**DETAILED PROGRESS REPORT OF THE FIRST PHASE**

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# ASSESSMENT OF THE IMPACT OF MAN MADE MODIFICATIONS ON THE CHALAKKUDY RIVER SYSTEM IN ORDER TO DEVELOP AN INTEGRATED ACTION PLAN FOR SUSTAINABLE RIVER MANAGEMENT


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Project

team.

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# ASSESSMENT OF THE IMPACT OF MAN MADE MODIFICATIONS ON THE CHALAKKUDY RIVER SYSTEM IN ORDER TO DEVELOP AN INTEGRATED ACTION PLAN FOR SUSTAINABLE RIVER MANAGEMENT

## Introduction

## Rationale and background of the Project.

### (A). State of rivers.

Rivers represent the most rapidly renewing and most enduring geomorphic features on the surface of the planet. As a result of the complex interactions of climate, running water and land, rivers are shaped by landscapes as much as landscapes are shaped by rivers.

Rivers have been an integral part of human development throughout history. They can be considered the pillars of human civilization as they have formed the nuclei for human settlements from the very origins of mankind. Despite their vital importance and our total dependence in the natural systems, indeed it is likely that rivers have suffered the single most intense destructive onslaught particularly during the past one century of human history.

On the basis of understanding the importance of the rivers, Indian culture revered rivers and has woven a series of mythologies around them, giving them personae, moods and human traits. Yet the same human communities that have relied so much on rivers have an ambivalent approach to them. During the past few decades an exponential increase in human population, alarming disappearance of forests, rapid

urbanization and industrialization, intense agriculture and irrigation, growing demand for energy etc., have led to the massive exploitation and abuse of the Indian rivers.

Rivers are an important part of Kerala's landscape and flowing water in the most characteristic feature of the State. The luxuriant moist forests that once clothed the Western Ghats, coupled with the abundant rainfall gave rise to the 44 rivers ( 41 West flowing and 3 East flowing) of Kerala. These rivers are the life -line of the unique culture of this State. The State owes its prosperity to its rivers. But through several of our unsustainable activities, almost all these rivers are either dead or are on the verge of death. Accelerating denudation of catchment area vegetation cover, construction of large dams across the rivers, exploitive and indiscriminate sand mining from the river bed, pollution of river water, destruction of riparian vegetation and encroachment of river banks, intrusion of salinity into the far inland areas of the rivers etc, have resulted in a shocking imbalance in the river basin environment of Kerala.

Rivers of Kerala are relatively small. The annual discharge from all the rivers of Kerala is approximately 78401 $mm^3$, whereas a single river like Godavari has an annual discharge of 1,05,000 $mm^3$ (James 1988). Smaller rivers are more sensitive and directly respond to the slightest of disturbances. This is another prime reason of the extremely fast degradation of the river systems of this State. Further, the rate of river water utilization in Kerala is comparatively high due to the high density population. When rivers die in a State like Kerala, it will simultaneously result in the destruction of the entire economic and environmental resource base of its population.

**(B). River basin as a major watershed.**

A watershed is all the land and water area which contributes runoff to a certain point. The watershed above any point on a defined drainage channel is therefore all the land and water areas which drains through that point. Watershed is marked by an elevated line that forms a division between two areas drained by separate streams, systems or bodies of water (Tideman 1996). A small watershed that of a few hectares that drains into a small stream forms part of a larger watershed, which in turn forms part of still larger watershed, until the combined watersheds may become a major river basin draining millions of square kilometers of land.

For planning and properly executing a conservation project, out of all possible units like Villages, States, Provinces, Countries etc., the only natural unit area is that of a watershed. Hence watersheds are considered ideal units for planning and management of natural resources. Since the largest watershed (mega watershed) which is the river basin is a natural integrator of all hydrologic processes within its boundaries, it forms a rational physical unit for soil and water management activities. Water interact with and to a great extent controls over natural components within a basin such as soils, vegetation, and animal life. Thus a river basin not only addresses water resource management activities but deals with issues of water quality, land conservation and management, domestic water supply, agriculture and irrigation, outdoor recreation, preservation of natural heritage, the livelihood of the people, especially the marginalized communities (CWRDM 1998). As a rule, watershed development requires the contributions of many disciplines and aims at improving the quality of life of local residents of the area, as well as management of resources.

The government of India in 1987 adopted a national water policy which stipulates that resource planning in the case of water has to be done for hydrological

units such as drainage basins as a whole. Thus for watershed development and management efforts the unit should be considered as a whole River Basin ( Chaudhuri 1998). The State water policy developed by the Govt. of Kerala in 1992 also envisages the urgent need for integrated river basin planning.

**(c). Development of a River Basin Action Plan.**

The ultimate aim of this project is to develop an integrated action plan for the sustainable management of the Chalakkudy River System in total on a watershed basis, giving due care to the marginalized societies within the area. The action plan shall be made in such a way as to make it into a series of small viable projects which can be implemented by the local bodies at the local level. So far in this State, there has been no effort for the proper coordination of the water- related activities of an entire river basin (James *et. al* 1997). Lack of such integrated planning has led to many of the river basin development projects ending up with several socio-economic and environmental problems.

Lack adequate basic data is an important handicap for the development of an integrated and sustainable action plan for any river system in this State. Therefore the very basic prerequisite for the development of an action plan is the generation of a sound database regarding several aspects that influence the river or which are influenced by the river. It is expected that such a database will go a long way in gaining a better understanding of the river system. Therefore maximum effort in this study was given for the collection and compilation of relevant secondary data. However efforts were also taken to have possible information from primary sources also. The ensuring model and experiences gained from this effort offer great scope for replication elsewhere in the State.

OBJECTIVES OF THE STUDY

1. **Survey for the data regarding the spatial changes in the forest cover of the basin.**
2. **Survey and compilation of the available meteorological and hydrological data from the existing sources.**
3. **Survey of the socio-economic status of the tribals in the basin.**
4. **Survey of the socio-economic status of the traditional fishermen in the basin.**
5. **To make an assessment of the wateruse efficiency of the major and minor irrigation schemes in the basin.**
6. **To make an assessment of the landuse and agriculture pattern in the basin.**
7. **To make an assessment of the drinking water scenario of the basin.**
8. **Survey for the pollution sources and assessment of the water and sediment quality in the river.**
9. **Evolution of the sandmining-related problems of the river.**
10. **Assessment of the present status of tourism in the basin.**

## CHALAKKUDY RIVER BASIN – AN OVERVIEW

**Location and extent.**

Chalakkudy is the fifth longest river in Kerala and its basin lies between $10^0$ $05^{'}$ to $10^0$ $35^{'}$ North latitude and $76^0$ $15^{'}$ to $76^0$ $55^{'}$ East longitude. The basin is located in the Eranakulam, Thrissur and Palakkad districts. The basin is bounded by Chittur and Alathur Taluks of Palakkad district and Mukundapuram Taluk of Thrissur district in the North, Alwaye, Kunnathunad and Paravur Taluks of Eranakulam district in the South, Kodungallur Taluk of Thrissur district in the West and Tamil Nadu in the East. The total drainage area is 1704 Sq. km. out of which 1404 Sq. km lies in Kerala and the rest 300 Sq. km in Tamil Nadu. The length of the river is 145.5 km. The basin includes15 Panchayats, one Municipality, and three Districts.

**Watershed delineation**

The mega watershed of the Chalakkudy Basin is divided into 57 sub watersheds and 140 micro watersheds. The shape of Chalakkudy Basin is triangular with its base along the east, having a length-width ratio of 3:1.

## Physiography

Chalakkudy River is formed by the conference of four major tributaries namely Sholayar, Parambikulam, Kuriarkutty and Karapara.

# Sholayar River

Sholayar River originates from the Coimbatore district in Tamil Nadu. It flows for 44.8 km and turns North and joins Parambikulam River 1.6 km before Orukumbankutty at an elevation of 464 m above MSL. Sholayar River enters Kerala on the Southern border of the Nelliampathy plateau.

**Parambikulam River**

Parambikulam River originates from the Coimbatore district in Tamil Nadu. It flows parallel to and North of Sholayar River and joins Kuriarkutty 536 m above MSL.

**Kuriarkutty River**

Kuriarkutty originates from Anamalais in Kerala and joins Parambikulam River at Kuriarkutty.

**Karapara River**

Karapara River originates from Nelliyampathy Hills of Palakkad district in Kerala. It flows West and turns South West till it reaches the main river at Orukumbankutty at 455m above MSL. From the spot where Karapara River loins the main River, it is called the Chalakkudy River that after a few kilometers reaches the plains. These are also certain independent and large streams directly joining the main river namely Anakayam Thodu, Charpa Thodu, Kannamkuzhi Thodu, Pillapara Thodu and Arurmuzhi Thodu. Till it reaches the plains, the river has a rocky bottom with deep crevices and pools and also with many rapids and falls, the most famous one being Athirappilly falls. In the plains the river flows through highly fertile tracts. The river finally joins the right arm of Periyar at Elanthikkara, a few kilometers before flowing into the sea.

**Dams in the Basin**

There are six dams in the Basin namely Poringalkuthu, Sholayar, Upper Sholayar (in Tamil Nadu), Parambikulam, Peruvaripallam and Thunakadavu. (There are a few small dams in the Basin which is within the Indira Gandhi Wild life Sanctuary in Tamil Nadu).

**Details of dams in the Basin**

1. **Poringalkuthu Hydro Electric Project**

This project is situated at Puliyilapara in Mukundapuram taluk of Thrissur district at $10^0$26' North latitude and $76^0$44' East longitude.

**Salient features**

| | | |
|---|---|---|
| Catchment arera (Sq.km) | - | 752.20 |
| Average Runoff (M.Cu.m) | - | 538.01 |

| | | |
|---|---|---|
| Design flood (Cu.m/sec) | - | 2265.35 |
| Type of dam | - | Masonary gravity |
| Full reservoir level (Meters) | - | 423.97 |
| Number of generating units | - | 4 |
| Date of Commissioning | - | 1957 |
| Installed Capacity | - | 32.0 MW |

**2. Sholayar Hydro Electric Project**

This project is situated at Ambalappara in Mukundapuram taluk of Thrissur district at $10^0$77 North latitude and $76^0$45' East longitude.

**Salient features**

| | | |
|---|---|---|
| Catchment arera (Sq.km) | - | 186.48 |
| Average Runoff (M.Cu.m) | - | 396.43 |
| Design flood (Cu.m/sec) | - | 1710.33 |
| Type of dam | - | Masonary gravity |
| Full reservoir level (Meters) | - | 811.68 |
| Number of generating units | - | 3 |
| Date of Commissioning | - | 1966 |
| Installed Capacity | - | 54.0 MW |

**3. Parambikulam Group Dams**

This group of three dams were constructed as per the Parambikulam Aliyar project signed between Kerala and Tamil Nadu. All the three dams are within the Parambikulam Wildlife Sanctuary. Water from these dams were being used by Tamil Nadu for power generation and irrigation.

**Submergible areas**

| | | |
|---|---|---|
| Parambikulam dam watershed area | - | 5104.000 Acres |
| Thunakadavu dam watershed area | - | 458.490 Acres |
| Peruvaripallam dam watershed area | - | 342.500 Acres |
| | | 5904.990 Acres |

**Other Constructions**

| | | |
|---|---|---|
| Parambikulam masonary dam alone | - | 31.200 Acres |
| Parambikulam earth dam | - | 17.400 Acres |
| Parambikulam Colony area | - | 35.890 Acres |
| Parambikulam Tunnel entry Colony and Central tower | - | 0.8525 Acres |
| Thunakadavu Camp exit | - | 24.553 Acres |
| Parambikulam Camp exit | - | 1.125 Acres |

| | | |
|---|---|---|
| Leading Channel from Thunakadavu | | |
| dam to Kerala Border | - | 37.550 Acres |
| Peruvaripallam Dam | - | 12.320 Acres |
| Connecting Channel between | - | 6.130 Acres |
| | | 169.0305 Acres |

**Upper Sholayar Dam**

This dam is situated within the Coimbatore district of Tamil Nadu.

**Proposed dams in the Basin**

**(A) Athirappilly Hydro Electric Project**

The proposed Athirappilly Hydro Electric Project is to be located 39 km from Chalakkudy, along Chalakkudy River at Vazhachal almost 3 km downstream of the existing Poringalkuthu left bank powerhouse. Here a 23m high dam is to be constructed and water will be diverted through a 4533 m long tunnel to a powerhouse to be constructed nearby Kannamkuzhy Thodu, a tributary of Chalakkudy River. However this proposed project being questioned at the Kerala High Court and at present the hearing is going on.

**Kuriarkutty – Karapara Multipurpose project**

The originally proposed Kuriarkutty – Karapara project was expected to meet the irrigation requirements in Bharatapuzha Basin after generating power. In this proposed project dams are to be constructed at Karapara and Kuriarkutty which are two major tributaries of Chalakkudy River and also another one along Pulikkalar which is a small tributary of the same river. It is understood that inspite of several submission of this proposal to the Ministry of Environment and Forests, clearance has not been given mainly because it will damage the some of the last remaining forest areas in the basin.

**Some of the most obvious impacts of dams on the River System**

Rivers with their moving waters maintain ecosystems which characteristically riverine. Therefore the construction of a dam across the river literally causes an ecological disaster. This has happened to Chalakkudy River System also. Dams along this river has drastically effected the riverine physical and chemical conditions. The biological communities which the river normally support are also destroyed. The obstruction causes a swelling of the river size through lateral spread of water. The resultant water quality is very different from that of a river bed become inundated and their ecosystems are destroyed. Such inundation have directly submerged extensive areas of thee moist forest in this basin. Apart from the direct submersion of forests, large areas of virgin forests in the basin are disturbed and degraded due to the associated developments with the dams like powerhouses, project colonies, approach roads, power lines, quarries etc.

Reduction of flow is another consequence of the construction of dams. This leads to the progressive restriction of the downstream reaches of the river to a smaller width within the original channel. Reduction of flow reduces the self purifying capacity of the river. This situation also leads to the incursion of salinity

into the far inland areas of the river. All the above mentioned problems are very obvious in the Chalakkudy River.

Numerous tribal families in this basin are affected by the construction of dams. Most of them have been displaced from their traditional hamlets. Unplanned displacement of tribal families due to dam construction has led to several sociological problems. All the above mentioned aspects related to the construction of dams in the basin will be explained in the appropriate chapters.

In some of the basic references and records (eg: Public Works Department, Department of Irrigation, Kerala State Electricity Board, Kerala State Land Use Board etc) it is seen that all the major tributaries above mentioned are perennial. However from our field experience, we have found that several parts of the channels of even the major tributaries are completely dry just after the monsoon. These are either because of deforestation or due to construction of dams. The important stream channel which are dry due to deforestation are upper reaches of Karapara river, Thekkady Ar, Veti Ar, upper reaches of Kannnkuzhy Thodu, Charpa Thodu, upper reaches of Kappa thodu etc. The channels which are completely dry due to the arrival of dams are the Sholayar River channel just downstream of Upper Sholayar Reservoir upto Kerala Sholayar Reservoir, Sholayar River channel downstream of Kerala Sholayar Reservoir upto Orukumbankutty, Parambikulam River Channel downstream of Parambikulam Reservoir upto Orukumban, Thunakadavu River channel downstream of Thunakadavu Reservoir until it reaches the Kuriarkutty etc. A detailed investigation is necessary in order to accurately calculate how many kilometers of the tributaries of this river remain dry just after monsoon. This should be taken into serious consideration while developing any sort of integrated planning for the river basin. Just like the case of the above mentioned streams, several waterfalls like Charpa, Karapara, Moonanakayam etc have also become seasonal.

**Inter Basin Transfer of Water**

Enormous quantities of water from Chalakkudy River Basin is being transferred to the adjacent River basins, perhaps the maximum among the rivers of Kerala. Water from Parambikulam Group Dams and Upper Sholayar is diverted to the Aliyar (tributary of the Bharathapuzha) Reservoir, situated in Tamil Nadu. As part of the Edamalayar augmentation scheme excess water from Poringalkuthu Reservoir is diverted during the monsoon season to Edamala (tributary of Periyar) Reservoir. The nature of transfer of water in the former is first through a tunnel and then through a canal, while that of latter is through the canal only.

Little is known about the impact of these water transfers from one river basin to another. Both the donor river and the recipient river definitely undergo substantial and relatively permanent geomorphological changes as a result of the major changes to the hydrograph, in terms of the magnitude and timing of flows. In the case if donor systems like Chalakkudy River these changes are associated with loss of water, while in the recipient river, the effects are associated with increases in discharge. Of course the results may be variable according to the variability of discharge either continuous (as in the case of Parambikulam Group Dams to Aliyar Reservoir) or seasonal (as in the case of Poringalkuthu Reservoir to Edamala Reservoir). Moreover these effects are influenced by the nature of the transfer route for eg: tunnels, canals etc. Along with the alterations in the flow, there could be several other impacts like drastic changes in water quality, changes in major nutrient

and ion concentrations, altered thermal characteristic and pH, variations in transport and retension characteristics, all of which are vital determinants of the health of the river system.

Another aspect to be considered is the impact on riverine biodiversity through and mixing of previously isolated biotas, communities and populations. Defined by topography, river basins represent natural islands in which some components of the biota is essentially restricted by its ability to disperse. Such topographic isolation and environmental fluctuations together drive speciation events within river basin. Thus river basins are natural units and there is seldom any chance for the inter mixing of fresh water species from one system to the other. Such transfers and genetic mixing of separate populations can also result in the loss of the genetic destruction of local endemic forms. Inter basin transfer of water provided the opportunity for the transfer of certain unwelcome, aggressive introduced species (eg: *Tilapia* and aquatic weeds). Through the transfer of water, exchange of diseases among the aquatic organisms are also common. It was understood in this survey that in 1990's, the dreadful fish disease which was observed in Parambikulam reservoir was also detected in Aliyar Reservoir within a few months. Detailed investigations are necessary inorder to find out the impacts of Inter Basin transfer of water and Chalakkudy River Basin provides immense scope for such studies.

**Parambikulam – Aliyar Project**

This project agreement was made between Kerala and Tamil Nadu Governments in 1970, with retrospective effect from 1958. As part of this agreement Reservoirs (in Chalakkudy Basin) were constructed on the Sholayar River (in Tamil Nadu), Sholayar River in Kerala, Parambikulam River, Peruvaripallam River and Thunakadavu River. Water from all these reservoirs except the Kerala Sholayar Reservoir is used by Tamil Nadu through conduits. The water thus diverted from Chalakkudy basin in used by Tamil Nadu for irrigation and power generation.

There is a persistent complaint from the Kerala part that this agreement itself is one sided ie; in favour of Tamil Nadu. Further, the adequate share of water which is to be given from the Parambikulam Group of Dams and Tamil Nadu Sholayar Dam to Kerala is not given by Tamil Nadu Government. Release of water from this reservoirs to Kerala is not as per the agreement but erratic. As part of the agreement, sharing of water is to be reassessed and renewed after 30 years from 1958. However nothing in this regard has happened so far.

**Regulator-cum-bridge at Kanakankadavu**

For the past 15 to 20 years incursion of salinity into the inland areas of Chalakkudy river has become a serious problem. In summer the natural flow in the river is very low, so that the intrusion of saline water cannot be effectively curtailed. Extensive removal of forests from the catchment areas, construction of six dams across the river, a major river diversion scheme and numerous lift irrigation schemes, transfer of water from this River Basin to other basins, uncontrolled sand mining etc, are the main reasons which reduced the flow in the river.

In order to check saline water intrusion a temporary barrier made of sand used to be constructed at Kanakankadavu during January each year. Along with the arrival of South West monsoon in June, flow in the river suddenly rises and this sand barrier (called bund) used to be demolished. This bund used to virtually cut-off the Chalakkudy river from the semi-saline lower reaches of Periyar and the back

waters. Due to the presence of the bund, high tide and low tide was not experienced in the lower reaches of the river. On the other hand the river continued to receive all the agricultural, industrial and domestic wastes from the headwaters up to its month. All these wastes thus got to be deposited in the river channel itself making it something like a sewage channel. The bund also acted as a barrier for several migratory fishes which are important components in the fishery wealth of this river.

As construction of the bund every year became inconvenient for the Panchayat (Puthenvelikkara), with the financial support from several agencies a regulator-cum-bridge was constructed in March 2000. The total expenses came to Rupees 16 crores. This regulator-cum-bridge is constructed almost 1 k.m upstream of the area where the former sand bund used to be constructed. The present position of the regulator was also decided for the convenience of road accesses through the bridge. This has turned 1 k.m stretch of the river with fresh water into semi-saline zone. Many lift irrigation schemes in this 1 k.m were forced to shut down. Within three months after construction, in the subsequent monsoon floods in July 2000, the lower portion of the regular got damaged and now sand-filled bags placed at the bottom of the river are supporting some of the shutters of the regular. There are also several complaints regarding the shabby construction of this regulator. According to the people of the area, the regulator is not functioning properly and the intrusion of saline water is a threat to the lift irrigation schemes in the immediate upstream.

**Status of certain ecosystem directly associated with the river**

There are several ideal habitats associated with the river which needs special mentioning. This includes a serious of riffles and pools along the low and middle section of the streams, several rapids and cascades, riparian vegetation, flood plains, oxbow lake-like structure, sand banks, perennial ponds, forested marshes, Pandanus wetlands, kolefields, the river mouth where Chalakkudy joins Periyar etc. A few of the above are mentioned below in details.

