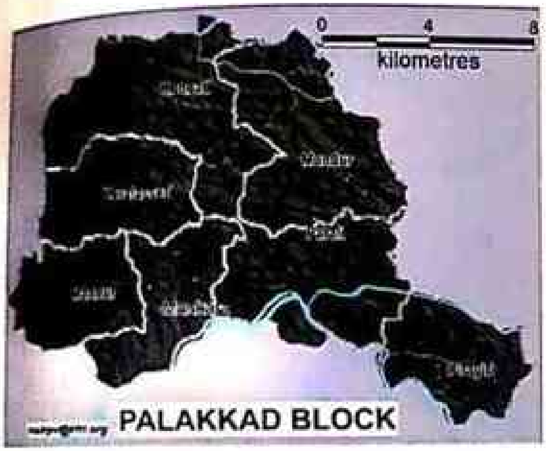


Fig. 9-18 Palakkad Block: Panchayats

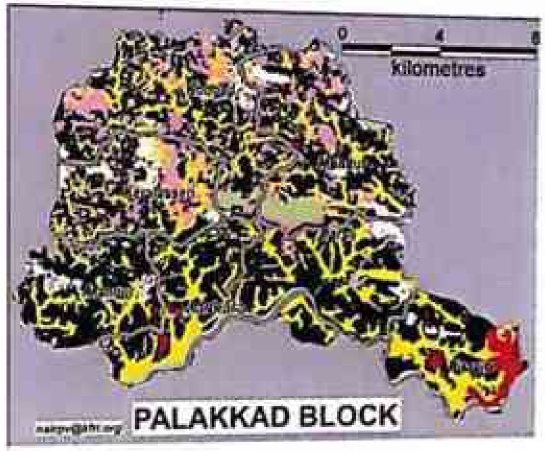


Fig. 9-19 Palakkad Block: Land use

Crops, Rubber, Paddy, Water, Built-up, Forest, Waste, Pantn.

Here the river is called Ponnani River or Nila. Near Parali, it divides into two and the northern branch continues as Kalpathi Puzha. This river branches again after about 10 km into Malampuzha and Koariayar at a place near Kadukkam Kunnu at the Palakkad town boundary. Thus Kalapathy Puzha drains much of Palakkad Block.

There are seven panchayats and Palakkad Muncipality in this block. The northern part of Plakkad block drains to Tuta Puzha (streams traverse long distance via parts of Sreekrishna Puram and Mannarkad blocks). The land use in these northern parts is mainly rubber. In areas nearer to Kalpathi Puzha, land use is dry land cultivation and paddy fields. The railway line passes along the right bank of Nila and then along Kalpathy Puzha. Mankara is a railway station enroute.

The Pollachi railway line passes through the middle of Palakkad town. Irrigation canals from Malampuzha reservoir complicate the drainage pattern. Branches of Kaplathy Puzha end into Malampuzha Block described next. Chittur Puzha (Kannadi Puzha) also flows south wards from Parali. Kalpathy Puzha dries up in summer.

Table 9-07 Palakkad Block

Panchayat	W Body%	Paddy %	Topo	MREDB	Pan Rsh
Keralassery	0.14	17.26	3	6	3
Kodumba	64.16	13.43	52	62	4
Kongad	0.12	20.98	2	14	3
Mankara	0.13	63.93	5	10	4
Mannur	0.15	3.48		4	4
Mundur	0.14	36.90	4	34	5
Palakkad MCP			58	26	2
Parli	0.23	16.97	12	15	3
Pirayiri	0.52	54.67	25	13	3

It seems, in many places paddy has been replaced by rubber. Historically, local kings were subdued by Kozhikkode rulers in 1757. This was followed by conquest by Hyderali of Mysore and then by the British. Palakkad fort was built by the Muslim rulers. Palakkad is well connected with the rest of India by road and rail. Palakkad's reputation as Kerala's granary is slowly becoming meaningless.