**Riparian vegetation**

Till recently Chalakkudy River had healthy riparian vegetation. Still this is one of the rivers in Kerala which is having relicts of riparian vegetation in substantial extends. Healthy riparian zones maintain the channel form and serve as important filters of light, nutrient and sediment. Riparian vegetation maintains the stream flow, improves water quality, provides habitats for fish and other riverine organisms, function as corridors for their movement, control river temperatures and maintain bank stability.

Destruction of riparian vegetation along Chalakkudy River is due to several reasons. Riparian vegetation in the upper reach (from Thumboormuzhi to the upper tributaries) has been degraded primary due to the construction of reservoirs, clear felling of forest, raising of both private and government plantations and also through the canalization of streams. On the other hand, degradation of riparian vegetation along the down reaches (from Thumboormuzhi to the river mouth) was primary due to the encroachment for agriculture and irresponsible construction of pump houses in the purampok lands along the river bank. In our survey it was found that from Chalakkudy, town to the mouth of the river (ie. a distance of 15 k.m.), within each kilometer there is an average of four major lift irrigation schemes (above 25 H.P) and an average of 15 smaller lift irrigation schemes (below 25 H.P). Each pump house for the lift irrigation schemes has cleared at least 20 meters width of

riparian vegetation and that of smaller scheme 5 to 10 meters. Within this 15 kilometer stretch, almost 3 kilometer area has been cleared for the construction of pump house alone. This is one of the important reasons for the fragmentation of the longitudinal continuity of the downstream riparian vegetation.

**Flood plains**

Floods are a part of the normal range of hydro-geomorphological events operating within the drainage basin. When the flow in the channel increase overtopping the lands it will spill over and spread out along the flood plain, where due to the flatness of the terrain, water spreads slowly to the maximum area possible. In the flood plains water will be almost stagnant resulting in the progressive deposition of alluvial silt. The deposition the flood plains which are among the most fertile areas on small. They are also ideal feeding, breeding and the nursery grounds of several fishes and other riverine organisms.

There were extensive flood plains along Chalakkudy River at Meloor, Kadukutty, Vayanthala, Mambra, Moozhikulam, Kuzhur, Kundur, Puthenvelikkara etc. All these flood plains have been transformed into paddyfields as the hydrologic regime of flood plains is most ideal for rice cultivation. These paddyfields perform almost all vital functions of natural flood plain wetland. Paddyfields are considered man-made, freshwater, grass covered seasonal wetlands. Recently extensive areas of these paddyfields have been reclaimed for construction of industrial, residential and commercial complexes, mining of soil for brick and tile-making, or for cultivation of dryland crops.

Some of these flood plain areas particularly in the extreme down reaches remain inundated for more than the six months for the year. In such areas paddy cultivation may be possible only for one season. Such paddy lands are locally called as kolefields. Certain extensive kolelands are found at the down reaches of this river.

**Oxbow lake – like structure**

The relicts of an Oxbow lake-lake structure still exists in Vainthala, which is part of an extensive flood plain of this river. Formation of Oxbow lake is a natural process of the river. A river meanders or takes a winding course when faced with an obstruction. As the river meanders, greater erosion occur on the outer concave side of the river bend while deposition of silt dominates the inner convex side. With the passage of time, the formation of the concavity continues until the U-shaped meander of the river closes it upon itself. Later in a flood, the main course of the river cuts a channel through the initial portion of the meander isolating the loop. Eventually through the deposition of alluvial soil, the loop gets detached from the main channel forming a lake. The name Oxbow is given to such lakes to denote the U-shaped frame forming the collar put on an Ox’s neck.

Formation of Oxbow lakes is very rare among the river of Kerala mainly because of the steep topography of the state, which does not permit meandering of rivers. The formation of this Oxbow lake must have happened several centuries ago, through the detachment from the main channel of the Chalakkudy River. A good portion of this Oxbow lake-like structure has been either encroached upon or degraded. A small portion remains undamaged. It needs urgent care and

protection as it is a part of our natural heritage and should remain as specimen for the generations to come.

**Perennial ponds**

There are numerous perennial ponds in this basin, most of which are found within paddyfields. Most of them are not properly managed and need urgent care and attention. Since water has already become a limited resource, these perennial ponds have a great role to play. At present it seems that the local bodies are not at all giving due care and attention to the natural ponds. These perennial ponds are of great importance from a biological point of view also. Such ponds among paddyfields may contain some of the relict species of former virgin plains. Large scale paddyfields reclamation in a major threat to these perennial ponds.

**Forested freshwater marshes**

Out of the several kinds of wetlands found in this basin forested freshwater marshes require special mentioning. There are a few characteristic forested freshwater marshes in this basin in particular in the Parambikulam area. The clayey soil found in most of the areas of Parambikulam Valley prevents fast percolation of water. This leads to poor drainage, which results in formation of the clayey loamy marshes commonly called as 'Vayals'. Such marshes are ideal wetlands and needs detailed investigations. The soil is chocolate coloured, rich in organic matter and support abundant vegetation. However such vayals found in Parambikulam are highly degraded due to soil erosion. The destruction of forest in this area followed by the taungya cultivation lead to massive soil erosion and the extensive development of teak plantations afterwards changed the hydrologic regime of these marshes.

These vayals have played the most significant role in supporting the remarkable rich wild life which once survived in this valley. The palatable grasses found in these vayals attract herbivorous like gaur, spotted deer, sambars etc. and also the carnivorous which depend upon these ecosystems for getting their prey. Therefore proper management of these marshes must get top priority in wild life management.

## COLLECTION AND COMPILATION OF METEOROLOGICAL AND HYDROLOGICAL DATA REGARDING THE BASIN.

**Rainfall in the Basin.**

Chalakkudy river basin experiences an average annual rainfall of 2599 mm of which 1188 mm is received during the South West monsoon and 655 mm during North East monsoon.

. There are only 16 rain gauge stations in this basin. Especially in the middle and down reaches of the river, there are only four rain gauge stations and West of Chalakkudy there is not even a single station. An accurate picture of the rainfall experienced in the basin can't be made with the available data. More rain gauge stations are needed adequately spread over the basin for better understanding. Out of the existing stations Vettilappara was installed recently in 1984 and it is understood from the Hydrology Section of the Irrigation Department that a new station would be started at Vainthala soon. The existing rain gauge stations and there locations are shown below.

| Rain gauge station | Latitude | Longitude. |
|---|---|---|
| Chalakkudy | - $10^0$ 17' 45" | $76^0$ 19' 30" |
| Potta | - $10^0$ 17' 00" | $76^0$ 17' 00" |
| Mattathur | - $18^0$ 16' 05" | $76^0$ 12' 43" |
| Thumburmuzhi | - $10^0$ 18' 00" | $76^0$ 32' 00" |
| Vettilappara | - $10^0$ 17' 30" | $76^0$ 32' 00" |
| Poringalkuthu | - $10^0$ 19' 22" | $76^0$ 37' 54" |
| Orukumban | - | |
| Orukumbankutty | - | |
| Sholayar (P.H) | - $10^0$ 18' 00" | $76^0$ 43' 00" |
| Sholayar dam | - $10^0$ 19' 00" | $76^0$ 44' 00" |
| Sholayar Reservoir | - | |
| Karapara | - $10^0$ 28' 00" | $76^0$ 41' 00" |
| Thellikkal | - | |
| Peruvaripallam | - $10^0$ 26' 30" | $76^0$ 46' 30" |
| Thunakadavu | - $10^0$ 25' 00" | $76^0$ 47' 00" |
| Peruvaripallam | - $10^0$ 18' 00" | $76^0$ 32' 00" |

The annual average rain received during 1963 to 1998 are shown in the table-4a. The maximum rain received in the basin during these years is at Thumburmuzhi (5969mm) in 1981 and the minimum rain received in the basin is at Peruvaripallam in 1986. (1014mm). In the basin 1965,1967, 1973, 1976, 1981, 1982, 1986, 1989, 1993 and 1996 can be considered drought years.

The only agro-meteorological station in the basin is at the Agricultural Research Station, Chalakkudy. Daily record of rainfall during the 1999, daily record of pan evaporation during 1999 and weakly weather data for the period from January to December 1999 are shown in tables-5, 6, and 7 respectively.

**Hydrological Data.**

The office of the Assistant Engineer, Hydrology Section of the Irrigation Department at Chalakkudy is measuring the daily discharge of this River at Ambalakadvu. Data from this office clearly indicate that, the flow in the river has gone down alarmingly since early 1980's (Fig-3). Fig-4 shows a sharp decline in discharge from 1981 onwards. Fig-5 shows that this declining trend of daily discharge is progressively increasing year after year from 1978 to 1991.

The reason for this declining trend of river discharge could be explained only after making detailed investigations. For this, the reservoir operation data, amount of

water used by major irrigation scheme, lift irrigation schemes, and domestic water supply, mode of operation of the regulator at Kanakkankadavu etc. are needed.

Fig-6 shows the utilizable yield as well as the total requirement of water in Chalakkudy River. The Total requirement which is 1900 $Mm^3$. Considerably exceeds the utilizable yield which only 480 $Mm^3$ Fig-7 indicates the monsoon flow and lean flow in this river. Monsoon flow is 1100 $Mm^3$ where as lean flow is 25 $Mm^3$ only.

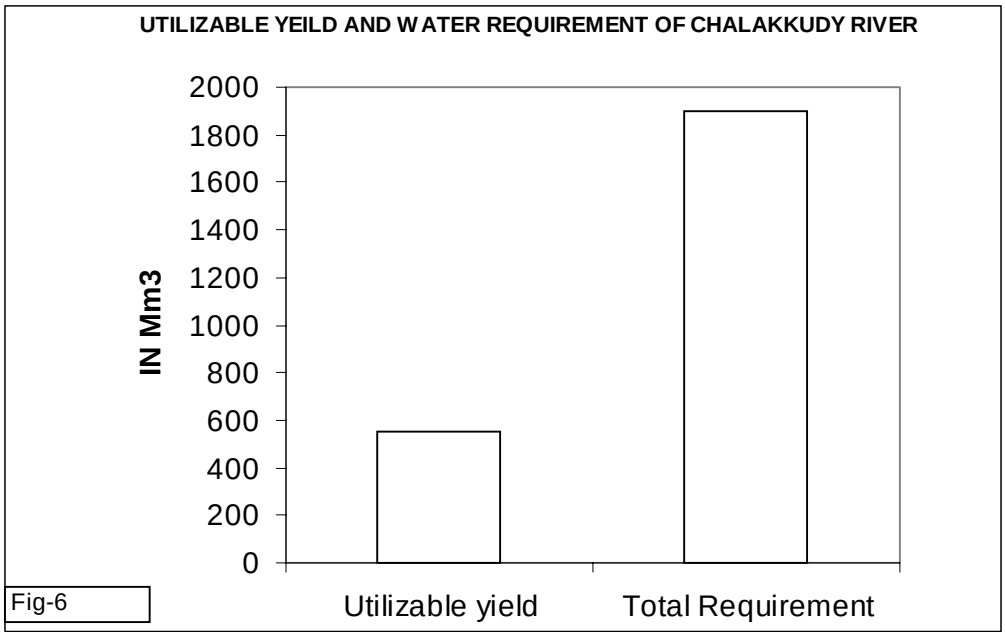

UTILIZABLE YEILD AND WATER REQUIREMENT OF CHALAKKUDY RIVER
IN Mm3
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Utilizable yield
Total Requirement

Fig-6

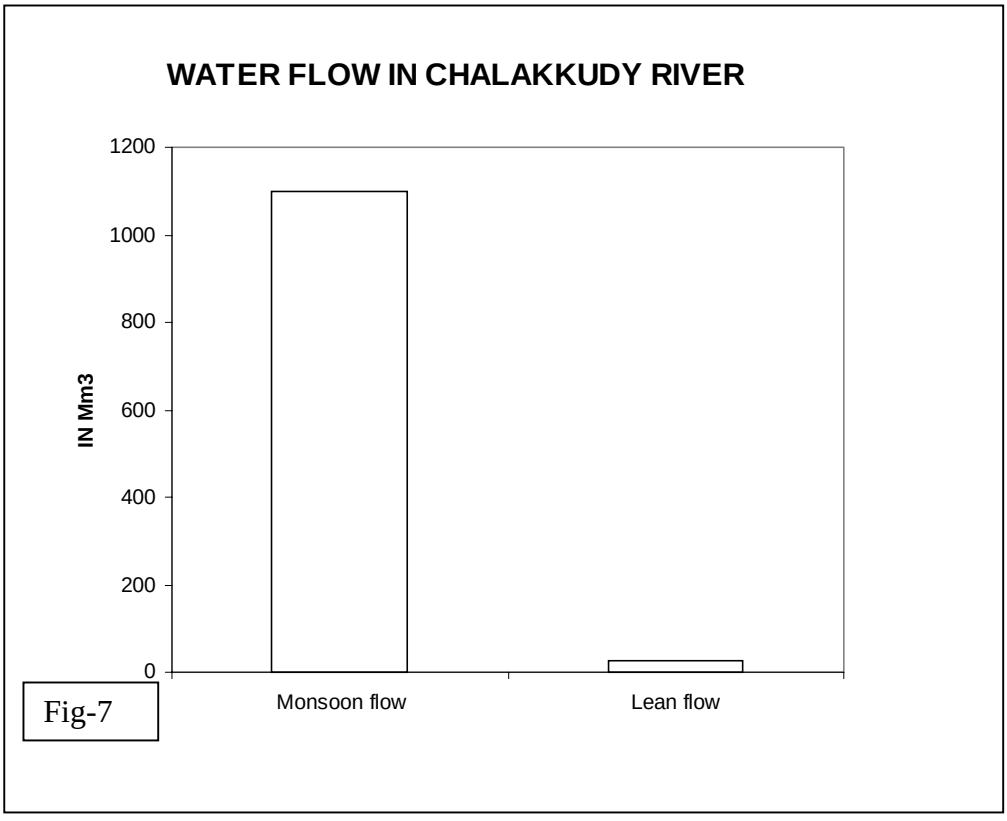

WATER FLOW IN CHALAKKUDY RIVER
IN Mm3
1200
1000
800
600
400
200
0
Monsoon flow
Lean flow

Fig-7

# SPATIAL CHANGES OF FOREST COVER IN THE BASIN

Forests in the Chalakkudy River Basin occupies a pivotal position in the natural vegetation cover of Western Ghats. Forests of this basin form a major chunk of the wildlife habitat extending from Peechi to Indira Gandhi Wildlife Sanctuary (in Tamil Nadu) through the Anamalais and therefore sustain large, viable populations of wildlife. The Parambikulam Wildlife Sanctuary which is the proposed second 'Tiger Reserve' in the State forms the central part of the above mentioned wildlife biological unit. Parambikulam Wildlife Sanctuary also forms the heart of the forest area along the upper reaches of the Chalakkudy Basin. To the North and North East of this sanctuary lies the Nelliyampathy Hills, to the East and South-East is the Indira Gandhi Wildlife Sanctuary, in the West the continuity of forests is maintained through natural forests of Vazhachal and Chalakkudy forests divisions. Because of all these reasons this broadest reach of forests in the entire Western Ghats needs special protection and scientific management.

## FOREST AREA OF CHALAKKUDY BASIN

The forest land in the Chalakkudy Basin falls within four Forest Divisions namely, Parambikulam, Vazhachal, Chalakkudy and Nemmara.

| Forest Division | Forest Ranges within the Division |
|---|---|
| Parambikulam (wildlife Sanctuary and proposed Tiger Reserve) | Karimala, Sungam, Parambikulam and Orukumban. |
| Vazhachal | Sholayar, Kollathirumedu, Charpa, Vazhachal and Athirapilly. |
| Chalakkudy | Pariyaram (Part) |

| | |
|---|---|
| Nemmara | Nelliyampathy (Part), Kollamkode (Part) |

## TYPES OF FORESTS IN THE BASIN

The natural forest types of the Chalakkudy River Basin can be classified as :

(a) West Coast Tropical Evergreen

(b) West Coast Tropical Semi Evergreen

(c) South Indian Moist Deciduous

(d) Moist Bamboo Brakes

(e) Reed Brakes

and (f) Fire Degraded Grasslands.

### (a) West Coast Tropical Evergreen Forests:

Undisturbed tropical evergreen forests exhibit luxuriant growth of lofty trees forming a closed canopy. The trees are generally cylindrical and a few trees will have buttresses. A complex web of various trophic levels is characteristic of this ecosystem. The high humidity, deep shade and sheltered conditions provide ideal habitats for epiphytic orchids, mosses, ferns and an array of herbaceous flowering plants. Sometimes bamboos, canes and reeds may be found in abundance. The herbaceous ground flora is sparse. The humus concentration is high giving the soil a dark brown colour and it is slightly acidic. Most of our rivers originate from these forests in the Western Ghats. In the Chalakkudy Basin large scale clearance of such forests initially was done primarily for the development of coffee, tea and cardamom plantations. Extensive areas of tropical rain forests in this basin were also destroyed for the construction of hydroelectric reservoirs. Remnants of tropical evergreen forests can be still seen in certain areas such as Karapara and Sholayar.

**(b) West Coast Tropical Semi Evergreen**

Semi Evergreen Forests appear along ecological transition zones where Moist Deciduous Forests merge with the Evergreen Forests. The ground flora receive more light than in the Evergreen forest due to the comparatively less dense canopy. Due to the complex inter mixing boarder between Evergreen and Deciduous Forests, there is difficulty in mapping the extent of Semi Evergreen Forests. Fire and selection felling have played an important role in retrograding evergreen areas into such transitional zones in several areas in the Chalakkudy basin.

**(c) South Indian Moist Deciduous Forests**

Many trees in the top canopy of moist Deciduous forests remains leafless from March to May. Beneath this canopy there could be other well defined strata and the forests floor may contain varied and rich growth. Some trees in the moist deciduous forests attain huge dimensions and the floral diversity is also high. Teak was one of the dominant species present in these forests in this basin and Kannimara teak (Girth 6.48mts and Height 48.7.8mts) and a few trees in a preservation plot in Sungam Range in Parambikulam Wildlife Sanctuary indicate the nature of old natural growth. In the Chalakkudy basin Moist Deciduous Forests were worked heavily. Almost all the teak plantations in this basin were raised after clear felling such forests.

**(d) Moist Bamboo Brakes**

These natural Brakes occur in numerous areas in the basin primarly along the stream banks and in sheltered valleys. There are two species, *Bamboosa*

*arudinacea* and *Dendrocalamus strictus*. *Bamboosa arudinaceae* comes up in highly fertile and well drained soil. *Dendrocalamus strictus* grow in areas where the habitat is relatively dry (eg: Elanthode, Thellickal East, Thekkady etc). This species is not as gregarious as *Bamboosa* but appear as thickets. In the Chalakkudy basin *Bamboosa arundinacea* follows a flowering cycle of 28 to 30 years (working Plan of Parambikulam Wildlife Sanctuary -1997).

**(e) Reed Brakes**

Reed Brakes generally occur in moist locations within Evergreen and Semi Evergreen Forests. Growth of Reeds may or may not be gregarious and their height varies between 2 to 4 meters. Three species of Reed Brakes are known from Chalakkudy basin namely *Ochlandra travancoorica, Ochlandra rhieddi* and *Ochlandra brandissi*.

**(f) Cane Brakes**

Canes are also called 'Rattan' and they were once abundant in the Evergreen and Semi Evergreen Forest in Sholayar, Kollathirumedu, Charpa and Vazhachal Forest Ranges. Canes belongs to the Hepidocaryoid major group of the family Palmaceae. *Calamus* is the only genus of cane found in Peninsular India and *C.rotany* and *C.travancooricus* are the most commonly found species of Canes in Chalakkudy basin. Over exploitation of Canes has made this Non Timber Forest produce an endangered item in this basin.

**(g) Fire Degraded Grasslands**

Along the higher ridges of this basin (1000-1600m) like Minnampara, Padagiri, Karimala etc, there are moderate expanses of fire degraded grasslands with islands of stunted Evergreen forests which are also called as Southern Hill top forests.

Probably these grassland areas were once covered by Evergreen Forest which later got degraded by fire. The Evergreen Forest islands with stunted growth found in such grasslands are relicts of the once luxuriant continuous Evergreen vegetation. These forest islands surviving in the midst of grasslands are getting progressively reduced due to repeated man-made fires sweeping through these grasslands.

## MAJOR EVENTS AFFECTING THE EXTENT OF FOREST COVER IN THE BASIN

While retracing the course of deforestation in the Chalakkudy basin during the last 200 years, certain major trends could be identified. They could be classified as follows:

**Landmarks in the history of forest destruction in the basin are:**

(1) Beginning from 1830's Nelliyampathy and Valparai areas were cleared for raising coffee plantations.

(2) From 1901 onwards forest were extensively worked in the Parambikulam area using the Cochin Forest Tramway.

(3) From 1942 extraction of timber increased due to the construction of Anamala Road from Chalakkudy to Valparai.

(4) Due to construction of man made reservoirs extensive areas of forest were cleared. The major river valley project in this periods were

(a) Poringalkuthu H.E. Scheme – 1957

(b) Sholayar H.E. Scheme – 1966

(c) Upper Sholayar (within Tamil Nadu) – 1966

(d) Parambikulam Group Dams – 1958

(5) Clear felling of natural forests for raising industrial raw material and raising plantations began in mid 1960's.

(6) Forest fire sweeping through most of the forest.

(7) Tourism in some locations and

(8) Cattle grazing all along the forest fringes adjoining settlement along the western edge.

**EARLIEST FOREST DESTRUCTION IN THE BASIN**

Large scale destruction of forests in this basin took place after the 1830's. During this period the forests in the Nelliyampathy Hills situated along the North East part of the basin and in the Valparai areas to the East were extensively clearfelled for raising Coffee Plantations. These higher elevation areas were selected by the British planters for raising coffee. Nelliyampathy Hill ranges now have extensive plantation of coffee, tea cardamom and pepper. The existing natural forests here are highly fragmented. In the Valparai almost all the forests have been converted into tea plantations.

**COCHIN FOREST TRAMWAY**

The plentiful availability of teak and rose wood in the forests of Chalakkudy basin attracted colonial rulers to these forests. However transportation of the logs form areas like Parambikulam was next to impossible because of topographical Peculiarities. After several decades of early laborious timber extraction by conventional means, proposals were made to construct a funicular railway to bring logs from the Western Ghats to Chalakkudy. In 1894, the idea of working these interior forests through a railway was put forward by Mr. J.C. Kolhoff, the first conservator of Forests of the Cochin State. He suggested a wooden Tramway from

Anapandan to Orucumban which was later extended upto Parambikulam. During the first half of this century, to the outside world, forests of Chalakkudy basin were more or less synonymous with the forest tramway. Chalakkudy was also the Forest Headquarters of the Cochin State.

The construction of the tramway commenced in 1901. The tramline was completed in 1907. The capital expenditure involved was a little over 22 lakhs. A brief description of that unique engineering marvel is given below. Leading the workshop at Chalakkudy, the tramline ran for 21 miles through the midlands North of Chalakkudy river. There were no steep climbs although their were same sharp curves. At mile-21 there was an abrupt rise of more than 300m. The ascent was made by a series of double track self acting wire rope inclines of which there were three at this place. The ascending van was hauled up at the end of a wire rope, which was more than 2.5cm in diameter and passed over a horizontal wheel fitted with two independent rim brakes at the brake house at the top. The descending load was attached to the other end of the cable served as counter poise. The first incline had a gradient of one in fifteen, the second one in seven and third one in three. Another train is then formed which descended the ridge by means of ten reversing stations, aligned in zigzags over the face of the steep hill. The next series of inclines varied from one in five to one in seven. The total length of the tramline was 50 miles (-Km) and it was usually covered in 10 hours.

From the inception of the tramway project in 1901, until its inauguration in 1907, the tramway was treated as part of the Forest Department. In 1907. The management of the tramway was taken away from the Forest Department and entrusted with the tramway engineer who was to work directly under the Diwan

of the Cochin State. The Tramway engineer had a special position in the Cochin State council.

The Tramway had its harmful effects. It was constructed without any proper working plan for the forests. For the purpose of working, the whole forest area was divided into 4 felling series i.e, A, B, C and D. Parambikulam Valley which had maximum natural teak constituted the 'C' series. The extent of the annual coupe was fixed at 640 acres and extraction was by selection felling. The exploitable girth for teak and rosewood were fixed at 1.97m and for other species at 1.67m. Survey and mapping which was originally proposed did not seem to have been done and the area of annual working had no relation to the area of felling series. Fellings were done with the sole aim of providing adequate work for the tramway inorder to enable it to work without loss. In the initial years working of the tramway was financially sound. In 1914, when the First world war started and there was tremendous demand for timber for war purposes. This resulted in indiscriminate cutting and enormous quantity of timber got exported to various war fronts around the world.

The cost of annual maintenance of the tramway came to about Rs. 15 lakhs and to keep it working, sufficient quantity of timber had to be provided. To solve this problem, the authorities changed all the previously decided norms and started cutting indiscriminately. Due to the excessive working of forests, the produce became scarce and inevitably it came to be unprofitable. Several proposals were made by experts to extend the tramline upto the Anamalais and them upto Chinnar, for constructing feeder lines to the existing tramline etc. But the government was reluctant to take the risk. In 1926, the special finance committee recommended the abolition of the tramway. However in 1928, the government unwilling to abolish this 'engineering marvel' decided to continue to keep the tramway running at any cost, mainly by exploiting the nearby forests in the most intensive scale possible. This was another conceptual mistake which resulted in the severe damage to the forests of the area.

In 1940's the Anamalai road, from Chalakkudy to Valparai came in to being and through this road motor vehicles started carrying the timber which diminished the unique role of tramway. The gradual depletion of the forests could not justify the capital expenditure and in 1950 a special committee was set up under the chairmanship of the Chief Conservator of Forests inorder to evaluate the situation. The committee recommended that the "Tramway is just a white elephant causing great loss of revenue for the state". Based on this recommendation of the committee, the Government Vide G.O.F4. 3594/49/DD dated 24$^{th}$ April 1951, decided to discontinue the tramway. However, in 1953, another commission under the Chairmanship of late Mr. B.V.K. Menon, Retired Chief Secretary of the former Cochin State was appointed to evaluate the possibilities of reviving the tramway. This committee reported that such a monumental venture should be revived at any cost.

But this idea did not materialize. In 1957, the Food and Forest Minister suggested that the tramway could be used for tourism purpose and allocated Rs 5 lakhs for the same. Three diesel locomotives (Benz engines) were brought from Germany for this purpose. But soon the ministry changed and the next ministry did not evince much interest to continue in to the work. Finally in 1963, the tramway was demolished and the staff (around 200) were absorbed in the various Departments of the State.

**ANAMALA ROAD**

The Anamala road which connects, Chalakkudy town with Tamil Nadu, through the western Ghats, has a significant role in the destruction of forests in the basin. Before the construction of this road, the tramway was the only route to the forests of this basin and the entire transportation of cut timber was through this funicular railway. In the tramway, after loading the timber from the forest, unloading was possible only at the depot at Chalakkudy. Just after the construction of Anamala road, the entire area got opened up for motorized vehicles and illegal plundering of forests and their transportation down the hills became a common feature. Furthermore numerous feeder roads into the forests from the Anamala road came into being which enhanced the ruthless exploitation of timber.

In 1942, Anamala road was first constructed from Chalakkudy to Poringalkuthu mainly for the convenience of the Poringalkuthu Hydroelectric Project work. Later in phases, the construction upto Malakkappara was completed by 1950.

**CONSTRUCTION OF MAN-MADE RESERVOIRS.**

Chalakkudy River Basin has lost extensive areas of forests due to the construction of man made reservoirs and associated developments. This river was considered by the experts as one of the rivers having excess water! and having

locations ideal for dam construction. The impact of construction of dam on the river system has been mentioned in the Chapter – This River Basin is ideal for conducting a detailed study on the impact of the construction of a series of dams and the associated structures on the forest ecosystem in the catchment areas.

**CLEARFELLING AND RAISING OF PLANTATIONS**

In almost all the forest ranges in the basin, the Forest Department is having hard wood and soft wood plantations. Most of these plantations were raised after clearfelling extensive areas of natural forests. These are either pure or mixed plantations of Teak, Bombax, Albizzia, Eucalyptus, Silver Oak, Bamboo etc. However many of the plantation experiments in the basin have ended up in fail ever resulting in extensive eco-degradation and fragmentation of the natural forests.

Rising of Teak plantations in Chalakkudy basin forests need to be mentioned in particular. In the Parambikulam Wildlife Sanctuary, the area of teak plantation as per records comes up to 8559 ha. (Among experts there is disagreement even about this figure). The most extensive clear felling for raising teak plantations started in 1960. In this year it was decided to clear fell 6073 ha of degraded forests for planting teak. At this time Parambikulam was part of Nemmara Forest Division. Then a separate division called the Parambikulam Teak Plantation division was constituted with its Headquarters at Thunakadavu. The Chalakkudy Basin, extensive forest areas was least to the Plantation Corporation Kerala for raising non forest species. The plantation corporation has estates of rubber cashew and oil palm. These plantation were raised in 1961 – 1977 and called as Kalady and Adirappilly Groups of Plantations. They were raised by clear felling large areas of natural forests. These plantations are distributed in the Vazhachal, Chalakkudy and Malayattoor Forest

Divisions and total area comes up to 4260.05 ha, out of which Vazhachal Division alone contains 3545.51 ha. Details of these plantation are as follows

(1) Athirappilly Estate: Total area is 1524 ha of which 1332 ha is under rubber and 192 ha is under cashew.

(2) Vettilappara Estate: Total area is 541.50 ha of which 399.51 under rubber, 120 ha is under cashew, 22 ha is under Matty.

(3) Kallala Estate: Total area is 1480 ha of which 1261 ha is under rubber and 219 ha under cashew.

In 1991 – 92 around 200 ha (area was extended later) of oil palm (*Elacis guineensis*) was planted in the area of the Plantation Corporation which is along the river margins at Vettilappara. After clearfelling rubber, this area was planted with oil palm after taungya cropping of banana, tapioca, ginger, bitter guard etc. leading to severe soil erosion.

**FOREST FIRE**

Forest fires have caused incalculable damage to the forest ecosystems of the Chalakkudy basin. Regular annual fires prevent the regeneration of forests in several areas in the basin. Picnic parties, travelers along the road, forest labourers engaged in the extraction of timber, bamboo, reads etc, trespassers entering the forest for smuggling non wood forest produce and poachers starts forests fires particularly after winder.

Forest fires usually occur during the months of December to May each year. Officials of the four Forest Divisions in the basin did not have recent data on the extent of fire damages. However the authorities admitted that fire in the most serious problem threatening the existence of forests in the basin.

Fire affects the forests in many ways. Fire damage may range from light fire damages to the litter and ground flora to the total destruction of large areas of forests. It kills the plants damages the trees drastically affecting the Non wood Forest Produce. Fire damaged areas are more prove to erosion and gully formation. Fire completely destroys forests microflora and fauna. It has a severe distractive effect

on the soil fauna smaller animals on the ground flora and on ground nesting birds. A single conflagration can destroy hundreds of hectors of forests.

In view of the ecological and economic impacts, protection of forests from fire should be given most serious attention. This has given high priority in all the Working Plans of the Forest Divisions in the basin. But the officials were of the opinion that funds earmarked by the Forest Department is grossly inadequate for effective fire protection. At present the only method adopted is the clearance of fire lines in some areas and engaging a few fire watches with whatever money available. The method adopted for construction of the fire lines is to clear the jungle growth to a width of 5.2 meters. This is done by scrapping all organic material for 1.8 meters on either side of a mid line and fire tracing the central line. This is not found to be effective in many areas of the basin.

It is easy to understand that it is just not possible for the Forest Department alone to control forest fires. Total participation of the tribals and others residing within the forest or adjacent to the forest in this prevention is one of the most essential prerequisites for protecting the forest from fire. The local bodies have to play an important role as fires are destroying the economic reasons essential for the survival of the most ordinary people. The local watch dog groups and voluntary fire brigodes can be formed from among the local people. The Forest Department on the other hand could give all the necessary help and the guidance of the group.

**TOURISM IN THE BASIN.**

Athirapilly, Vazhachal, Malakkapara, Nelliyampahy and Parambikulam have become popular forest and river- related tourism spots. However the development of tourism in these areas are totally unplanned, which has several crucial environmental implications as tourism in all these areas depend upon natural endowments for its existence.

Forests in and around the above mentioned tourist areas of the basin are most severely fragmented. Therefore unplanned growth of tourism here will be the last nail on the coffin of this highly sensitive hill forest ecosystems. The peace of mountains and wild life has already been spoilt by the regular presence of automobiles. This is most obvious from the hundreds of vehicles entering (especially on weekends) into the Prambikulam Wildlife Sanctuary and also through the Anamala road connecting the

Athirapilly, Vazhachal, Sholayar and Malakkapara, which are sensitive areas with rich wildlife. The tourists have made deep inroads into the hither to inaccessible and relatively undisturbed tracts, thus disturbing the unpolluted environment. Frequent forest fires intentionally or unintentionally caused by the tourists have become an alarming threat for the forests in these and nearby areas. Serious planning is necessary in these areas before the tourism is developed further. Only then can we control the varied and complex deleterious consequences of tourism threatening the forests of this area.

**CATTLE GRAZING IN THE FORESTS OF THE BASIN.**

Cattle grazing and forestry are often considered mutually exclusive demands for the same land. Grazing the forest is deleterious to the growth and regeneration of forest species which has led to the framing of laws to regulate or prevent grazing. Still grazing in Reserved Forests land continue. Grazing eliminates the seedlings of forest lands, creates deformity by repeated browsing, injures young plants etc, thus progressively destroying large areas of forests. The increase in removal of vegetation cover and trampling accelerates soil erosion. Spreading of various diseases to wildlife through domestic cattle grazing in the forests areas is also a possibility.

In Chalakkudy basin, Cattle grazing in Reserved Forests is severe only in the Nelliyampathy area, where the estate labourers keep large number of cattle as a means of additional income. These labourers staying in the estates quarters do not posses private land. Building of cattlesheds is not allowed by the estate owners and the labourers regularly send the cattle into the forests for grazing. There are 600 cows and 1062 goats in the Nelliyampathy Panchayat of which around fourty percentage could be seen in the fire degraded grasslands and adjacent Reserve Forest lands. Cattle often get killed by carnivores and such incidents leads to conflict with the wildlife. Labourers here have tried to poison the carnivores with the pesticides. Since grazing in the forests used to be unofficially allowed for several years, it has almost become a privilege for the labourers. It is difficult to control all of a sudden. There are also several incidences in this area, where cattle grazers cause short forest fires.

The area of forest cover in the four Forest Divisions within Chalakkudy River basin in 1961 and 1988 as shown below (Prasad *et al* 1998). Although there are certain differences of opinion regarding the figures shown in these tables, it may help to have an understanding of the trend of spatial changes of forest cover in this basin during this period.

**Area ($Km^2$) of Forest Cover in 1961 and 1988 in the four Forest Divisions within Chalakkudy River Basin.**

| Division | Evergreen -Semi Evergreen | Deciduous | Plantations | Degraded/ Scrub | Non-Forest | Total |
|---|---|---|---|---|---|---|
| **1961** | | | | | | |
| CHALAKKUDY | 74.73 | 268.21 | 21.35 | 0.00 | 847.57 | 1211.86 |
| NEMMARA | 165.43 | 13.34 | 0.00 | 0.00 | 930.76 | 1109.53 |
| PARAMBIKULAM | 220.16 | 28.02 | 25.35 | 0.00 | 138.73 | 412.26 |

| | | | | | | |
|---|---|---|---|---|---|---|
| VAZHACHAL | 236.27 | 245.63 | 0.00 | 0.00 | 89.46 | 571.36 |
| **1988** | | | | | | |
| CHALAKKUDY | 33.36 | 157.45 | 140.12 | 0.00 | 880.93 | 1211.86 |
| NEMMARA | 26.29 | 192.10 | 17.37 | 12.00 | 858.74 | 1106.87 |
| PARAMBIKULAM | 24.02 | 96.07 | 196.13 | 2.67 | 93.38 | 412.27 |
| VAZHACHAL | 141.50 | 44.05 | 234.95 | 24.03 | 125.50 | 570.03 |

Table-8

## HISTORY OF DISPLACEMENT OF TRIBAL COLONIES IN THE BASIN

**Pillapara colony (Malayas)**

Most of the inhabitants of this colony were brought here from the Poringalkuthu dam site. For the purpose of the construction of Poringalkuthu reservoir, they were first displaced to the Plantation Corporation area. Later these families were shifted to Pillapara. This was for the development of rubber plantation in the plantation corporation area. A few families of the Pillapara colony were brought here from Kannankuzhi K.S.E.B. Office area. They were displaced for the construction of this office and associated structures.

**Vazhachal colony (Kadars)**

These families were brought from Poringal dam site for constructing the reservoir. Now they are again going to be displaced for constructing the Athirapilly Hydro Electric Project.

**Pukayilapara colony (Kadars)**

These families were also brought here from the Poringal dam site. These families are again going to be displaced for constructing the proposed power house of Poringalkuthu left bank scheme.

**Poringal thuruthu colony (Kadars)**

This is a colony which has not undergone any displacement for the last several decades.

**Vachumaram kadar colony (Kadar)**

These families were brought here from sholayar mainly for the construction of Sholayar Power House.

**Vachumaram malaya colony (Malayas)**

They were brought here from Thavalakuzhipara for raising teak plantations. But the land first given for these families at vachumaram were taken back for the construction of Edamalayar augmentation canal.

**Thavalakuzhipara colony (Malayas)**

This colony has not undergone major displacement for the last several decades.

**Sholayar (Ambalapara) colony (Kadars)**

These families were brought here from the area where the Kerala Sholayar reservoir is existing now.

**Malakkapara colony (Different tribal groups)**

The families in this colony were brought from many locations including Poringal, Thavalakuzhipara, Sholayar etc.

**Adichilithotty colony (Muduvas)**

All the families of this colony were brought here from Edamalayar reservoir area for the purpose of constructing this reservoir.

Thekkady colony

This colony at present contains Kadars and Malamalasars. Kadars of this colony displaced from the forests of Parambiukulam due to the clear felling of forests for the development of teak plantations in the near by areas. Malamalasars were recently brought here from Tunnel entry area in Parambikulam Wildlife Sanctuary itself.

**Kuriarkutty Colony (Kadars)**

The present location of this colony was made for the purpose of getting labourers for the Cochin Forest Tramway. These kadar families were living in the near by areas of Kuriarkutty.

From the displacement history of the tribals in this basin it is obvious that construction of reservoirs in the basin has resulted in maximum dislocations for tribal families. Deforestation and raising of plantations is the second important reason paved the way for displacing them.

**Sungam colony (malayas)**

This colony has not experienced major displacement for the last several decades.

In Parambikulam Willife Sanctuary, colonies like Parambikulam (Kadar), Earth dam (Kadar), and Poopara (Muduvas)were made for accommodating the displaced families through construction of Parambikulam Group Dams.

## TRIBALS IN THE BASIN.

The tribals have been living within the forests of Chalakkudy Basin since time immemorial. The life of tribals and forests are inseparably interconnected. They have evolved a way of life which is woven around the forest ecology and its resources. The following are the groups of tribals living in the basin.

(1). **Kadars**

They are primitive group of tribals characteristic of Chalakkudy basin. They depend upon the collection of non-wood forest produce like honey, wax, shivakai, kasthurimanjal, maramanjal, black damer, white damar, gooseberry etc, for their livelihood. They are not interested in agriculture. They are also familiar with conventional methods of fishing from the hill streams.

**(2). Malayas.**

These tribals are generally seen in Thrissur district. They practice agriculture and are not interested in the collection of Non-wood forest produce.

**(3). Muduvas.**

They are generally seen in the high range areas. Muduvas are good agriculturists and grow a variety of crops like, rice, maize, ragi, tapioca, banana etc. These products are most often sold in the nearby markets. Muduvas have been traditionally dry land cultivators practicing shifting cultivation in the Western Ghats.

**(4). Malamalasars.**

Very little is understood about this tribal group. A few families of Malamalsars are found in Chalakkudy basin. Formerly they were at the tunnel entry

colony but have been recently shifted to Thekkady colony. Malamalasars are believed to have been nomadic once upon a time.

**(5). Ulladars.**

They are seen only in one tribal colony (Kuttichira) in the basin. They have already merged with the low countrymen and it is difficult to distinguish them with the rest of the public.

Although the Indian constitution in theory ensures total protection to the tribal people that they do not lose their ethnic and cultural identity, most of the tribals in the basin are in a deplorable state mainly due to the adverse impact of our developmental activities. The plundering of natural resources of the area, unsustainable developmental activities, degradation of environmental quality and irreparable damages caused to the fragile forests, force the tribals in the basin to live in sub-human conditions. It was observed that adequate care was not taken while displacing the tribal families. New colonies were formed to incorporate the displaced families without proper planning. Out of the 21 colonies only Poringal (Thuruthu), Thavalakkuzhipara and Sungam have not faced much displacement problem for a long span of time. All the other colonies are sites where they have been resettled by authorities without providing any amenities or basic living conditions. The tribal people never had a voice in deciding the location of their hamlets. It was also found that in several cases not even substitute land was given by the

authorities long after the tribals were evacuated from the old colonies. (Eg. Malayas in Vachumaram.). Many of the houses provided by the Tribal Welfare Department are in pathetic condition. Acute drinking water scarcity is experienced in many colonies, as the nearest water source is far away (Eg.Pillapara, Vachuamaram, Malakkapara, Thekkady etc.)

Collection of non wood forest produce is one of the major source of income for the majority of tribals in the area. However due to destruction of forests, availability of non wood forest produce has also shrunk. Almost nothing is done by the authorities to regenerate non wood forest produce. Further pilferage of non-wood forest produce by non tribal people reduces the existing share of the tribals. Many tribals now are going for daily wage forestry works whenever such works are available. This has totally changed their ethnic life style and culture. These changes could be easily observed in their preference for food, rituals, festivals, interests etc.