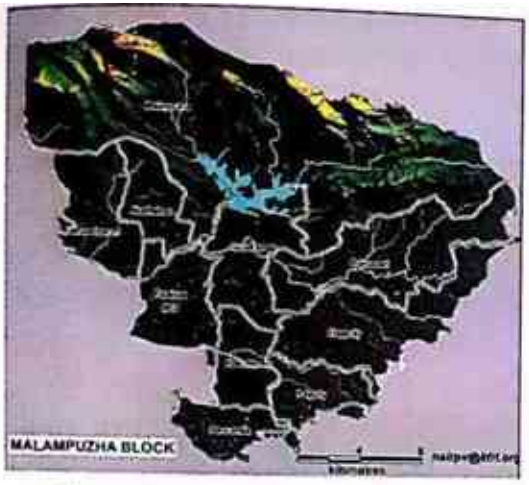


Fig. 9-20 Malampuzha Block: Panchayats

There are 10 panchayats in Malampuzha Block. As mentioned earlier, the terminal streams of Kalpathy Puzha are in this block. First branch is Malampuzha, from which Korair branches.

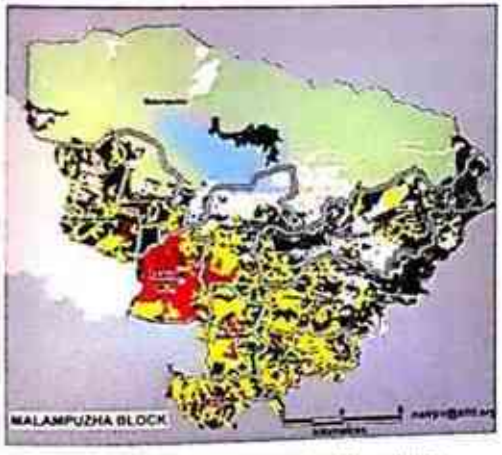


Fig. 9-21 Malampuzha Block: Land use

Crops | Rubber | Paddy | Water
Built-up | Forest | Waste | Pantn.

Northern regions are forested; Malampuzha reservoir is in the middle, which irrigates the paddy fields in the southern side. Land use is notably paddy fields in the southern part of the block. Malampuzha block is in the Palakkad gap. Industrial establishments of Palakkad is in this block.

Panchayat	WBody %	Paddy %	Topo	NREDB	Pan fish
Akathethara	0.38	21.57	6	7	3
Elappuly	0.18	65.71	112	42	1
Malampuzha	10.77	0.98	8		2
Marutha road	0.25	9.13	34	13	3
Peruvambu	0.57	85.41	22	94	3
Polpulli	1.49	12.65	30	44	
Puduppariyaram	0.13	12.67	10	9	3
Pudussery	1.39	14.11	89	9	2

Kuzhalmannam Block

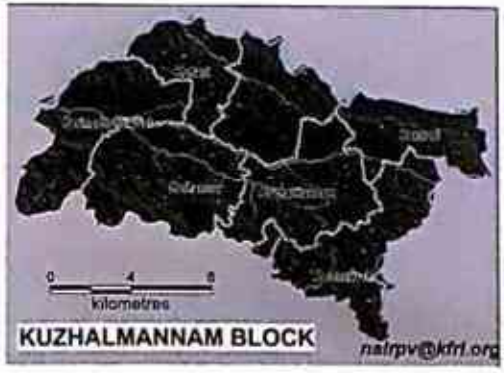


Fig. 9-22 Kuzhalmannom Block: Panchayats

Kuzhalmannam block is drained by Nila and its itributary, Kannadi Puzha. There are a large number of ponds and tanks in the basin. Land use is paddy fields followed by dry land crops. There are seven panchayats in the area.

The block has witnessed historical changes similar to Palakkad regions in general. There is a famous cattle market in this block. General features such as land reforms helping peasants and abandoning of paddy cultivation is common to this block also.

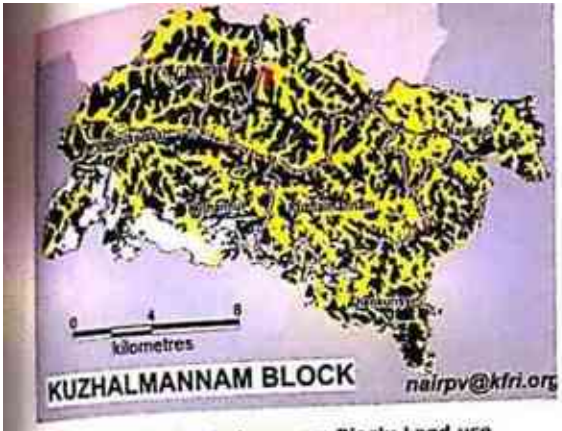


Fig. 9-23 Kuzhalmannom Block: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Fig. 9-09 Kuzhalmannam Block