Religious conversion is also going on among tribals in the basin. Men coming to the forests as laborers show special interest in marrying tribal girls as they can avail of all the tribal benefits from the Government. Although the tribals in this basin are well built, malnutrition is very common among them. The alarming reduction of the conventional resources, change of food habits, high incidence of alcohol consumption etc are the reasons for the same. Their innocence and faithfulness are also heavily exploited by the plains- people pushing the tribals into pathetic condition.

**SOCIO ECONOMIC SITUATION OF THE TRIBALS IN THE BASIN.**

From the directorate of the Block Panchayats, Thiruvananthapuram, we are able to collect some data regarding the housing status, sanitation status, landholdings, income and expenditure of some of the colonies namely Adichilithitty, Malakkapara, Sholayar, Thavalakuzhipara, Poringal and Vazhachal. The numerical data thus obtained was tabulated and shown here. Fig-8 shows the housing status of families in these colonies. In colonies like Thavalkuzhipara, Poringal Vazhachal and Pillapara there are families without proper houses. As per the figure-9 certain houses in almost all colonies except Sholayar lack toilets. Colonies like Adichilythotty and Poringal have no toilets at all. Regarding the land holdings, maximum land is available with the families of Adichilythotty colony. Here 29 families are having above 150 cents of land. Where as in Malakkapara colony, not even a single family is having more than 10 cents of land (Fig-10). Regarding the annual income among all these colonies, 23 families in the Adichilithotty colony are getting an annual income between Rs. 10,000 and 15,000. In Malakkapara colony and Thavalkkuzhipara colony most of the families are having annual income between Rs. 10,000 and Rs. 3,000 (Fig.-11). Families in Adichilithotty colony have maximum monthly expenditure, where as families in Vazhachal colony have minimum monthly expenditure. (Fig.-12).

We are at present is not in a position to make detailed interpretations of the socio-economic data received so far. Income of tribal families depends upon the collection of non wood forest produce, plantation labour available for each families, etc.. Expenses depends upon the mode of life of each tribal groups, influence of river related tourism in these areas, location of these, colonies, nearness and changes for interacting with the low

countrymen etc are also important factors. Therefore detailed interpretation of the data available could be done after making intensive study in this area during the second phase of this project. Meanwhile efforts will be taken to collect more data available from ever possible source in this regard.

**Sholayar Scheduled Tribal Co-operative Society, Malakapara**

There are two Girijan Development Societies Functioning in the Basin at Malakkapara and Muthalamada.

This co-operative society was started as part of the Western Ghat Development Programme of 1981-82. Its area of operation include the Forest Ranges namely Sholayar, Vazhachal, Kollathirumedu, Charpa and Athirappilly. The scheduled tribes living within these areas alone can be the member of this society. There are 277 members at present.

The Governing council of the society consists of 16 members. Out of this 11 members are ex-officio members, who are Government officials. Five selected individuals from the scheduled tribals will also be there in committee. The Revenue Divisional Officer is the Chairman. The other members from the Government side are: District Planning Officer, Tribal Development Officer, Assistant Executive Engineer (Local Public Works, PWD, Irinjalakuda), Asst: Registrar of Co-operative Societies, Irinjalakuda, Divisional Forest Officer, Vazhachal, Assistant Director of Agriculture Chalakkudy, Secretary Block Panchayat Chalakkudy, President Athirappilly, Grama Panchayat, MLA Chalakkudy and the Managing Director of the Society.

The post of the Managing Director is vacant and has not been filled for the last many years. Other staff include two sales men, one collection agent, one driver, one watcher and one sales assistant.

The Head Office is at Malakapara with depos, one at Wachumaram and an other at Vazhachal. The activities of this society include (a) collection of non timber forest produce, its storage and marketing (b) Management of Plantations owned by society (Rubber, Coffee and Cardamom) (c) Provision Sales. The society has 202.4 acres of plantations. Out of which 90 acre of coffee, 40 acre of cardamom, 25 acre of lemongrass and also pepper and rubber.

Approximate yearly collection of non wood forest produce of this society is as follows: 500 Kg of Beewax, 4 to 8 tonnes of honey, 1.5 tonnes of Kattupathry, 12 tonnes of Manjakuva, one tonne of Kakkumkaya. Collection prices for these produce are: Honey Rs.50/kg, Bewax Rs.50/kg, Black dammer Rs.20/kg, White 27/kg, Manjakuva Rs.19/kg, Kakkumkaya Rs.5/kg, Kattupathry Rs.120/kg.

The members are given yearly bonus depending upon the quantity of non timber forest produce they are collecting. Some of the members have received Rs.8000/ last year has bonus. From the records it was understood that around 225 individuals are actively involved in the collection of this produce. The annual turnover of this society comes upto 25 to 40 lakhs. Out of this non timber forest produce alone contribute 20 to 30 lakhs.

Inspite of the great potential of this society, its performance is pathetic. The post of the Managing Director is not filled for the last several years. Although the secretary of this society has been provided the quarters at Malakappara itself, he is staying at Irinjalakuda. Therefore proper day to day administration is not effective. The salary for the staff and the maintenance of the jeep and other establishment charges works out huge amounts each year. Non of the staff are from the tribals and storage of the non wood forest produce leads results in loss of quality which resulting in items fetching low prices.

Although we have collected the data regarding the non wood forest produce

collection in the Sholayar Girijan Cooperative Society, at present it is difficult to

make interpretation of the same. This is because the yearly fluctuations in the availability of each non wood forest produce namely honey, bee wax, kasthurimanjal, cheenika, black and white damar etc., depends upon the combined effect of many complex factors. Some of these factors include, rainfall in the area, time available for the tribals to go for the collection of these items, frequency of plantation labour in the nearly areas, pilferage of these items by non-tribals, direct sales (not through the society) of these items by the tribals to the tourists etc. Therefore detailed studies are necessary for interpreting these data. However all the collected data are shown in the Fig-13, 14, 15, 16 and 17.

## FISHING COMMUNITY IN CHALAKKUDY BASIN

The remarkable diversity and abundance fish fauna in the Chalakkudy river system facilitated the emergence of large and varied group of traditional fisherman depending upon the river for survival. Formerly such fishermen existing even in far inland areas but at present they are restricted to the extreme downstream reaches of the river. Some of the groups are found to fish from every possible part of the river. Due to the drastic decrease of fish population in the river during the last couple of decades, most of the fishermen are facing poverty related problems. Despite these difficulties, the traditional fishing community who are exclusively involved fishing activity for several countries are finding it difficult to switch over to any other occupation. So they are struggling to maintain fishing as their primary lively hood.

For the purpose of convenience, the fishermen in this River system can be classified in to three categories depending upon the time they spent for fishing. They are (a) occasional fishermen (b) part-time fishermen and (c) full-time or professional fishermen.

**(a) Occasional fishermen**

Several people living close to the river use to fish whenever there is some free time using different kinds of simple apparatus from the banks or by wading. Most of the fish caught goes into their domestic family consumption. Although the time spent by them may be low, the number of people participating are high.

**(b) Part-time fishermen**

Just after the peak agriculture season many people give priority for fishing as a co-equal activity. Such fishermen have almost all type of gear used by professional fishermen they also sell a major portion their catch.

**(c) Professional fishermen**

These are fishermen who live entirely by fishing. They use a wide range of crafts and gears. In Chalakkudy river, non of these fishermen use powered craft but completely depend upon manually propelled canoes. While men go for fishing women are engaged in selling the fish either in the markets or carrying it from house to house. Most of this artisan fishing communities have developed elaborate

traditions, legends and even religious systems which enable them to integrated culturally with the general ecology of the river. There are 245 families of traditional inland fishermen in Puthenvelikkara Panchayat alone and their total population is 1149, out of which 570 are males and 579 are females.

The diversity of fishes in this river has also paved the way for the use of highly diverse types of fishing gear. The types of fishing methods chosen for use in this river are conditioned by three factors. (a) nature of fish stock (b) form of river and (c) degree of advancement of the fishing community. The fishing method adopted by the fishermen in this river are of conventional and the indigenous types. Generally they are operated by single or limited number of fishermen. Despite their indigenous nature, the fishing gears and their operation have found to be very efficient to suite the existing conditions. Fortunately we were able to make close observations of the mode of operation of almost all the gear used in this river system. The vanishing traditional methods based on sustainable fishery have utmost importance therefore we have given special consideration for these traditional methods and have explained them in detail with the hope that it won't be out of place here.

1. **Fishing by stick**

This is an interesting conventional method practiced in the shallow water bodies for the capture of *Etroplus.* The gear consists of two bamboo measuring about 1-1.5 meters in length.

**Mode of operation**

In this method the fish is to be located first. Then the sticks are placed at the bottom of the water some distance behind the fish in such a way that the proximal part of the sticks placed together and the distal parts kept apart. Then the sticks are slowly and uniformly moved towards the fish until the fish is positioned in between the sticks. The distal parts of the sticks are then gradually brought close together to a parallel position holding the fish in between the sticks. The sticks are brought close together to prevent the escape of the trapped fish. The fish is then caught by hand and taken out. Under normal conditions, during one operation, only one fish can be caught by this method. Hence much effort is needed for getting enough catch. Moreover in waters with uneven bottom this method is not suitable.

2. **Fishing by 'kuduka'**

Although this method does not have any fishery importance, it is worth while to mention it as a sort of conventional technique for catching small fishes. The 'kuduka' is a clay bowl with a small mouth and a large belly.

**Mode of operation**

The bowl is baited with tapioca powder or cooked rice and kept immersed in shallow water areas. Small fishes like *Puntius, Rasbora, Mystus, Etroplus* etc. enter into the 'koduka' and get traped inside. The bowl is taken out intermittantly and the fishes inside the bowl are removed. The process in continued until enough quantity of the fishes obtained.

3. **Fishing by Luring**

Mainly two types of 'lure' fishing are known from Chalakkudy river.

**I. Light luring**

Like many other animals, fishes also show the instinct of positive phototropism. This innate behavior is being utilized by many fishermen for fish catching during night. The principle of the method is that when a source of light is placed in the water surface, a wide variety of fishes are attracted towards this source

of light and tend to assemble around it, from where they are eventually caught by using different types of fishing gears.

Some of the important light luring methods employed in this area are summarised below.

**(a) Luring by Petromax**

This method is mainly used for catching 'karimeen' (*Etroplus suratensis).* The pertomax is lit and placed on a stand in the shallow areas of the river or canal and the fishermen wait near the light, holding a hand net. The fishes attracted by the light move towards it and assemble around the petromax. They are then swiftly caught by means of
hand nets.

**(b) Luring by Lantern**

A special type of lantern is used for catching mullets and cichlids from the shallow water of the river and canal. One side of the lantern is covered with a tin sheet to prevent the emission of light. During operation the lantern is kept in the water in elevated position, some distance away from the bank, so that light is emitted towards the shore. A variety of fishes including mullets, cichlids etc. are attracted by the light and assemble in the area between the shore and the sources of light. These fishes are caught intermittently by means of cast nets.

**(c). Luring by 'Pandam'**

Pandam is a conventional torch made by winding a piece of cloth at one end of a stick. Usually it is operated from a country boat, which is boarderd by three fishermen. During the operation one of the fishermen drives the country boat swiftly through the water without making much disturbance, the other person who is holding the lit-'Pandam' in his hand keeps on lashing it in air near the water surface while the third person who is holding a hand net keeps a constant watch on the surface of the water. Those species attracted by the light wandering on the surface of the water near the country boat are collected by the hand net in quick action.

**(d). Torch and Knife.**

This method is mainly practiced in shallow waters like canals, streams, paddyfields, ponds etc, during night time. In this method the fish is at first paralyzed by a strong beam of light from a torch and then inflict a strong wend by means of a sharp knife. Then the dead or wounded fishes are collected and removed.

**(e). Chinese Dipnet (Cheenvala)**

The Chinese dip net locally called 'Cheenavala' is extensively used in the extreme down reaches of Chalakkudy river. While on operation, during nights, the net is usually equipped with some sort of lightning mechanisms. Now electric bulb is used for this purpose. The bulb is hung from the wooden frame of the net so that when the net is immersed in the water the bulb is brought close to the water surface and the fishes are attracted towards the net.

**II. Luring by Temporary Nests.**

In this method the fishes are attracted towards a temporary nest, made of tree branches in the river or canal waters. In the deep water area these nets are hung by means of a stone pieces or fixed by Bamboo poles to make them stationary. The leaves and tender branches gradually get decayed resulting in a rich micro fauna in and near the nets. The twiggy shelter which is rich in micro fauna attracts a large number of fishes including economically important varieties like Etroplus, Sciaeana, Lutianus, Mugil etc towards it. As the fishes begin to establish in this shelter, a

temporary movable fence of Bamboo reeds is made surrounding the nest, a little distance away. Gradually the fence is brought near to the nests reducing the enclosed area. After this, the tree branches and other decaying materials of the nest are taken out and the trapped fishes are collected by means of hand searching or by using hand nets.

**4. Blow pipe (Oothuli)**

It consists of a metal spear and a hollow metal pipe of about 1 meter length and 2 centimeter diameter. The proximal end of the spear is connected to the metal pipe by means of a long thread. The spear is kept inside the hollow tube and the thread is wound round the pipe, while not in operation.

**Mode of Operation**

For operation of the gear the fish is first located and aimed. Then the spear is strongly and accurately blown against the fish. If aimed accurately the spear hits the fish and pierces the body. The connecting thread between the spear and pipe prevents the fish from being escaped.

**5. ‘ Scare line ‘ Fishing.**

It is an interesting fishing method practiced by the local fishermen both in fresh and brackish water bodies. The scare line consists of a long rope on which a larger number of tender palm leaves locally called as ‘ kuruthola’ are kept hanging at intervals.

**Mode of Operation.**

The scare line is mainly operated in the following three ways.

**(a). Scare line and Cast net**

In this method the rope and Palmyra leaves are dragged along the water in a specified direction. This causes the water to become disturbed and turbulent so that the fishes of that area are scared. In panic they begin to move swiftly against the direction of the scare line. In this way the fishes are driven and concentrated to a certain area from where they are caught by means of a cast net.

**(b). Scare line and Double Stick Dragnet.**

Scare line is also used in association with double stick dragnet (Koruvala). It is practiced in small canals and ponds. In this method the net is kept opened in the water and the scare line is dragged towards to net area from a distance and the fishes in that area are driven towards the mouth of the net. Depending upon the mesh size of the net any variety of fish can be caught by this way. In backwaters the same method is widely employed using large conical nets for catching ‘ Tiruda’ *Mugil cephalus*.

**(C). Scare line and hand searching.**

This is widely employed in the backwater areas of this river, usually a team of 4-5 fishermen are associated with this method. Of them, two fishermen act as pilots and they drag the scare line in a semicircular form through the bottom of the water body. During this process many of the bottom dwelling fishes and prawns from the bottom mud came to the water column. The collected fishes are soon transferred into a narrow mouthed aluminum bowl locally called ‘Kudam’, carried along with them.

**6. Angling.**

Angling is the commonly practiced fish catching method in all along the river. At least four types of angling methods are known from this area. They are:

**(a). Pole and Line (Choonda).**

Choonda is the commonest mode of angling. It consist of a line and hook tied at one end of a Bamboo pole. The size of the hook varies according to the size and type of the fish to be caught. Earthworm, small fishes, insects, gastroped meat etc are

commonly used as baits in the pole and line. A variety of fishes including Murrels, Catfishes, Cichlids etc are caught by this fishing gear.

**(b). Drift line.**

It is a modified form of pole and line. However, in this, the hook bearing line is smaller than that of Choonda (aproximately half a metre in length). The proximal end of the line is fixed to a float of about 25-30 cms in length which is made up of petiols of banana plant or the stem pieces of 'Iringana' a local plant very similar to sugarcane in appearance, or by using pieces of bamboo sticks. The length of the line can be adjusted in such a way that the excess length may be wound around the float. Drift line is mainly used to catch Murrels and Catfishes. For Murrels the important baits used are small live fishes such as *Etroplus maculatus, Aplocheilus* etc. Some insects varieties are also used occasionally.

**(C). Throw line.**

This is mainly used for catching fishes like *Wallgo, Sciaena, Lutjanus, Channa* etc. and employed both in fresh and brackish waters. The gear consists of a long thread of about 10-20 meters with a hook at its one end. It is mainly used in rivers or large canals. It can be operated either from the bank of the water body or from small canoes locally called ' Thoni'. During the operation the baited hook-end is taken in the right hand whirled round to get momentum and then thrown into the desired area of the water, keeping the other end in the custody of the fishermen. Through line may be operated both during day and night time.

**(d). Ayiramchoonda.**

This is a miniature form of long line used in marine water. It is designed to operate in rivers and large canals. The gear consist of a long plastic head rope with 30-40 hooks hanging from it. Each hanging line has a length of approximately 50 –70 cms. The length of the hanging line and the number of hooks vary according to the nature of the water in which it is operated. Usually the head rope is provided with some floats. While operating, the gear is usually tied across the river or canal in such a way that the head rope just floats along the water surface and the hooks are well immersed in the water column. All the hooks are usually baited during operation. Prawns, small fishes, gastroped meat, insects etc, are used for this purpose. Ayirmchoonda may be operated both during day and night time. A variety of fishes including *Lutganos, Sparus, Channa, Sciaena, Wallago etc*, are caught by 'Ayiramchoonda'

In Chalakkudy river during summer season, Ayramchoonda is widely used for catching skates which are migrated from the marine waters. For this the unbaited Ayirmchoonda is simply tied across the water body in such a way, that the hooks almost reach the bottom of the water. The Skates while crossing the gear occasionally get hooked by the hanging hooks and are trapped.

**(7). Traps.**

The important types of fish traps are (a). 'Pathayam', (b). 'Bamboo Screen'. (c). 'Kuruthi' (d). 'Thumpu' and (e). Cover pot.

**(a). Pathayam.**

This trap is designed to operate in small canals and canal mouths. It consists of a bamboo screen and 1-3 bamboo cages, having a height of about 3-4 meters. The length of the bamboo fence and number of cages may vary according to the width of the canals in which the trap is operated. The cage is a rectangular one provided with a

small slit near the base. The slit is made in such a way that the fish entering the cage through it can't escape because of the valve like device.

**Mode of operation.**

While on operation the bamboo fence and the cages are fixed across the canals with the help of bamboo poles in a wide 'U' shape by totally ceiling the entire width of the canal. The fishes wandering in the canal enter the cage through the slit of the cage and get trapped in it. These trapped fishes are caught by means of a square net. Once the 'Pathayam' is fixed in a canal it is kept in operation for a number of days. Depending upon the space between the bamboo reeds any type of the fish can be caught by this trap.

**(b.) Bamboo screen.**

This is a fence of bamboo sticks tide each other by means of coir ropes. Usually it is fixed across the shallow tidal water bodies including canals, branch canals and paddyfields adjoining to backwaters or rivers. The principle behind this fishing gear is that, during high tide a large number of fishes enter these habitats along with the tidal water and they are prevented from being returned, by the bamboo screen. The trapped fishes are then caught by castnets or hand searching when the water recedes.

**(c.). 'Thoompu'**

It is an indigenous fishing method practiced in several parts of the river and in the paddy fields adjacent to rivers or canals. The paddyfield and the river or canal are connected by a small channel, through which the water enters the field. Sometimes the channel is strengthened by means of wooden frame. During high tide, water is allowed to enter the paddy field through this channel so that a large number of fishes also find their way into the field along with water. The sluice gate is fixed at the end of the channel near the paddy field to prevent the escape of the fishes during the low tide. When the water recedes through a channel a conical net is fixed at the other end of the channel facing the river side. Bamboo poles are used at both the ends of the channel to fix the sluice gate and the net. The fishing operation starts during low tide, when the sluice gate is removed and the fishes are trapped in the net kept on other end. During night, a 'Petromax' is lit and kept near the net to attract fishes towards the net. prawns, mullets, cichlids etc, are abundantly caught by this method.

**(d). Kuruthi**

Kuruthi is the another type of trap widely used in narrow mouthed canals, streams etc. It is a conical trap made up of pieces of bamboo sticks of about 1-½ meters in length. It has a wide mouth and tapering tail end. The mouth of the 'Kuruthi' is nearly similar to the sucker of a leech, provided with an incurved valvular mechanism to prevent the escape of the trapped fishes. The tapering tale portion is usually kept tied together by means of coir rope during operation.

Kuruthi is operated either in single or in association with bamboo screen. If the mouth of the canal or stream etc. correspond to the mouth of the 'Kuruthi' in width, it is fixed in singly at the mouth of the water body by means of two stumps. However, if the mouth of the water body is wider than the mouth of the 'Kuruthi', it is operated in such a way that a bamboo screen is placed on either side of the Kuruthi. The fishes entering the mouth of the Kuruthi may get trapped in the belly of the trap. The incurving bamboo pieces fixed around the throat of the Kuruthi

prevent their return and escape. The trapped fishes in the Kutruthi then taken out after the tail portion.

**(e) Cover Pot (Ottal)**

Ottal is a conical drum shaped trap made up of closely place bamboo sticks. This is used for catching fishes from shallow and muddy waters. It has got a wide basal part and narrow mouth region. The size of the ottal is subjected to a wide range variations. During summer periods the trap is widely used in drying ponds, canals and paddy fields for catching fishes like *Channa, Hetropneustes, Clarias, Anabas* etc.

**Mode of operations**

During operation, first the ottal is strongly plunged into the water and fixed it to the bottom mud. Then the fisherman insert his hands into the belly of the ottal to search out the trapped fishes which are then taken out.

In some areas a stick is also used along with ottal. By this stick the hiding fishes are driven from mud and burrows and then caught by using the ottal.

**Nets**

Mainly eighty type of nets are commonly used in the inland water of the district. The details are as follows.

**(a) Double stick dragnet (Koruvala)**

Koruvala is one of the commonest nets used in this area. It is designed for catching fishes from shallow water bodies such as canals, ponds etc. The net has a length of about 2.6m and mesh size 1.5-5 cm. The mouth of the net is rectangular in shape and reinforced by bamboo poles. The size of the mouth is 2x1.5m. With the help of the bamboo poles the mouth of the net is kept open during operations.

**Mode of operation**

The net is operated in two ways

(1) Two person drag the net along the water column by holding the bamboo sticks in such a way that the bottom of the net touches the bottom and the upper edges is generally little above the water surface. The fishes trapped in the net are hand picked and removed.

(2) The net is kept stationary at a certain place by means of sticks keeping the mouth opened. Then the fishes in the nearby areas are driven towards the mouth of the net by a scareline. When sufficient numbers have entered the net, the net is taken out and the fishes are removed.

**(b) Neetuvala/ Kandadivala**

This is commonly used gill net in Chalakkudy river. It is a large sized net extensively used in both fresh and brakish water canals as well as in rivers. It is a ‘wall net’ made up off nylon meshes or hemp. Usually the net is having a head foot rope. The head rope is provide with float and foot rope with sinkers. (However the Kandadivala used in reservoir lack the sinkers). The length of the net ranges from 5-30 meters according to the nature of the water body in which the net is operated. The net below 10 meters are generally used in small canals and are often without floats or sinkers. The floats vary from conventional materials like the trunk of the plant, Iringana (a local plant) and bamboo pieces to modern spongy and plastic materials. The mesh size also shows a wide range of variation depending on the type of fish to be caught. Four types of mesh sizes are generally used in rivers and canals. They are (a) 3.2cm (tumb finger net) (b) 7cm(three finger net) (c) 7.6cm (four finger net) and

(d) 17cm (eight finger net). However the nets used in reservoirs ranges from 7-22.5cm.

Each type of mesh size is specially used for catching specific fishes. For example in backwaters 3.2 cm mesh size is mainly used for catching mullets, the 7 cm. variety for Perches, the 8.6 cm. variety for 'Tiruda'(mullet) and the 17cm variety for catching *Lutanus, Sciaena, Eutheronema* etc.

Fishermen usually practice certain conventional methods for the calculation of net mesh size. Among these the finger method is the mostly adopted measure. In this method the mesh size of a net is calculated with respect to the number of fingers that can be penetrated through an individual mesh of a net. The above mentioned net may be classified in this way as thumb finger net, three finger net, four finger net and, eight finger net.

**Mode of operation.**

During operation the net is vertically suspended across or longitudinally in rivers or canals. Generally it is left over-night. The fish while trying to pass through the mesh of the net introduces its head through it but fail to pass its body as it is bigger than the mesh size. In this context the fish attempts to withdraw the head from the mesh , but becomes entangled as the twines pass through the space between the gills and gill cover.

**(C). Uduvala.**

It is a gill net used exclusively in reservoirs . In appearance the net is very similar to Kandadivala. However the width of this net is only half the width of the Kanadivala. The mesh size is generally 5-8.5 Cm.

The 25-30m long net is mainly used for catching fishes like *Tilapia mossambica* and *Etroplus suratensis* etc. It is not usually used for the capture of major carps.

The 'Uduvala' is generally operated in certain pockets of the reservoir where the fishes like *Tilapia, Etroplus, Sarana* etc are largely seen. The wall of the net is fixed in the water in such away that a space of about 10-15 meters is left between the net and bank. After fixing the net, the fishermen standing on the bank start to throw pieces of stones and agitate water to drive the fishes towards the net scaring. The fishes in panic try to escape through the meshes of the net but get trapped by gilling in the net.

**(D). Thadavala (Pursenet).**

In shape 'Thadvala' is very similar to 'Neetuvala'. The net is mainly used for catching channa (ophiocephalus). This net is also used in the pockets of reservoir waters. The length of the net is about 20-30 meters and mesh size 7-8.5 cms. The head rope of the net is of nylon and feed rope is of coir.

The 'Thadavla' is usually operated during nights. The selection of the site is the first step of net operation. Generally ' V' shaped or 'U' shaped water pockets are selected as sites. After selecting the site the bottom of the proposed area is well examined and the obstacles if any are removed. Thus a large number of long sticks with bifurcating tips are fixed along the net fixing area in a series in such a way that a distance of about 20-25 meters is let in between the sticks and the bank of the reservoir. The tip of the sticks are kept well above the water surface and they are connected each other by a central rope for their stability. These arrangements are usually completed approximately before 4 p.m..

During the next step at about 8 p.m. the wall of net is fixed by the fishermen, with the help the sticks that are already fixed in the area. Then a large number of stone pieces are placed all over the lower edge of the net so as to keep the bottom of the net and substratum intact to prevent the escape of the fish through this way. The width of the net is always larger than the length of the sticks. after fixing the net the loosy fluttering central portion of the net is taken up and hooked on the bifurcation of the sticks. Now the upper two thirds of the net forms a large purse like structure. All these works are done with least disturbance to the water body. After these arrangements the fishermen start to agitate water from bank side towards net area. During these process the Murrels if present in the water are scared and driven towards the net, where there movements are hindered by the nets and stops. As their movement is suddenly stopped, as an instant they tent to jump over the net fencing to escape. The jumping fishes are usually hit on the upper edge of the net webbing and are dropped into the purse like structure, from where their escape become impossible. This process is continued for a considerable period and trapped fishes are removed carefully.

**(e.). Oonnyvala.**

It is extensively used in the extreme down reaches of Chalakkudy river. 'Oonnyvala is a conical stationary net having a length of about 8-10 meters with a wide mouth and a long tapering tail.

Oonnyvala is primarily a prawn capturing gear hence small mesh size is prefered in this net. However, a wide variety of fishes ranging from small to large sized fishes are also obtained by this net. The nature of the tide and the velocity of the tidal water flow are the important factors that influence the efficiency of the operation and the yield from the 'Oonnyvala'. During the high tide the net is fixed in the water by means of bamboo poles in such a way that the lower edge of the net touches the bottom surface. Usually large number of nets are fixed in series across the river. During the low tide the residing water brings large variety of fishes and prawns into the net where they get trapped. As the velocity of the water decreases the net is taken out and the trapped fishes are removed.

**(f.). Tirudavala (Perruvala).**

'Tirudavala' is a large sized, squirely webbed net mainly employed in the backwaters and estuaries. The method of fishing by this net is locally called 'paithu' and it is done with the help of fire canoes and 10 to 12 fishermen. While on operation, 4 canoes are arranged along the four corners of the net. Usually the anterior set of the canoes are boarded with two fishermen each and the posterior set with three each. The net is provided with four ropes at its four corners. During operation these ropes are tied on the rawing poles of each canoe and the poles are fixed in the water in such away that the posterior edge of the net is totally immersed in the water and the anterior edge kept well above the water surface. After this the fifth canoe drags a long scare line towards the immersed area of the net from a considerable distance so that large schools of fishes present in the surrounding area are driven towards the net area. Simultaneously the net is lifted by the joint venture of fishermen bordered in the canoes. Then the fishes trapped inside the net are collected and removed.

'Tirudavala' is a specialized net for 'Tiruda' (*Mugil cephalus*) capture. However, it is not commonly practiced, since the fishing operation is time consuming. Before the commencement of fishing operation, the fishermen often make an assessment on the fishery prospects of the proposed fishing area. If the conditions are favorable a single 'paithu' can provide them a large quantity of fish.

**(g.). Chinese Dipnet (Cheenavala)**

'Cheenavala' is extensively used in Chalakkudy river and the near by canals. The net consist of a large piece of 'U' shaped mesh work fixed on a rectangular frame. The frame is fixed on a stationary platform made up of joining wooden pieces or planks. The frame along with the net is capable of moving up and down by means of a large coir rope attached to a projecting wooden piece at the tope of the frame. While the net is not in operation it is kept hoisted above the water surface by means of the rope and during operation the rope is released and the net and the lower portion of the frame immersed in the water. The net needs the labour of 2-3 persons for its operation. After keeping the net in the water for a certain period, it is lifted and then checked for fishes that are trapped in

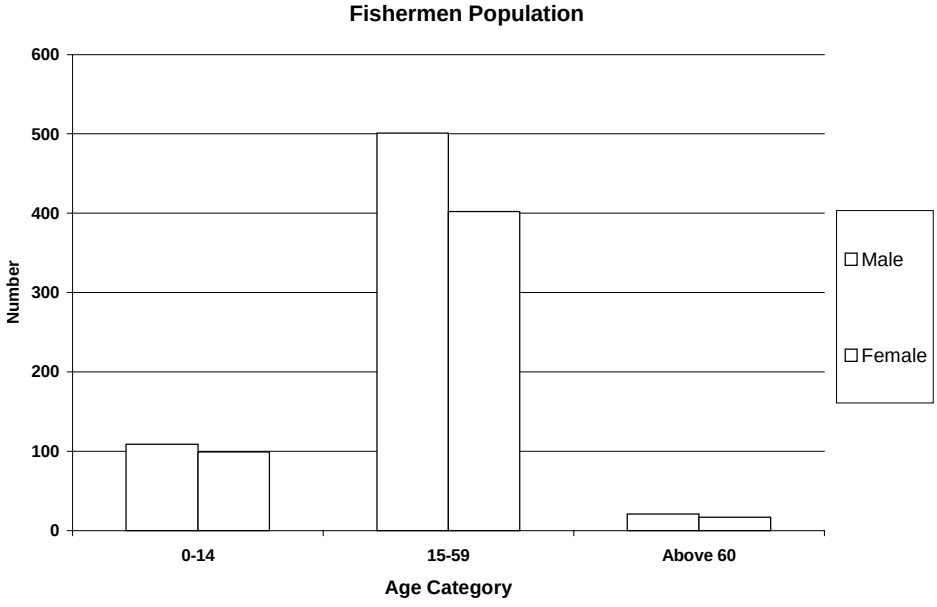
it. Then the central portion of the net is lifted up by means of a nylon coir attached to it and the fishes trapped are removed using a hand net. This process is repeated continuously. Generally, monnings, everings and night periods are preferred for the operation of the net. While the net is operated during the night it will be usually equipped with some lighting mechanism for luring the fish. Generally electric bulbes or haricane lamps are used for the purpose. The lamp is hung from the wooden frame in such a way that when the net is immerced in the water the lamp reaches near to the surface of the water. The light attracts a variety of fishes towards the net area.

Usually 'Cheenavala' is assosicated with a small thatched hut. This used as a shelter for the fishermen during night operations.

**(h) Cast net (Veesuvala).**

Veesuvala is one of the most commonly used nets in the Chalakkudy river and associated water bodies. The net is a circular net webbing attached to a centrally located hauling line. There are a number of lead sinkers along the circumference of the net. However the hauling line may be absent in some cast nets where it is replaced by a simple pulling rope. During operation the circumference forms inwardly directed purse like structure or pockets which prevent the fish from escaping.

On the basis of mesh size two types of cast nets are known from this area. They are (a) net with smaller mesh size locally called as 'Pattuvala' and (b) net with larger mesh size locally called as 'Thalivala'. Depending upon the mesh size almost all type of fishes can be caught by cast nets.



**Mode of operation**

Cast nets can be operated from the bank of the water body or from a canoe in shallow waters. During operation the net is thrown over the water by means of the hauling line or pulling line. As the net falls on the water, the led sinkers attach on the edge of the net rapidly sinks the net into the bottom of the water and the fishes present in that area trapped. Then the hauling line is pulled and the fishes are collected.

**Socio-economic status of the Traditional Fishermen in Puthenvelikara Panchayat:**

We have collected the socio-economic data of the traditional fishermen community living in Puthenvelikara Panchayat. The total population of these fishermen here is 1149 out of which 631 are males and 518 are females. There are109boys and99 girls below of 14 years.. Between 15 to 59 years of age there are 501 men and 402 women and above 60 years of age there are 21 men and 17 women. 190 adults of this community are illiterate. 370 persons have studied upto high school level. Out of the 280 families, 176are Hindus, 103 are Christians and only 2 families belongs to Muslim religion

Sanitation facility in very poor among the fishermen families in this Panchayat. 101 families have no toilet facility and open deification is opted by these families. 38 families have earth pit toilets, 81 have single pit toilets, 24 have double pit toilets and 37 have septic tank facility.

This data was available from the Directorate of Block Panchayats, Thiruvananthapuram. The numerical data made available from this office (which was collected in 1998) was later tabulated by us. It is surprising that neither the concerned Panchayat nor the Block Panchayat is having these details. All over data has been handed over to them which they found very useful in the People Planning process.

# FISH DIVERSITY IN CHALAKKUDY RIVER BASIN

Chalakkudy River is one of the richest in India in terms of fish species abundance and has found a place in the publications of the World Bank (NBFGR-2000). The reason for the unique richness of fish fauna in this river may be because of three factors. (a) It is one of the wildest rivers in Kerala and almost half of the total area of the river basin is within Reserved Forest boundaries. (b) The banks of this river even at the downstream possess substantial extend of riparian vegetation. (c) This river receives relatively low quantity of industrial effluents.

A total of 98 species of fish have been so far reported from this river. Between 1994-97, five species new to science have been recorded from Chalakkudy river reflects the unique fish diversity of this system. In a detailed survey conducted by Ajith Kumar *et.al* (1999), it is understood that 61 species were found living in the

low land areas (that lies<75m above MSL), 68 species in mid land (that lies between 75-500 m above MSL), 36 species from high land areas (that lies>750m above MSL), and 14 species from high range areas (that lies>750m above MSL). There are five introduced species in the river, out of which *Oreochromis mossambica* (commonly called as *Tilapia*) is one of the well established fishes which has recorded from the low land, mid land and high ranges. Out of the total species known from this river, 36 are endemic to the Western Ghats of which 10 are endemic to the Kerala part of the Western Ghats. 27 fishes of this river are used as ideal food fishes. Fishes like *Aplochiles lineatus* has got great application value as they are ideal predators of mosquito larvae. There are 12 species of migratory fishes (also called as secondary freshwater fishes) in this river which used to migrate from the backwater to the inland areas. It is most interesting to note that from Orukumban (which is the confluence of Karapara River and the Parambikulam River), scientists were able to locate 32 species of freshwater fishes. The maximum water available for this area is from the Karapara River which is the only undamaged major tributary of Chalakkudy River. The same authors were able to record only 8 and 11 species from the nearby damed Parambikulam and Sholayar Rivers. Therefore detailed studies in this area could prove the impact of dams on fish diversity .

Ajithkumar *et.al* (1999) in their detailed fish survey in Chalakkudy River found that 15 previously recorded species are not found in this river now. These species considered either extremely endangered or extinct from the system. Because river is only one component of a larger system, the Basin, fish communities in rivers are affected not only by the events occurring within the channel and its associated waters but are also subject to a wide range of external influences. The reduction of fish diversity in this river can be combined effect of many factors.

Extensive destruction of forests in the catchment areas and the continuos degradation of riparian vegetation along the banks, appearance of 6 large dams along the upstream of the river, uncontrolled sandmining, indiscriminate uptake of water for interbasin transfer, irrigation, domestic supply, industrial use, recreation purpose etc, ever increasing soil erosion into the river channels, alarming deterioration of water quality due to industrial, agricultural and domestic pollution, the regulator constructed at mouth of the river in order to check salinity intrusion, uncontrollable growth of aquatic weeds, destructive means of fishing,
introduction of exotic fishes etc, have contributed to the alarming decline of fish biodiversity in this river.

Understanding the health of the river is a pre-requisite for developing sustainable management strategies. A multitude of factors determines the health of a river system. They include geomorphologic characteristics, hydrological and hydrolic regimes, chemical and physical water quality, nature of instreams biodiversity etc. Monitoring of every factor is impractical but we can select certain indicator representatives of the main component of a riverine ecosystem to obtain a realistic measure of the health of the system. Fish comprise one of the main biological component of aquatic ecosystem . Since they are long – lived and mobile, they can indicate long-term influences (even over years) and general habitat condition of the river reach. Further, fishes represent a variety of trophic levels and hence can integrate effects of environmental changes. This river is most ideal for conducting detailed studies in this regard.

## DETAILS OF WATERSHED

| | |
|---|---|
| Water Shed No: | 16c 53a |
| **Name of Watershed** | KADUKUTTY WATERSHED |
| **Area of Watershed** | 13.3348 sq.km |
| **Latitude & Longitude** | $10^{O}16'$ & $76^{O}19'$ |
| Slope | |
| *Including wards :* *KADUKUTTY ----- 4, 5, 6, 7, 8, 9, 10*<br>KORATTY ---------- 8, 9 | |
| Boundaries | |
| North | **CHALAKUDY RIVER** |
| East | MELOOR WATERSHED |
| West | CHALAKUDY RIVER |
| South | CHALAKUDY RIVER ,<br>KORATTI WATERSHED |
| Mixed Crops | **797 Ha** |
| Quarry Rock | 1.92 Ha |
| Quarry Laterite | 0.64 Ha |
| Quarry Clay | —— |
| Paddy Fields | 317.2 Ha |
| Paddy Fields Reclamated | 60 Ha |
| Paddy Cultivable Fallow | 18.34 Ha |
| Water Bodies | 0.32 Ha |
| Coconut | 17.2 Ha |
| Total Number of Wells | 3784 |
| Total Number of Perennial Wells | 2867 |
| Total Number of Seasonal Wells | 917 |

| | |
|---|---|
| Total Number of Ponds | 105 |
| Important Streams: KLAMA THODU, PERUM THODU,KANNANCHIRA THODU, THANIYAM THODU | |

**DETAILS OF WATERSHED**

| | |
|---|---|
| Water Shed No: | 16c 5a |
| **Name of Watershed** | VAINTHALA WATERSHED |
| **Area of Watershed** | 8.7316 sq.km |
| **Latitude & Longitude** | $10^{O}16'$ & $76^{O}18'$ |
| Slope | |
| *Including wards :* *KADUKUTTY* ---------- *1, 2, 3*<br>ANNAMANADA ---------- 11 | |
| Boundaries | |
| North | **ANNALLOOR WATERSHED** |
| East | CHALAKUDY RIVER |
| West | ALOOR |
| South | ANNAMANADA WATERSHED, KUNDUR WATERSHED |
| Mixed Crops | **598 Ha** |
| Quarry Rock | —— |
| Quarry Laterite | —— |
| Quarry Clay | —— |
| Paddy Fields | 263 Ha |
| Paddy Fields Reclamated | 65 Ha |
| Paddy Cultivable Fallow | |
| Water Bodies | 2.24 Ha |

| | |
|---|---|
| Coconut | 11.52 Ha |
| Total Number of Wells | 1496 |
| Total Number of Perennial Wells | 1202 |
| Total Number of Seasonal Wells | 294 |
| Total Number of Ponds | 28 |
| Important Streams: KOKKA THODU, KONDAZHINJAL THODU, ALATHUR THODU | |

**DETAILS OF WATERSHED**

| | |
|---|---|
| Water Shed No: | 16c 54a |
| **Name of Watershed** | KORATTY WATERSHED |
| **Area of Watershed** | 4.3437 sq.km |
| **Latitude & Longitude** | $10^{O}15'$ & $76^{O}21'$ |
| Slope | |
| *Including wards :* *KORATTY* ---------- *6, 7, 11*<br>ANNAMANADA ---------- ½ PORTION OF ANNAMANADA | |
| Boundaries | |
| North | **KADUKUTTY WATERSHED** |
| East | NALLUKETTU WATERSHED |
| **West** | CHALAKUDY RIVER |
| **South** | VALUR THODU WATERSHED |
| **Mixed Crops** | **277.20 Ha** |
| Quarry Rock | 1.12 Ha |
| Quarry Laterite | —— |
| Quarry Clay | 20.48 Ha |

| | |
|---|---|
| Paddy Fields | 29 Ha |
| Paddy Fields Reclamated | 44 Ha |
| Paddy Cultivable Fallow | |
| Water Bodies | 33 Ha |
| Coconut | 15.60 Ha |
| Total Number of Wells | 1266 |
| Total Number of Perennial Wells | 846 |
| Total Number of Seasonal Wells | 420 |
| Total Number of Ponds | 22 |
| Important Streams : VALUR THODU | |

**DETAILS OF WATERSHED**

| | |
|---|---|
| Water Shed No: | 16 c 54 b |
| **Name of Watershed** | NALUKETTU WATERSHED |
| **Area of Watershed** | 9.4489 sq.km |
| **Latitude & Longitude** | $10^{O}15'$ & $76^{O}23'$ |
| Slope | |
| Including wards : KORATTY---------- 1, 2, 3 | |
| Boundaries | |
| North | **POOTHIRUTHI WATERSHED & MELOOR WATERSHED** |
| East | ERNAKULAM DISTRICT |

| | |
|---|---|
| **West** | KORATTY WATERSHED & VALUR THODU WATERSHED |
| **South** | ERNAKULAM DISTRICT |
| **Mixed Crops** | **216 Ha** |
| Quarry Rock | 3.84 Ha |
| Quarry Laterite | 2.24 Ha |
| Quarry Clay | —— |
| Paddy Fields | 161 Ha |
| Paddy Fields Reclamated | 42 Ha |
| Paddy Cultivable Fallow | |
| Water Bodies | 4.2 Ha |
| Coconut | 317.67 Ha |
| Total Number of Wells | 1329 |
| Total Number of Perennial Wells | 898 |
| Total Number of Seasonal Wells | 431 |
| Total Number of Ponds | 79 |
| Important Streams : VALUR THODU, CHUDAPUZHA THODU | |

# LAND USE IN THE BASIN

The land in a watershed has to be used for several purpose like crop and live stock production, housing, roads etc .It is true that the land cannot be always put into uses which will provide maximum or most desirable uses for the protection of the water shed. However, land use highly influences rates of runoff, infiltration and types and quality of vegetation cover.