Panchayat	W Body%	Paddy %	Topo	NREDB	Pan fish
Kannadi	1.74	0.39	5	30	3
Kottayi	0.45	37.53	21	17	3
Kuthanoor	0.39	25.38	14	45	3
Kuzhalmannam	1.09	35.33	13	55	4
Mathur	0.88	4.21	30	30	3
Pattancheri					1
Peringottukurissi	0.15	51.55	12	24	4
Thenkurissi	0.91	17.31	12	37	2
Vadakkarapathy					1

Chittoor Block

...nnadi Puzha comes into this block as Chittoor P... and continues on to Tamil Nadu. Koraiyar b... ...es into Valayar and Koraiyar at Kanjikkod. V... ...ar ends in the reservoir and streams joining it ...raiyar continue south wards and pass through C...toor Blcock into Tamil Nadu. Eastern portions ha...e black cotton soil.

Fig. 9-24 Chittoor Block: Panchayats

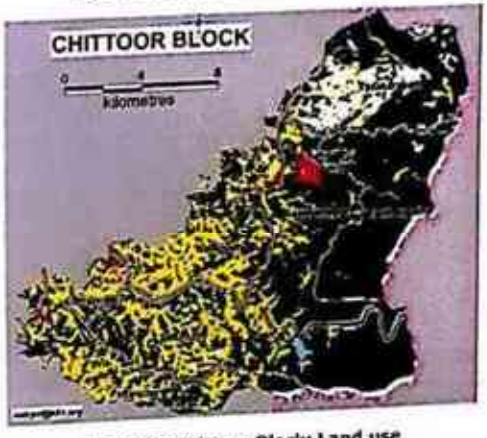


Fig. 9-25 Chittoor Block: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Fig. 9-10 Chittoor Block

Panchayat	WBody%	Paddy %	Topo	NRE DB	Pan fish
Chittur-Thathamangalam MCP			9	40	3
Eruthempathy	0.03	0.95	11	5	3
Kozhipampara	0.33	14.85	21	13	3
Nallepilly	0.85	17.93	78	49	2
Pattancherry	1.21	47.25	37	120	4
Perumatti	1.93	27.37	39	68	2
Vadakkarapathi	0.0	4.67	36		1

Alathur Block

Only three blocks remain to be described in Palakkad district. First is Alathur. Now we come down to Nila and follow a tributary that flows southwards. This tributary, Gayathripuzha flows down through Pazhayannur Block of Thrissur District and branch into two at an unnamed location as it enters the Alathur Block. One branch comes from southern side and is called the Mangalam Puzha.

Fig. 9-26 Alathoor Block: Panchayats

It goes beside Vadakkancheri town. Further upstream is the Mangalam Dam. Canals from the dam complicate the drainage system. Another branch from eastern side originating in Mudappallur areas (Aylur Puzha) join Mangalam Puzha. Gayathri Puzha continues east wards and flow beside Alathur town. It's origin is further east wards in Kollegode block and nearby areas. There are few reservoirs also in Kollengode block.

Alathur region was ruled local rulers and local chieftains before the British period. Land reforms have empowered peasants. Population and traditions are partly Tamil. The locality is well known on rest of Kerala as high way from Ernakulam to Palakkad and Coimbatore pass through the block.

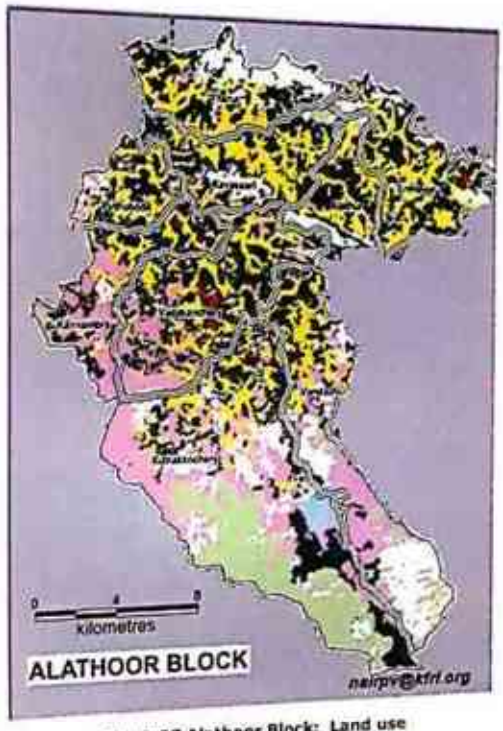


Fig. 9-27 Alathoor Block: Land use

Crops · Rubber · Paddy · Water
Built-up · Forest · Waste · Pantn.