From the data collected from the Resource Maps made by the Kerala State Landuse Board, it is very obvious that the present trend of landuse in the basin is in an unsustainable fashion. Almost 50 percent of the total paddyfeilds in this basin has been reclaimed during the last 30 years. Maximum reclamation of paddyfields occurred in Aloor Panchayat.

Fig -24 shows the extent of existing and reclaimed paddyfields in each local body in this basin. It is to be specially noted that Athirapilly Panchayat which had 20 ha of paddyfields some 20 years ago have been completely reclaimed and this is the only Panchayat in the basin without even a cent of paddyfield. Paddyfields are man made wetlands and they perform almost all vital functions of this ecosystem. Paddyfield ecosystems are extremely important for a State like Kerala, where natural wetlands are very rare. Paddyfields often help in controlling floods, recharging ground water and maintaining water quality. Disappearance of paddyfield is an alarming threat for the ecology of this basin. Table-11 shows extent of paddyfeild in each panchayat which are kept as paddy cultivable fallow land. Kerala is a state with chronic food deficit. In this period of time extensive area of paddyfields are kept uncultivated in this basin. In Chalakkudy Municipality, Kadukutty and Mala Panchayats 44 ha, 47 ha, and 45 ha of paddyfields are left as paddy cultivable fallow.

While scanning through the landuse pattern of the basin indiscriminate granite quarrying, laterite quarrying and claymining are another major aspects worth special mentioning. Maximum extent of area used for granite quarrying in basin are in Pariyaram and Kodassery Panchayat ie;

14 and 15 Ha respectively. This activity is going on in most of the Panchayats except Athirapilly, Mala and Kuzhur. 15 Ha of area is used for laterite mining in Aloor

panchayat which is the maximum among the Panchayats of this basin. Mining of clay is maximum in Kuzhur panchayat, where an area of 52 Ha is used for this activity (Table-11).

Through mining or quarrying, the landscape and land stability are seriously affected. Eventually certain hillocks are completely removed making serious changes in the landscape. Due to quarrying activity which used to have drilling and blasting, the nearby areas are drastically affected. Most of the contractors involved in the same are found to be least bothered about this impact. Extensive mining of clay always leads to the development of stagnant water bodies. It is surprising that the sanction for the mining is always given for taking day only upto a depth of 2 feet. But this is often violated. There are strict rules for each and every kind of quarrying and mining activity which being most often flouted.

From the Resource Map of local bodies collected the from Kerala State Landuse Board, we have identified certain areas where exceptional landuse changes happened during the last two to three decades. Such 21 areas within the basin have been selected and in each case preliminary observations were also made. Brief descriptions of these areas along with the maps are shown here with the hope that detailed and intensive studies may be possible in future.

## Map showing plantation of oil palm along Anamala Road

The area shown in three of the above maps are forest lease lands where Plantation Corporation of Kerala have raised cash crop plantations. Around 4260 ha of forest land has been leased out to this corporation. The species planted include rubber, cashew, matti and oil palm. These plantations were raised during 1961-1977 after clear felling large areas of natural forests. In for the area shown in the map, after

clearfelling of natural forests, taungya cultivation was practiced prior to rising rubber. Later rubber was planted in this area. In 1991-1992, around 200 ha of rubber was clear felled and oil palm was planted. Taungya was practiced again in this area for 3 years.

The terrain of the area shown in the map is steeply slopping and is not very suitable for any sort of intensive agriculture. From the workers of this plantation, it was learned that, during the planting operation of oil palm 1 Kg of BHC (Organochlorine pesticide) was applied per seedling to ensure protection against to pest attack during the early stages of growth.

According to some of the workers who were engaged in clearfelling the forests in this area in late 1960's which now has been completely wiped out riparian vegetation occurred extensively along these river margins. Clearfelling of forests and taungya cultivation have led to severe soil erosion. There is no existing data regarding the extent of soil erosion. It is also logical to expect that significant quantities of pesticides used here have reached the river. As a part of this study, alarming quantities of both $\alpha$ BHC and $\gamma$ BHC were detected from the river sediments collected from the lower reaches.

Extensive clearfelling of the natural forests in this area for developing these estates, have led to the drying up of several streams and many of the streams have become seasonal. In a random survey, out of the 200 Ha of land along the river bank where oil palm plantations exist now, sixteen large streams which were once perennial have become seasonal (flowing during the rainy days). All these large streams were contributing to the main river. This area provides an excellent study area for understanding how deforestation leads to the drying up of streams.

**LAND USE IN PONGAM AREA**

The area shown in the map is part of an extensive former flood plain of Chalakkudy River. This area comes within Valur thodu watershed. In spite of

Government order banning reclamation of paddy fields large area have been reclaimed here during the last ten years for various purposes, including construction of buildings, cultivation of cash crops like coconut and banana etc. Conversion of paddy fields for constructing buildings is still going in the area.

Some of the small laterite hillocks in between the paddy field are being quarried. Laterate quarrying a very recent development in this area is an after effect of the decline of cement hollow brick industries in Chalakkudy and near by areas. Formerly people used to prefer hollow bricks instead of laterite stones because the former were cheaper and more readily available. But the sudden hike in the price of cement made the hollow bricks more costier. Poor quality bricks turned consumers away lead to the collapse of this small scale industry. Lack of adequate water for wetting the bricks during manufacture is another factor which lead to the declining of this industry. All this have contributed to an upswing in the demand for laterite blocks in here. Moreover, new technologies like the cutting of laterite using the tiller machine, easy removal of the surface soil above the hard laterite using JCB machine have made laterite cutting less labour intensive and hence cheaper. Formerly when laterite blocks were cut manually, the contractors were not able to meet large orders in short notice. But the emergence of mechanized cutting using tiller has changed this situation. This has resulted in a boom in laterite quarrying in most of the Panchayats in this basin. Indiscriminate laterite quarrying would lead to serious ecological problems. Detailed studies in this regard is possible in this area.

**LAND USE IN KONUR AREA**

Rubber is the most prominent crop cultivated in the area shown in the map. This is adjacent to the Plantation Corporation of Kerala plantation where extensive rubber cultivation is being practiced. Vast areas of virgin forests were

clearfelled for the development of plantations by the corporation from 1961-1977. Raising of rubber plantation by this corporation acted as a sort of inducement for the individual farmer who also started cultivating rubber even in the bits of land they possessed. Some of the farmers even clearfelled extensive areas of mixed crops and trees for developing even very small scale rubber plantations. It is intresting to see certain families who have only less than 25 cents of land but cultivating rubber alone. Local people of the area said that this has led to the loss of several species of trees having high economic value and several others of regular use. The recent fall in the price of rubber has become a serious problem for such farmers who are exclusively dependent up on this particular crop. Some of the rubber farmers said that they are going to cut down rubber trees and try nutmeg, banana or even coffee.

Some of the paddyfields in the area shown in the map have been reclaimed for planting coconut and mixed crops. This has led to further fragmentation of paddyfields. Such fragmented paddyfields may not be able to survive the pressure of reclamation as it may be very difficult to cultivate and irrigate such small plots. The local people said such tiny paddyfields which have lost major portions by reclamation, may not survive as paddyfields for long. Thus they too will be converted in due course at time.

**Land use in Annanadu Area**

The area shown in this map has a series of ponds which is the main source of water for irrigating the area. All these ponds have been dug by farmers for the purpose of irrigating paddy. There are no canals either of the major or minor irrigation schemes in this area. Here extensive areas of paddyfields were reclaimed for cultivating mixed crops, especially nutmeg, coconut, banana, arecanut etc. The local people said that this has led to the reclamation of several ponds also. Within the

area shown in the map 23 ponds could be seen. However when we checked some of these ponds, it was found that they have been heavily silted up. No serious effort has been made by the farmers to remove the silt which if properly done could retain more water in the ponds for longer periods.

This is a location where a network of farm ponds could be tried as a watershed Development programme. The local people when contacted expressed their willingness to propose such a scheme in the peoples plan programme. We have already handed over the information collected by us in this regard to the concerned local bodies. Possibilities for the same should be investigated in detail.

All these ponds are located in a former flood plain of the river. Although the entire flood plain has now been converted to paddyfields, there are chances of finding the remnant populations of the former flood plain biota in these perennial ponds. Most of these ponds could be biodiversity Sanctuaries especially in the dry seasons. During the drought period, these ponds are refugia for almost all the fresh water organisms. Thus these local biodiversity hotspots are ideal for detailed biological investigations. This could be tried in the second phase of this study.

**Land use in Government polytechnic area Koratty**

The most interesting aspect about the landuse in this particular area is around 28 ha of paddy is cultivated 3 times a year depending on water from 3 adjacent natural springs. These springs originate from hard laterite and not much fluctuation in the outflow from these springs throughout the year. The approximate summer discharge from the largest spring is 512 litres of water per minute. In Kerala, out of the total of 236 springs recorded (springs in Kerala, by CWRDM), only 19 have a

summer discharge of more than 500 litres per minute. These springs shown in the map have not been recorded in the CWRDM listing.

After irrigating paddy fields, the remaining water from the springs flow into the Chalakkudy River. Some of the areas around the location of these spring like Palamuri, Parakuttam, Konnur etc., face acute scarcity for drinking water. Therefore the quantity of water remaining after irrigating the paddyfields may be stored in a large tank or so and could be used for providing drinking water to the necessary areas. The springs are located within the Poramboke land ( public property) and the cost for development and maintenance of these springs will be much lower than the cost for any other drinking water supply schemes proposed for the these areas facing water scarcity.

As per the records of the "Springs of Kerala", there are only 9 springs in Thrissur District. But during this study itself, we came across 8 springs (3 in Koratty, 3 in Pottachira, and 2 in V.R. Puram) within a very small area. This indictes that detailed surveys could reveal the presence of several more springs within the basin. The potential of springs, if sustainably harvested could solve the shortage for drinking water atleast in a few areas easily.

**Landuse in Adichili Area**

The area shown in the map is a narrow string of paddyfield. It was once properly cultivated using water from a natural stream called Adichili thodu. This thodu is a small tributary of Chalakkudy River. 15 years ago, paddy was the only crop cultivated in the area through which this Perennial thodu passes. Later small bits of land got converted for the cultivation of mixed crops leading to its fragmentation. Some of the old generation paddy farmers here are still sticking on to paddy

cultivation. They are of the opinion that paddy cultivation gives them the satisfaction which they consider something great than their profit.

While the farmers who have reclaimed their own paddyfields were contacted, each of them had different reasons to tell. Almost all these farmers said that it is increasingly difficult to manage paddy cultivation anymore. But these farmers have spend lots of money for reclaiming paddyfields and planting mixed crops including Coconut, Banana, Arecanut etc. The same farmers are now of the opinion that the present agriculture pattern also is not yielding profit for them. It is interesting to note that none of the farmers in this area have kept the paddyfields uncultivated. Assured water availability throughout the year from Adichili thodu is considered the main reason for this.

Some years back, there was a hike in the price for rubber and a few of the farmers in this area converted their mixed crop lands to rubber cultivation. But the recent low price of rubber is at present forcing them to think about alternative crops. Another aspect we have noted here is that the farmers here are very dynamic and it seems they do not have any hesitation in uprooting even a half grown tree crop and try another crop depending upon price fluctuations. But the recent continuous down trend as for as all agricultural produce are concerned fluctuations of prices is a matter of serious concern for them.

**Landuse in Melur Pallinada Area**

In this area, paddyfields are being used for mining of clay, for developing coconut plantations, mixed crops and for cultivating tapioca etc. It is interesting to note that till recently this paddyfield had one of the best ‘Padasekara

samithis' in the basin. This samithi is receiving many subsidies including reduced electricity charges for the lift irrigation motors they use. However some of the farmers tempted by high prices offered by the mining lobby decided to sell their land for clay mining. Two years ago the land value of this area was Rs.300/- per cent. While a cent of land was offered Rs.3000/- if sold for the mining of clay. The land owners who are not residing near the paddyfields were the first to sell their lands for clay mining. Farmers residing adjacent to their fields were reluctant to sell the land for this purpose because of the fear of various environmental consequences. In the beginning there were certain local agitations against the selling of their excellent paddyfields for clay mining.

Now the farmers of this area who are still wanting to cultivate paddy are finding it increasingly difficult to do the same because of the lowering of the watertable. This factor is forcing them to sell their land for whatever prices offered by the clay mining lobby. Local people in the area said that intensive clay mining here could even change the flood pattern in the river. Each year for the collection of clay, permission is to be given by the Revenue Divisional Officer. The R.D.O used to give permission to mine clay by digging two feet of earth from the surface. But the local people said that most of the laws are violated here and the contractors are mining far more clay than is permitted by the authorities. There is also another complaint that the authorities seldom verify the process of mining by the contractors even once in a few years.

**Landuse in Nayarangadi Junction area**

The area shown in the map include location of six granite quarries. This area comes within Kodassery watershed of Kodassery Panchayath. At present 15.84 Ha of land is occupied by granite quarries in this Panchayath. Recently there has been a great boom in granite quarrying activities in this Panchayath. Just after the commissioning of the Kochi International Airport, granite quarrying within a radial distance of 25 Km from this Airport was officially banned. This has forced several granite quarries in Periyar basin to wind up. But this has led to the development of several new quarries as well as increase in the extent the of production from existing quarries. This pressure is certainly felt among the quarries shown in the map also. In this watershed granite quarries occupy an area of 0.96 Ha. There is good demand for rock in and outside the basin. The landlords who manage granite quarries are not residing near by the quarry lands. Most of the people residing adjacent to the quarries complain about the sound pollution and vibrations due to rock blasting. The local people are of the opinion that the constant vibrations are causing serious damage to the nearby houses and their land. But the managers of the quarries said that they have 'no objection certificate' from the concerned authorities. Some of the people residing nearby were also given job in the quarries. For quarrying one cubic metre of granite, the royalty which has to be paid to the Government is Rs.40/- only. For quarrying up to $25m^3$ the permission has to be given by the local Thahasildar, if it is up to $50m^3$, the permission must be granted by the Revenue Divisional Officer and if it is upto $100m^3$, District collector's permission is necessary. The local people said that most of these norms are commonly violated.

**Landuse in Kuruppam Area in Melur**

The area shown in the map comes within Poothiruthi thodu watershed in Melur Panchayath. In this area most of the paddyfields have been converted to banana cultivation Tapioca cultivation is also seen in some locations. This is a general trend of Melur Panchayath where banana cultivation is widespread. A total of ……. Ha of land in this Panchayath is under banana cultivation. …….. Ha of land in the Panchayath is under Tapioca.

A thodu by the name poothiruthi thodu is the main source of irrigation in the area shown in the map. Recently clay mining is becoming widespread in this area. Paddyfields which were used for banana and tapioca cultivation are now being used for mining clay. Clay is being excavated from three locations in there paddyfields. The local people said that this would drastically lower the water table in the area. One of the clay mining sites is right on the bank of Poothiruthi thodu which is definitely illegal. This will certainly adversely affect the natural flow of this stream.

The local people also said that irrigated agriculture in the area is becoming increasingly difficult as the water table in the area is going down alarmingly year by year. While on one hand clay is being mined from the paddyfield lowering the water table, on the other hand the bed of Chalakkudy river (which is passing through the northeastern portion of the area shown in the map) is also getting rapidly lowered due to indiscriminate mining of sand. Both these factors are making agriculture in the area more and more difficult.

**Map Showing Landuse in Kalady in Melur Panchayath**

The area shown in the map belongs to Melur watershed in Melur Panchayath. This area is hardly 200 meters away from the Chalakkudy river. Almost the entire area was part of the former flood plain of the Chalakkudy river. This flood

plain was later modified into an extensive paddyfield. Three crops of paddy used to be cultivated here till recently. Later the Nadathuruthu-Muringoor road came almost exactly through the middle of this paddyfield and the paddyfield became virtually cut into two sections. Arrival of the road paved the way for more residential buildings in the area. For this people started reclaiming small bits of paddyfields. Later extensive areas of paddy fields along both sides of the road were reclaimed and even more residential buildings sprung up.

Large coconut plantations could be seen on either side of this road. However the havoc caused by "Mandari disease" of coconut is forcing these farmers to think about some other profitable crop.

In the Melur watershed the prime reason for conversion of paddyfields is for the development of mixed crops, monoculture of banana, coconut etc. Out of the 211 Ha of paddyfields that existed in this watershed 30 years ago, 71 Ha have been already reclaimed for this purpose.

The area shown in the map proves to be an ideal location for detailed studies about the impact of roads cutting across paddy fields.

**Map showing land use in Valur and Mampra Area**

The area shown in the map can provide a case study of how the non-co-operation of a single farmer would affect the agricultureal pattern of the whole area. There were extensive paddyfields on both sides of the Valur thodu till recently. However, one farmer having paddy land on the right bank of the Valur thodu just before where it joins the river gave his land for mining clay. Soon several country-brick choolas mushroomed in the paddyfield and they started mining clay even right up to the bank of the thodu. Now water from this thodu is entering in to the pit that has appeared in the paddyfield as a result of indiscriminate claymining. This has changed the flow pattern of the thodu causing great difficulties for routine lift irrigation from the thodu. The change in the flow pattern has reduced the pumping efficiency of the lift irrigation motors. These and other related factors have forced some of the farmers in the area to stop cultivating their paddyfields. Following the precedent set, a few other farmers also have given their paddy lands for claymining recently. The local people in the area said that soon the entire paddyfields in the locality will get in to the hands of the claymining lobby who are offering relatively high prices for these paddyfields. This area is an ideal location for studying the reason

for landuse changes in paddy areas and also how individual decisions are affecting the future of the whole area.

**Map showing landuse in Munipara Junction Near Kanjirapilly.**

The area shown in the map includes the sites of some of the largest granite quarries in the basin. This area belongs to Velookara watershed in which 12 Ha of land is being used for granite quarrying. The ban on granite quarrying activity within 25km radial distance from the recently commissioned Kochi International Airport has resulted in the increase in demand for granite from the quarries shown in the map.

The local people residing in the area said that the intense vibrations resulting from blasting of rocks is causing serious problems. Due to the regular explosions and vibrations, a crack appeared on one of the sides of water tank (Thrippapilly water tank) which is providing domestic water supply for the Pariyaram Panchayat. Because of this crack, it is not possible for storing water in this tank for more than few hours. The local people also raised the complaint that inspite of several attempts neither the water supply authorities nor the revenue authorities who give sanction for granite quarrying responded to this incident. Cracks have appeared on the walls of a few houses which are adjacent to the quarries. But the contractors gifting some money and occasionally giving some jobs restrain these people from agitating for long. This area provides an ideal location for a detailed studies on the economic and environmental impact of granite quarrying.

There was the practice of allowing contractors to quarry granite from certain areas within the Reserved Forests of the Pariyaram Range. Maximum number of such quarries existed on both sides of the Anamala road at a place locally called as ‘ Chakrani ‘. But this practice was stopped in 1984, when a few lorries were seized by the forest officials which tried to transport illegally cut timber concealed beneath the granite.

**Map showing landuse in Kattipokkam (Chalakkudy).**

The area shown in the map belongs to Elinjipra watershed of Pariyaram Panchayat. This is one of the watershed in the basin where intensive agricultural activity is going on. This watershed had 125 Ha of paddyfields some thirty years ago, but now only 64 Ha remain. There are a few natural thodus in this watershed namely paruthichira thodu, poonkody thodu, kuttadam thodu etc. Most of the paddyfields are found along the sides of these thodus. Formerly paddy was cultivated in this area three times a year. But now this practice has been changed and each farmer is cultivating paddy according to his convenience.

In the area shown in the map, farm holdings are small and again the area illustrates how reclamation of scattered paddyfields leads to their complete fragmentation. The local people in the area are fully aware that even small scale paddyfield reclamation will make the paddy cultivation in this area increasingly difficult. But they said that all farmers are not thinking alike and proper awareness about watershed management is necessary.

One of the interesting features we have noted in this watershed is the very high number of private lift irrigation schemes operating from the natural streams. This watershed is really blessed by the abundant availability of water. The branch canal of the Chalakkudy River Diversion Scheme is also having year round water flow.

**Map showing landuse in Vettikuzhi.**

The area shown in this map belongs to Randukai watershed in Athirapilly Panchayat. This Panchayat once contained 22 ha of paddyfields. All the paddyfields of this Panchayat was in Randukai watershed which has been completely reclaimed for cultivating mixed crops. At present not even a cent of paddyfield exists in this Panchayat.

The paddyfield area which has been reclaimed for developing mixed crops is clearly shown in this map. A rock quarry has been operating in this area since the last 15 years. Some of the areas which once contained mixed crops and wild trees have been converted into Rubber monoculture. Some of the areas which once had wild tree growth has been recently clearfelled and converted to Teak plantation. It is interesting to note that the farmers in this area are highly dynamic and adaptive willing to experiment with new agricultural ideas.

This area faces serious soil erosion problems and much of the fertile top soil has already been lost exposing extensive areas of hard rock. The impact of the constant landuse changes has not been documented. Many locations in this area face acute scarcity of drinking water. There has been a rapid increase in the population and consequently a sporadic increase in the number of houses in this area during the last 20 years. This area is an ideal study location for reconstructing landuse changes and assessing its impact on the local environment.

**Land use of NH-47 By-Pass Area, Chalakkudy**

This area comes whitin Potta watershed. This watershed has an area of 2.24 Ha of cultivable paddy lands now left fallows. Paddy is not cultivated in this area because the fields remain water logged for most of the year. The construction of the NH-47 By-Pass in 1992 resulted in this situation. The By-Pass road was constructed through the middle of the paddyfield bifurcating it. A culvert constructed for the proper drainage of water from paddyfields an one side of the road to the other side is not functioning properly due to flawed design. Hence the entire paddyfield area remain waterlogged for most of the year. Several complaints were filed by the local people at the Chalakkudy Municipal Office regarding the same., but the authorities have not responded. According to the municipal authorities, this work should be partially funded by the National Highway authorities belonging to the Government of India. When the National Highway officials were contacted, they said that no complaint was

filed by the local people as soon as the work of the culvert was completed and now it will be difficult to reopen the file or to recall the contractor. The net result is that approximately 2 Ha paddyfields remaining useless. These paddyfields belongs to several people and it is a fact that they are not really united for the cause. Some of the farmers are keen in cultivating paddy while others says that it is not profitable and they are hesitant to take serious pains to repair the culvert for evacuating water from the paddyfield.

**Land use in Annanad North**

This area lies adjacent to the left bank of Chalakkudy River at Annanad in Kadukutty watershed. The most interesting aspect to be noted here is the presence of several sacred groves in the area. Most of these sacred groves are located very near the river. The river in this area is also having one of the last remaining sandbanks along its entire course. This sandbank is called Arangali sandbank. Sand mining is restricted here solely due to people's opposition. This area comes within Kadukutty Panchayat and normally when sand is being auctioned by the Panchayat, they eliminate auction from this sandbank as local people won't permit the Panchayat authorities or anybody else to mine sand from this area. In a recent estimation made by the Centre for Earth Science Studies as part of a sand budgeting in Chalakudy river, it was found that the sand from this bank is worth around Rupees up to 3 cores. Still, the local people are not permitting the local body from auctioning sand from this area.

When we made a preliminary investigation for finding the reason for the united support of the local people against the mining of sand, it was understood that the number of scared groves near the sandbank has religious cultural interrelationship with it. Hence the local people in general and especially the women of the area come out in large numbers for protecting the sandbank whenever there was a move to collect sand from the area either by the local body or the sand contractors. The huge Arangali sandbank remains as a symbol of the unity and commitment of the local people in protecting the last remaining sandbank along the river as an invaluable monument.

**Land use in Kottatt Area**

Kottatt area comes within Chalakkudy watershed and is part of the Chalakkudy Municipality. A good portion of the area shown in this map was formerly in the flood plain of the river. It was then converted in to paddyfields and till recently they were well managed. But now major portions of these paddyfields are either left uncultivated or used for vegetable cultivation. In Chalakkudy watershed 42.86 ha of paddyfields are kept uncultivated for the last 10 years or so. Vegetable cultivation among paddyfields is also a common feature in this watershed. 12.68 ha of paddyfields have been used for vegetable cultivation. The local people said that, if paddy cultivation become profitable, they really wished to start cultivating paddy again. Short term change from paddy to vegetable is at present giving them good profit. There is a very good market for vegetables within Chalakkudy Municipal area

itself. The most common vegetable item raised by the farmers here is cowpea which is having good demand and can be marketed easily. Most of the cowpea arriving in the Chalakkudy Municipal market produced locally.

10.32 Ha of paddyfields within Chalakkudy Municipality has already been converted for building construction. But paddyfields in the area shown in the map has not been reclaimed for constructing buildings. The practice of reclaiming paddyfields for developing mixed crops is also not observed in the area shown in the map.

**Land use in Kundur Area.**

The area depicted in the map shows the land use in Kundur area. The entire area was part of one of the widest floodplains of Chalakkudy River. Later when people started inhabiting the area, the whole floodplain got transformed into paddyfields. Some 30 years ago, these paddyfields used to get regularly flooded during the monsoon season, thereby enriching the soil. But there have been no big floods in the river for the last two- three decades. Later the landowners started to gradually convert the paddyfields into mixed crops. Now very little paddyfields are left in this area shown in this map.

Reclamation of paddyfields for cultivating cash crops have several consequences in the area. Flow of water in some of the natural streams has been reduced considerably. In order to compensate for the reduced water availability from the steams, several lift irrigation canals appeared in the area. According to the local people, when the paddyfields existed, there were many large and small ponds in this area which also were reclaimed later. It is the version of the local people that the large- scale paddyfield reclamation done in the area has led to the lowering of water table among the wells. Detailed PRA exercises along with scientific studies are necessary for clarifying the same. This area comes within the Kundur watershed of Kuzhur Panchayat. So far 244.82 ha of paddyfield have been reclaimed for various purposes in this watershed .

## REMAINS OF AN OXBOW LAKE AND LANDUSE IN VAINTHALA

Remains of an Oxbow lake- like structure could be located at Vainthala, West flowing Chalakkudy River takes a sharp turning to the East. A good extent of paddy fields in the area has been converted into coconut plantation. But fringes of paddy fields are still kept in the area which are irrigated almost throughout the year using the water available in the oxbow lake-like structure. Sides of this lake-like structure was also encroached by the local people. Several attempts in the area were done for dewatering this lake-like structure and using its fringes for cultivation. These attempts were started even before 200 years, when the then landlord of the area, Sri

Kuttan Nair made a canal from the lake to the river in order to drain water and reclaim the entire water filled area for paddy cultivation. But he could not succeed in this venture. This canal which has been made through the hard laterite could be seen even today. At present the relatively undamaged portion of this lake in under the possession of the Kadukutty Panchayat which forms part of the Chalakkudy Block Panchayat. This lake which might have formed through the detachment from the river formed several centuries ago, has to be protected as it is part of our precious natural heritage. It is highly appreciable that Kadukutty Panchayat is taking serious interest in the same.

## LANDUSE IN THE WATERSHEDS OF THE BASIN

Some of the watersheds in the down reaches of the river basin have been mapped. The location of these watersheds in the basin have also been plotted on the basin map. The details of these watersheds namely the area, latitude and longitude, slope, the wards of the local bodies in which the watershed belongs to, boundaries, landuse, agriculture, wells, ponds, streams etc. have been collected. This is as follows:

## AGRICULTURE SCENARIO IN THE BASIN

The secondary date available from the Krishi Bhavans all over the basin reveal an approximate picture of the agriculture scenario of this basin. Table 12 shows the extend of various crops cultivated within each local body of this basin. This data, of course was updated by the authorities almost five years back. However it is presented here with the belief that it could show the trend in the agriculture pattern within the basin.

Coconut is the crop within the basin which covers maximum area. The local people whom we had interviewed said that there was a steady increase in the area of coconut during 1970's and 1980's. Most of these areas later turned into intercropping. Intercrops include pepper, nutmeg, arecanut, pineapple, banana etc.

Paddy is the crop which occupies the second maximum area in this basin. This is mostly seen in the down reaches of the river, where water is available. Most of the paddyfields were former flood plains of the river. A good portion of the paddyfield have got reclaimed for building industrial, residential or commercial complexes or for cultivating terrestrial crops.

Banana is the most important fruit crop in the basin. While considering the area of production it is only next coconut, and paddy. Cultivation of banana in Melur requires special mentioning. In this Panchayat 566 ha is under banana. The laterite soil of this area is most ideal for banana cultivation.

Rubber is a major crop in the basin which is seen in all the Panchayats except Kadukutty and Kuzhoor. This crop had a steady increase in area until the price for rubber went down drastically almost 3 years back.

Coffee which is an important beverage crop is grown in two Panchayats namely Nelliyampathy and Athirapilly. Out of the 2174 ha of coffee grown in the basin 2164 ha is in Nelliyampathy panchayat. Robusta coffee is the pre dominant variety grown in this basin.

Tea is grown in this basin (excluding the Tamil Nadu areas) predominantly in the Nelliyampathy Panchayat. In this Panchayat cardamom is also cultivated in 1908 ha which is the only area in the basin where significant cultivation of the 'queen of spices' is going on. . Black pepper in another spice cultivated relatively extensively in this basin.

## Farmers Association registered in the Krishi Bhavans of the basin

**Kerasamithi:**

These samithis are for the enhancement of coconut cultivation. It came into being in 1987. Kera- samithis are started corresponding to the number of wards in the local body. Each Kerasamithi is a Registered society. The main activity of this samithi is to remove the diseased coconut trees, provide subsidies for planting new seedlings, spraying pesticides, introducing better yielding varieties to the farmers etc. All the benefits from the Comprehensive Coconut Development Programme of the Govt: of India is charted through Kerasamithis of each Krishi Bhavans.

**Harithasangam:**

This scheme started during 1977-78 as part of the Intensive Vegetable Development Programme. Harithasangams are meant for the enhancement of

vegetable cultivation and production. Each Haritha sangam is a registered society. A compact area of 5 ha in necessary for receiving subsidies as part of this samithi. Rs. 50,000 will be provided as subsidy for the samithi. From the farmers we learned that this scheme has reasonably good result in certain areas of the basin.

**Groupfarming samithi:**

Groupfarming samithis were started in 1989 in order to cultivate paddy in a collective and organized fashion. It is expected that as part of the activities of this samithi, farmers have to collectively decide which kind of rice seed to be used, pesticides to be sprayed, fertilizer to be applied, steps for collective harvesting etc. Each groupfarming samithi is also a Registered Society. These samithis also collectively receive subsidies and other benefits from the Agriculture Department.

**Agroclinic:**

This clinic is meant for providing implements for the farmers on the basis of nominal rent. The officials are also expected to provide technical advice to the farmers. This scheme started in 1997. Agroclinicis are mainly meant for paddy cultivation. But the local farmers are of the opinion that this scheme is not working effectively.

**Agro Service Centre:**

This scheme was started in 1986. It is mainly meant for paddy and coconut. The main objective of this scheme is to provide enough labors to the farmers. For this, the Krishi Bhavans have to register the farmers in the respective Agro Service Centers. However the labors are not showing intrest in working as per the direction

of this clinic mainly because the Government prescribed wages are much lower than that of commonly prevailing in the area. Upon discussing with the farmers it was learned that they have registered only with hope that the Government may make them permanent labors.

Live stock in the basin

Table-14 shows the lives tock within each Panchayat of the basin In the Panchayats within the basin, the number of cows are maximum in Kodassery Panchayat. This is because there are several benificieries of the PDDP within the Panchayat. PDDP used to provide cows to these beneficiaries as lone, so that even poor people can afford having a cow. Moreover there are ideal grazing grounds for cattle within this local body.

Broiler chicken farms are very high within Kuzhur Panchayat and this is the main reason for the large number of broiler chicken within the Panchayat. Some of the large farms in the area are having several satellite farms. These satellite farms are provide with money for developing all necessary infrastructure including the young chicken and seed by large farms. This process has become a great success here. This is done in a contract basis.

In Annamanada duck farming is found to be maximum among the local bodies of the basin. The extensive Kolelands of this area are ideally used for this purpose.

# DRINKING WATER SCENARIO OF THE BASIN.

An analysis of the drinking water scenario in the basin shows that this basin is slowly getting into a serious drinking water crisis. As per the data collected during the study, there are 62,397 wells used for domestic purpose in the basin. Out of which 19,892 have gone dry by February 2001. From the local people it was understood that the water table in most of the areas in the basin has gone down by an average of 2.5 meters during the last 20-30 years. Within this basin 89 acute drinking water scarcity areas were detected. An area were at least 150 domestic wells which are getting dry is demarcated as an acute drinking water scarcity area. Going by the present trend the study expect that drinking water scarcity area in the basin will increase upto 150 by 2010.

There are 30 drinking water supply schemes in the basin (Map-52) and it is very obvious that starting of new scheme alone cannot check the ever increasing drinking water scarcity of the basin. Proper watershed management and rainwater harvesting would provide sustainable and long-term solution to this problem. Unfortunately efforts in this direction are very rare in this basin. Not even a single rainwater harvesting effort has been made any were in Chalakkudy basin so far by any agency. The present population of the basin is 4.5 lakhs and considering the growth of population and declining availability of water, it could be expected that two-third of the population may not get adequate quantity of water for domestic use by the year 2020. Table -41 shows the domestic water supply schemes in this basin.

In this period of acute water scarcity, it should be seriously be considered whether drinking water is to be supplied to the area where people can very well mange collecting water from wells and similar other sources. Numerous perennial wells in Chalakkudy municipal area become needless and got reclaimed after the arrival of water supply. Whereas Chalakkudy Drinking Water Supply Scheme is not able to provide water to certain areas within the Municipal boundary where there is acute shortage for drinking water.

**Some of main reasons for the inefficiency of drinking water supply scheme are:**

**(1). Misuse of water:**

Water from the domestic water supply schemes is expected to be used only for bathing, drinking, clothing, flushing toilets and washing. However this water is being extensively used for other purposes like irrigating gardens, building construction activities, fish culture etc.

**(2). Overuse of water.**

The domestic demand per person per day is assumed to be around 75 litre. But daily use of water for people is increasing in an alarming rate. Because the consumers have to pay only a nominal charge for the use of water, they are not much concerned about the real value of the same.

**(3) Managerial mistakes.**

Leakage of pipes are of frequent occurrence and the leaks may not be identified and repaired in time. Numerous water consumption reading meters are not properly functioning Neither the Kerala Water Authority nor the consumer is taking serious initiative in rectifying this defect.

**(4). Difficulty in pumping from the river.**

Because the water level from the river has gone down due to the lowering of the river bed through sandmining, there is grate difficulty in pumping especially in summer months. Therefore expected quantity of water is not able to be pumped during this period. Intrusion of salinity is a threat for pumping for the domestic supply scheme of Puthenvelikara Panchayat.

Table-42 shows the number of perennial and seasonal wells in each local body of the basin.

Table-43 shows the number of perennial and seasonal ponds in each local body of the basin.

From the Panchayat Resource Maps made by the Kerala State Landuse Board we have identified certain areas which face serious drinking water problems. The map of these areas are been shown in the coming pages with a preliminary description of the drinking water scenario of the area. Detailed investigations in these areas could provide the reasons for the increasing drinking water scarcity in the basin which also can be a replicable model for any where in the state.

# SANDMINING

Mining of sand from Chalakkudy river can be considered as the major environmental problem faced by this river. Sand, which is an integral part of the river collectively hold huge volumes of water in their interstitial spaces and function as reservoirs capable of retaining water for long periods. This facilitates better percolation contributing to the groundwater, positively influencing the water table in the nearby wells, ponds and paddyfields. In addition sand particles also help in regulating the riverine flow by releasing water when the water velocity is low, especially during summer months. Extensive sandmining upsets the entire system. As a result of the removal of sand in larger quantities, the clay underneath in most of the areas got exposed, which cannot hold water as much as sand does. Moreover it leads to lowering of river bed and consequently that of the water table leading to a paradoxical situation in which acute shortage of drinking water in experienced by the people living nearer to the rivers.

A survey was conducted by KSSP in 1991 to understand the extent of drinking water scarcity felt along the banks of Chalakkudy river. 955 domestic well situated 50 meters on both sides of the river bank from Thumboormuzhy to Elanthikkara were surveyed and it was found that 70 percent of these wells used to go dry in summer. From the local people, it is understood that this situation started only from early 1980’s which coincides with the period when active sandmining in an industrial scale started in this river.

Lowering of the river bed has weakend the banks of this river resulting in extensive bank erosion. Strengthening of the river bank by constructing concrete walls is adopted in some of the areas. For every 100 meters, the total cost comes upto Rs.80,00000 .

The lowering of the river bed and the reduced flow in river have led to the intrusion of saline water into the river for the backwaters. This has been felt by fishermen and the beneficiaries of the lift irrigation schemes. In march 2000 there was Rs. 25,00000 worth loss of agriculture (mainly nutmeg and banana ) due to the presence of salinity in the water pumped from Chalakkudy river in Kuzhoor Panchayat alone. In order to check the intrusion of salinity into the river a regulator–cum-bridge has been built at Kanakankadavu. Soon after the installation, it started showing construction defects. It is also making havoc for the traditional fishermen as the regulator blocks the route of economically important migratory fishes.

Sandmining also cause extensive damage to the riverine biodiversity. Erosion of river banks has wiped out the unique riparian vegetation in many areas along the river. Increase of turbidity due to the mining of sand causes serious damage to aquatic life particularly the filter feeders and benthic organisms. Many interstitial and benthic organisms specially adapted to a particular habitat get completely destroyed by the physical alteration of the habitat.

One argument in favour of sandmining is its employment potential. Table-44 shows the authorised sandmining locations, amount of sand mined and the number of registered laboures. It was alarming to note that at least 10 times of the number of labourers actually registered are involved in this activity. In our survey we were able to locate several unauthorised Kadavus all along both the banks of the river. In four cases we noticed that just for the sake of unauthorised mining of sand certain people have recently bought a few cents of land along the river bank and built a Kadavu. Map shows the authorised and unauthorised Kadavus along the river. The daily wages of a sandmining worker was found to be Rs.700 to Rs.1000 . A detailed socio-economic survey among these labourers may provide very useful information.

While speaking of the economic benefits from sandmining, what is being overlooked is the death-blow it has made on the large number of traditional fishermen who were depending upon the river for their livelyhood. Traditional fishermen are involved in fishing activity for several centueries and now it is most difficult for them to switch over to any other kind of job. However due to the lowering of river bed, it has become difficult for operating the conventional nets and activities like mussel collection. A detailed investigation on the impact of sandmining on the fish diversity and the socio-economic status of fishermen would be most useful, if conducted in a later phase of this study.

As a part of this study, Chalakkudy Municipality has sponsored a study by Centre for Earth Science Studies, Thiruvananthapuram to make a detailed sand budgeting of Chalakkudy River. Centre for Earth Science Studies has submitted the report with proper recommendations for sustainable sandmining. It is highly promising that a few local bodies in the basin have already started implementing the recommendations mentioned this report. Rest of the local bodies must also start implementing the same.

The office of the Asst:Engineer of the Hydrology Section of the Irrigation Department, at Chalakkudy has regularly taken the cross section of the river three every year from Ambalakadavu, Chalakkudy since 1963. From this data it is understood that the river bed has gone down at least by 5 meters since 1976 and 1998.

(fig-26,27, and 28 ). Office of the Central Water Commission at Arangalikadavu in Kadukutty is also taking the cross of the river (fig-29). From these figures it is clear that the river bed has gone down considerably. However it requires special mentioning that Arangali is one among the two only

remaining sandbanks in the river. This sandbank is preserved just because of peoples pressure against sandming in this area. Both the local body as well as the sandmining contractors never used to consider this sand bank while auctioning. There is a vigilant people's group actively working for the protection of this sank bank at Arangali. The only other sandbank kept undisturbed is at Annamanada where sandmining is restructed because it is a "Sivarathri Manapuram" of the Annamanada Siva temple.

The recent spurt for construction activities as well as increased demand for sand from Tamil nadu and Karnataka naturally exerts pressure to continue sandmining from rivers in Kerala. Unless effective measures are quickly formulated and strictly implemented, the consequences may be disastrous.

## WATER AND SEDIMENT QUALITY OF CHALAKKUDY RIVER

Because the river is only one component of a large system called the River Basin, quality of water in the river is determined not only by events occurring within the channel and its associated water bodies but also subject to a wide range of external influences. Precipitation falling within the basin find its way into the river through surface and sub-surface run off carrying with it the top soil and any contaminants it might contain.

The river ofcourse is having its own natural purifying capacity. But there is a limit for this process. When we increasingly depend upon the river for diluting and dispersing the effluents and to carry wastes away from the centers of our communities, it slowly exceeds the self purifying capacity resulting in the deterioration of water quality.

Chalakkudy River was once believed to contain water with medicinal properties. This situation has changed to a pathetic stage where bathing in this river causes immediate irrigation for the skin. Formerly the flow in this river was enough to keep the quality of water in satisfactory limits. But the extensive deforestation, six large impoundments constructed across the river, the Chalakkudy River Diversion Scheme and the numerous lift irrigation schemes operating from this river, transfer of water to other river basins, uncontrolled sandmining etc, have reduced the river flow making it difficult for properly diluting and flushing the wastes.