Table 9-11 Alathur Block

Panchayat	W Body%	Paddy %	Topo	NREGS	Panfish
Alathur	0.38	22.80	6	14	1
Ennayur	7.76	46.11	12	44	2
Kanambra	0.25	33.43		30	2
Kavassery	0.47	36.09	6	38	3
Kuthakkanchery	3.28	11.08	1	31	2
Pudukkode	0.33	32.95	9	19	4
Thanur	0.35	27.61	11	31	1
Vadakkancheiry	6.53	18.89	5	35	3
Vandazhi	0.17	12.74	1	21	2

Land use consists of paddy fields and dry land crops in the lower regions and rubber and forest in the upper regions.

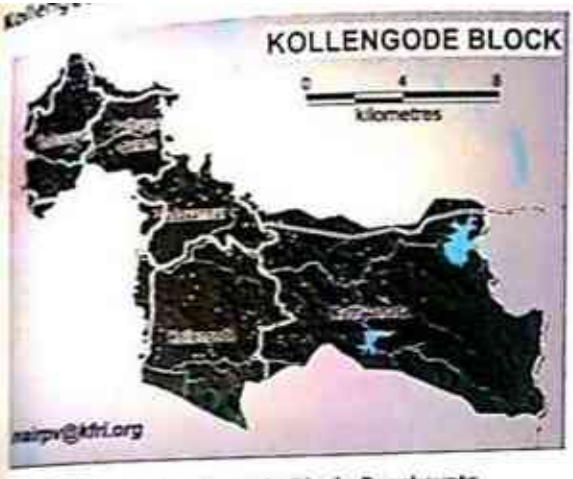


Fig. 9-27 Kollengode Block: Panchayats

There are five panchayats in Kollengode block. There is a large number of pond and tanks in Kollengode block. Land use is mostly paddy in the lower reaches and dry land crops in the upper reaches. Meenkara Chulliar dams are in this block.

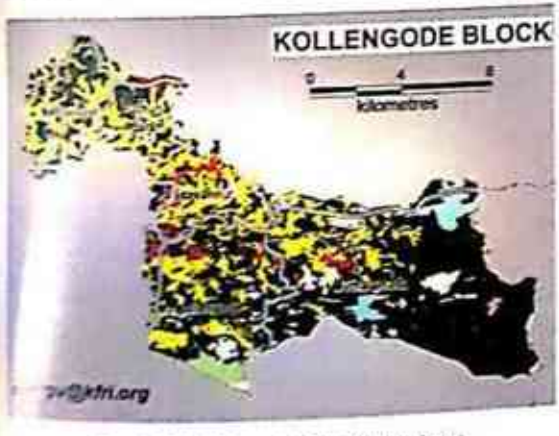


Fig. 9-28 Kollengode Block: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Table 9-12 Kollengode Block

Panchayat	Mlody %	Paddy %	Topo	NREDB	Pan tnh
Kudavayur	0.91	41.18	12	59	3
Kollengode	1.56	27.19	52	136	3
Muthalamada	5.57	10.10	56	85	2
Pudunagaram	1.40	25.05	13	34	4
Vadavannur	3.12	3.12	25	78	2

Fig. 9-29 Nemmara Block: Panchayats

There are six panchayats in Nemmara Block. Eastern portion of Nemmara Block is drained by rivers of Chalakudy basin. There is a prominent hill chain, the Nelliampathies separating Bharata Puzha and Chalakudy basins.

Historically Nenmara was part of Cochin. Later came under British rule. Nelliampathy is inside this block.

Fig. 9-30 Nemmara Block: Land use

Crops Rubber Paddy Water
Built-up Forest Waste Pantn.

Table 9-13 Nemmara Block

Panchayat	WBody%	Paddy %	Topo	NREDB	Pan fish
Ayiloor	0.30	17.90	3	32	3
Elavanchery	1.11	39.41	12	82	3
Melarkode	0.62	43.27	6	51	3
Nelliyampathy	5.13	0.00	1	1	
Nemmara	2.61	21.58	4	39	3
Pallassana	1.56	3.52	17	60	3