Deterioration of water quality in this river is also due to the ever increasing sewage agricultural and industrial wastes.

**Sewage wastes:**

Sewage in a foul smelling fluid that is the spent water of a community. Sewage wastes commonly arriving Chalakkudy river include kitchen wastes, domestic wastes, hospital wastes, slaughter house wastes, dead animals, night soil, garbages, solid wastes etc.

Regarding the sewage waste pollution in Chalakkudy river we were able to conduct a detailed case study within Chalakkudy Municipal area. The management and Parent Teachers Association of a High School in Chalakkudy, filed a case at the Hon: Munsiff Court, Chalakkudy against the Chalakkudy Municipality regarding the sewage waste pollution from a natural stream (Pallithodu) carrying sewage waste through the School compound. The Hon: Court appointed the Principal Investigator of this project as the Expert Commissioner to visit the area, make observations and report back to the Court. This was a good opportunity for understanding the status of sewage pollution in this area.

Description of the area suspected of pollution and its relationship with the river:

Pallithodu is a branch of Parayanthodu which is a tributary of Chalakkudy river. Pallithodu originates from Pallippadam ( adjacent to the Municipal market ) and this natural channel passes through 22,23 and 27 wards of Chalakkudy Municipality. Both sides and bottom of Pallithodu are lined upto 400 meters from its origin. A narrow sewage channel carrying wastes from the Municipal bus stand and housing board colony is connected to Pallithodu nearby Ambedkar colony. Pallithodu passes through the thickly populated areas of Chalakkudy Municipality. After crossing the railway station road and for the rest of the distance before joining with the Parayanthodu, Pallithodu passes through mainly paddyfields.

**Observations**

Dirty grey, foul smelling fluid that is the spent water of a community produced from various sources were found to be flowing through Pallithodu. It contained a mixture of dissolved and suspended materials including slaughter house wastes, human excreta, kitchen wastes, plastic and paper wastes. The sewage is expected to run directly under gravity to the downstream through Pallithodu.

Since the outlet of the slaughter houses and fish market are into Pallippadam and because Pallithodu originate from Pallippadam, the semi-putrefied slaughter house wastes enter into Pallithodu. Significant quantity of human excreta was observed at different points of Pallithodu. Substantial quantity of semi – putrefied hotel and kitchen wastes were also found in Pallithodu.

Enormous quantity of solid wastes were also seen in this thodu, of which the decomposable ones include garbage, decaying banana leaves used for supplying food, sweepings from houses, fruit and vegetable wastes etc. The non-putriscible solid wastes observed include plastic, glass, ceramic, bricks, etc. Here plastic wastes requires special mentioning since it was found in large quantity. Accumulation of plastic wastes obstructed the flow at certain locations.

**Laboratory analysis**

Water samples from the wells adjacent to the unlined portion of Pallithodu were collected for laboratory analysis. This was done inorder to examine the extend of

damage caused by the passage of sewage through Pallithodu, on the water quality of the nearby water bodies.

Water samples (3 liters each) were collected from the wells located in the following properties.

Sample No:1

Domestic well ( 25 feet away from the sewage channel coming from housing board colony ) of Mr. K.T. Johny , Kannampuzha house, Chalakkudy, ward no:23.

Sample No: 2

Domestic well ( 14 feet away from Pallithodu) of Mr.P.V.Kandan,Vettiyattil house, Ambedkar colony Chalakkudy, ward No:23.

Sample No: 3

Domestic well (72 feet away from Pallithodu) of Carmel Bhavan, Chalakkudy, Ward No: 22.

Sample No: 4

Domestic well (8 feet away from Pallithodu) of Carmel High School, Chalakkudy, ward no:22

Sample No: 5

Swimming pool (12 feet away from Pallithodu), of Carmel High School, Chalakkudy, ward no: 22.

**ENVIRONMENTAL CONSEQUENCES**:

(1). Environment consequences within Chalakkudy Municipal areas:-

i. The open (uncovered) transportation of sewage through the middle of Chalakkudy Municipal area is of course unhygienic from a public health point of view.

ii. Several houses were found to be very close to the banks of the channel. During rainy season, this sewage can over spill into near by residential compounds.

(2). Environmental consequences outside the Chalakkudy Municipal area :-

i. Pallithodu- a natural water course if used for dumping waste :- Pallithodu is a natural water course through which the excess rain water reach Parayanthodu and in turn the Chalakkudy river. Therefore the untreated sewage materials received by Pallithodu many pollute Parayanthodu, and then the Chalakkudy river itself. This may deteriorate the water quality and threaten the bio-diversity of Chalakkudy river.

ii. sewage dumping in Pallithodu and its consequences on domestic water supply:-

Pallithodu is a branch of Parayanthodu which meets with Chalakkudy river almost 1km upstream of Njaralakadavu (Vainthala), the very spot from where two major drinking water schemes pump water for the purpose of domestic supply for 10 local bodies. Therefore, there are all the chances for the arrival of a portion of the sewage wastes received by Pallithodu into the Chalakkudy river through Parayanthodu. This could be certainly harmful to these drinking water supply schemes. The details of these schemes are mentioned below.

(a) Comprehensive scheme for Mala and adjoining Panchayats.

This scheme includes supply of water for the domestic use of Kuzhur, Annamanada, Poyya and Mala Panchayats of Mala Block Panchayat and Vellangallur and Puthenchira Panchayats of Vellangallur Block Panchayat. 40 H.P. motor is used for pumping and 7.25 million liters of water is being pumped per day.

(b) Kodungallur domestic water supply scheme:

This scheme provide drinking water to Kodungallur Municipality and to Methala, Eryad and Edavilangu Panchayats of Kodungallur Block Panchayat. 40 H.P. motor is used for pumping and 6.2 million liters is being pumped per day.

**(3) Interpretation of laboratory results:**

All the five samples collected were analysed for bacteriological contamination. Sample no:2 was used for detailed physico-chemical analysis.

Out of the five samples analysed, all of them contained coliform bacteria in large numbers. *Eschericia coli (E.coli)*, the most common fecal coliform bacteria, was detected in all the five samples.

According to the drinking water standards recommended by the bureau of Indian standards (BIS), the minimum possible numbers (MPN) per 100 ml of total coliforms in domestic well water is only 50. Whereas in the well water sample nos: 1,2 and 4 the number of total coliforms is >24000. (it is mentioned >2400 because of the difficulty in counting, since in these samples, coliform bacteria were found in extremely large numbers.) in sample 3 and 5 total coliform numbers detected per 100 ml are 460 and 1100 respectively.

According to drinking water standards recommended by the bureau of Indian standards (BIS), *Escherica coli (E. coli)* should not be seen in drinking water. Whereas *E. coli* has been detected in all the 5 samples analysed. In sample nos: 1,2 and 4 *E.coli* is mentioned as ‘present’ because it was difficult to count them since this bacteria were found in large numbers. In sample nos: 3 and 5 the number of *E. coli* detected per 100 ml are 11 and 210 respectively.

Numerous pathogenic and non-pathogenic bacteria are excreted by humans. Such bacteria are normally not expected to be found in a water body. The presence of these bacteria in the domestic well indicate that human excreta is entering into these water bodies.

The danger of water does not lie in the mere occurrence of fecal coliforms, but their asociation in the fecal matter with organisms of disease. Hence fecal coliforms are looked upon as “ indicators’ to warn us that pathogens may be present .

Their presence in large numbers must be taken seriously, since this indicates the possibility of the presence of pathogens as well. On the other hand if they were not present, this would have been a good indication that pathogens are also absent.

Presence of fecal coliforms in such large numbers among the wells along the unlined portion of Pallithodu indicates that sewage from this thodu may be percolating through the soil into the adjacent water bodies including domestic wells.

Contamination of domestic water sources by sewage is the principal cause of water-borne diseases including cholera, typhoid, paratyphoid fever, dysentery, diarrhoea etc. Upon the presence of the abundance of fecal coliforms in the wells situated very close to unlined portion of Pallithodu, the possibility for the occurrence of an epidemic in this area cannot be ruled out.

From the detailed physcio-chemical analysis done for sample no:2 it was found that almost all the parameters analysed are safe as per the drinking water standards recommented by the bureau of indian standards (BIS) except for a slight increase in pH, which of course can be considered to be within the tolerable limit.

**Agricultural wastes:**

Agricultural Wastes is a board term which include the refuse of any form of agricultural operations. Agricultural wastes arriving in Chalakkudy River are

(a) Pesticides that escape into streams (b) Fertilizer runoff from crop land (c) Manure and other wastes from farms.

**(a) Pesticides that escape in to streams:**

Intensive agricultural activity using tonnes of pesticides is going on in several parts of the basin. Even the upstream areas are not excempted. There are several plantations in the upstream areas like Nelliyampathy and Malakapara. Organochlorine pesticides like DDT was commonly in use among these plantations in huge quantities till recently. Even now certain organochlorines like BHC, Dicophol are in use here. A good quantity of pesticides might have reached the river through agricultural runoff. In the laboratory analysis of the sediments collected from various areas of the river we came across pesticide residues. However detectable limits of pesticides were not found in the analysis of water samples collected from several parts of the river system.

Fig-33 shows the concentration of Dicophol found in the sediments samples within the stagnent areas of the streams among the estates of Nellilampathies. Dicophol is a multipurpose pesticide used here against the attack of mites on tea plant. Out of the four samples shown in the figure maximum concentrations of Dicophol (10.4 ppm) was found in the sediments of Manalaroo Estate in Nelliyampathy and minimum (1.1 ppm) in Karapara Estate. The analysis was done at Aromatic and Plants Research Station, Kerala Agricultural University, Odakkali.

Fig-31shows DDT concentrations in the sediments of Chalakkudy river in the downstream. Out of the six samples shown in the figure, sediments from Kanakankadavu (near by the regulator cum bridge) contained maximum concentration of DDT (0.905 ppm). Fig-32 shows that BHC is also present in the sediments of this. This pesticide was detected from two locations namely Kanakankadavu (0.016 ppm) and Kadukutty (0.032 ppm) .

However this random and piolet analysis of a few samples alone is just not enough for making an interpretation of the pollution status of this river system. However these results clearly indicates that pesticide residues are present in the sediments of Chalakkudy river. More systematic and detailed investigations are necessary for the same. But these piolet results can only be considered as an eye opener in this direction. Among the plantations in the upper reaches of this river system we have noticed that potentially dangerous pesticides are sprayed by the labourers without using any protective measures. It is surprising that the labour unions in these areas have not raised this issue sofar. Majority of the labour unions are illeterate and are not adopting proper scientific methods for diluting the concentrated pesticides before use. There is also the common practice of washing the empty pesticide containers in the nearby streams. We have also seen that after use some of these small and empty pesticide containers are thrown into the nearby streams or water bodies.

**(b) Chemical fertilizers runoff from crop land:**

Use of chemical fertilizer have become a must for intensive agriculture. However not all the quantity of the nutrients applied is utilized by the plants and part of the residues will remain in the soil. Moreover there is a common practice among farmers to use a little more than the prescribed limits with the false expectation of receiving higher crop productivity. Through agricultural run off significant amounts of nitrates may be reach in the near by streams. Consumption of water with significant quantities of nitrates is detrimental to human health. Through surface water nitrate can also reach the ground water. Therefore the problem of excessive use of chemical fertilizer may take several years to start showing its results.

Residues of phosphate fertilizer reaches the nearby stream either as such or with the eroded top soil, causing excessive growth of algae and aquatic weeds. Even 0.015 ppm of phosphate can make eutrophied conditions among water bodies. Excessive growth of aquatic weeds can be seen at several areas of Chalakkudy river. Detailed and systematic studies regarding nitrate and phosphate concentrations in certain selected locations of this river shall be done in the next phase of this project.

**(c) Manure and other wastes from farms:**

Enormous quantities of cattle farm and pig farm wastes are sent into the river from a few farms on the river banks of which the maximum is from one farm at Muringoor. The local people said that these wastes have already started contaminating the nearby wells and ponds and thus making it unhealthy for drinking purpose. Pollution from these waters causes additional burden of water purification for the nearby drinking water schemes.

**Industrial Pollution:**

It seems that industrial pollution in Chalakkudy river is relatively low in comparison with other rivers of the state. The industries which are sending their effluents into this river are Sree Sakthi Paper Mills,Ltd, Pariyaram and Kerala Protiens and Chemicals Ltd, Kadukutty. It is understood that the effluents of Kerala Protiens and Chemicals Ltd contain large quantities of phosphates and nitrates. When flushed into the river it overrich the system leading to a eutrophied condition. It is

expected that this is the main reason for the uncontrollable growth of algae and aquatic weeds just after the downstream of the effluent point of this factory. We have observed that in summer the eutrophied condition in the river extends upto 3 to 4 Km downstream of the effluent point.

**Excessive growth of aquatic weeds:**

One of the most obvious features along the downstream of Chalakkudy river is the presence of large floating mats of weeds. Out of many species of weeds, *Eichornnia Crassipes* and *Salvinia molusta* causes the most severe problem. These weeds are typical of stagnant waters. The local people said the explosive increase of these weeds is due to blocking of water at the mouth of the river by the regulator constructed for checking the intrusion of saline water. This regulation of water of the mouth of the river naturally blocks the flow and all the wastes from the mouth to the down reaches are not getting properly flushed into the backwaters. This includes the residues of chemical fertililzers reaching the river through agricultural runoff which results in over enrichment of the system. Further the significant quantities of phosphate, nitrate, etc flushed into the river from the Kerala Proteins and Chemicals Ltd at Kadukutty also may tremendously enhance the growth of these weeds.

Both *Eichornnia crassipes* and *Salvinia molusta* can double in number every 8 to 10 days in warm nutrient rich waters. Each of these weeds can make an annual organic production of around 50 tonnes per hectare. Both these weeds had their origin in South America and later got dispersed to other parts of the world mainly tropical and subtropical areas.

Excessive growth of these weeds cause grave hardship to inland navigation, irrigation, local fishing and domestic washing. The water, infested by these weeds has obnoxious smell and suspended particulate matter making it unfit for human consumption. The mats of weeds effectively cut off all light from underlying waters and also produce significant reduction is dissolved oxygen concentrations. Fish deaths are common in certain areas of this river which are heavily infested with the nuisance weeds (eg: Mambra, Moozhikulam etc.).

Excessive growth of weeds is a nightmare for the traditional fishermen due to certain peculiar reasons. Whenever the shutters of the regulator are opened the floating vegetation will get flushed into the semi saline backwaters. The weeds cannot survive in semi saline conditions and they will start decaying and sinking down. The decaying process of *Eichhornia* and *Salvinia* are relatively slow so that, they will remain in a semi-decayed condition for one or two months. During this period if the fishermen happened to use their nets for fishing, large quantities of heavy, submerged and semi- decayed weeds used to get into the nets. Just because of this reason the fishermen are reluctant to use their nets in the backwaters even during the most ideal periods for fishing. Acute poverty is the result of the same followed by several other sociological problems.

# SALINE WATER INCURSION INTO THE INLAND AREAS OF THE RIVER

For the last 15 to 20 years, incursion of salinity into the far inland areas of the river has become a serious problem. It was observed from several of our visits that the flow in the river is very low especially in summer. Satisfactory flow in summer is a must for resisting the incursion of Salinity into the inland areas of the river. The reduction of flow in summer is due to the extensive disappearance of forests in the catchment areas, the appearance of six dams in the upper reaches water intake by major irrigation, interbasin transfer and numerous lift irrigation schemes, uncontrolled sandmining etc.

Upto 1999, for checking the fast intruding saline water into the inland areas of the river, a barrier made of sand used to be constructed at Kanakankadavu (which is the mouth of the river). This barrier used to be made in January each year. In June along with the arrival of South West Monsoon, flow in the river suddenly increases and bund used to be demolished manually. The expenses for the construction of the bund was met by Puthenvelikara Panchayat. From March 2000 onwards a regulator-cum-bridge has been in operation. Local farmers complainted that there are certain leaks for the regulator and saline water is entering into the river in significiant quantities. Moreover there are several clay mining locations along the banks of the river and some of them are situated right at the river bank itself. When the shutters of the regulator are closed water level in the river suddenly rises and water enter into the clay mining areas. From the local people we heard that the clay mining contractors used to bribe the operator of the regulator for opening the shutters at most of the times so that clay mining works won't suffer. This is one of the another reason for the intrusion of salinity in this river. Table shown the salinity present in the river during six months (Nov-April). Analysis was done at the School of Environmental Sciences, Kochin University for Science and Technology.

**Analysis of salinity from the river at Kanakankadavu (in the upstream of regulator)**

| MONTH & YEAR | **SALINITY** |
|---|---|
| Nov 1999 | 0.4 ppm |
| Dec 1999 | 2 ppm |
| Jan 2000 | 7 ppm |
| Feb 2000 | 6.8 ppm |
| March 2000 | 7.2 ppm |
| April 2000 | 7.1 ppm |

Incursion of salinity has already started affecting the drinking water supply of Puthenvelikara Panchayat . This water supply scheme was completely stopped in January 2000 due to the salinity of water which led to serious agitation against between the concerned office and the beneficiaries of this scheme.

In this area, in Feb 2000, we found that a total of 26 small lift irrigation motors (in Puthenvelikkara, Kuzhoor and Kunnukara Panchayats) were stopped pumping from the river as irrigation water contained salinity. This also led to agitation between the farmer of the area and the major irrigation Department which controls the operation of the regulator.

## RIVER – RELATED TOURISM IN THE BASIN

Thumboormuzhy, Athirapilly,Vazhachal, Sholayar, Malakkapara, Parambikulam and Nelliyampathi are the important river- related tourist spots in the basin. All these locations except the last two are situated along the Anamala Road, from Chalakkudy to valparai. The Kerala Tourism Development Corporation, Tourism Promotion Council and certain private agencies regularly organize conducted tours to these stations.

Tourism is considered one of the largest and only smokeless industry in the modern world. However this smokeless industry has certain crucial environment implications, especially when implemented in the sensitive areas like the ones mentioned above. Tourism so far developed in the basin is totally unplanned and if it is going to grow in the same manner, it may result as the last nail to be put on the coffin of these sensitive areas. The forest areas in and around these tourist spots are heavily degraded. The tourists without any ethics have made deep inroads into the hitherto inaccessible and relatively undisturbed tracts thus exposing unpolluted environment. They extract and rob the surroundings to the maximum extend possible for meeting their recreational needs. Nothing in known about the carrying capacity of these areas. Fig-34 shows the number of tourists visited Vazhachal and Parambikulam. The number of tourists show steady increase from year after year. In a

random survey, it is understood that about 6,00,000 people visit Athirapilly each year. Less than half of these people visit Vazhachal also.

The huge quantities of solid wastes comprising of plastic covers, tetra packs, aluminium foil, paper, glass, ceramic etc, deposited by the tourists in these sensitive areas is of alarming concern. In a survey conducted by us in collaboration with Kottapuram Integrated Development Society, it was noticed that almost 18 kg of plastic wastes were dumped in Athirapilly during every weekends. Riverine ecosystem also suffer due to these waste disposal. The severity of pollution from solid wastes in most obvious in the summer months which is the peak tourist season of this area as well as the period when the discharge in the river becomes minimum. All these pollutants are not only dangerous to the riverine organisms but to the wildlife too. Recently plastic covers and aluminium foil were detected in the elephant dung at vazhachal. At present there is no agency responsible for removing wastes generated by tourists in this area. In view of this, an association called " Vanasamrakshana Samithi" was formed in 2000 at Athirapilly Vazhachal area. The objective of this samithi is to protect the forest of the concerned area in every possible ways and means. Actually this samithi has been developed as part of the World Bank funded Social Forestry Project. The members of this samithi are exclusively Kada tribals of this area. They are now involved in the protection of forests of the area by primarily removing the wastes from Vazhachal and Athirapilly tourist areas. A small contribution ( Rs. 3 per person ) should be given by each tourist arriving at Vazhachal towards the Vana Samrakshana Samithi for this purpose. This fund is named as "Chalakkudy River Protection Fund" is used for this purpose.

Frequent forest fires intentionally or unintentionally created by tourists has become a headache for the Forest Department. Several tourists arriving in this area, prepare food using fire wood. Irresponsible and careless disposal of half burnt firewood may become the reason for serious forest fires especially during the summer months. Now the Forest Department have understood that it may not be possible by them alone to control fire which is the most alarming problem of forests of this basin. Another organization called " Moolika" has now become a model in this connection. It in an organization made primarily for protecting the area from fire. Only tribal woman are members of Moolika. They systematically watch the concerned area every day from morning to evenning inorder to check the occurrences of forest fire incidents and do the needful to check fire. No serious forest fire incidences occurred in the area operation of this association after its emergence in 2000. Appreciating their remarkable work, the Forest Department gave Rs. 45,000/- for this association. This money was earmarked by the Department for the prevention of fire in the area.

The police authorities said that the deterioration of law and order in the area is directly proportional to the development of tourism . In spite of restrictions, fishing by tourists using dynamites is common. There are local agencies to provide dynamites. Illegal supply of country-made alcohol and drugs to tourists are also common. There is an alarming increase of social evils and crimes during the last two decades in Athirapilly-Vazhachal area which are the most popular tourist spots in the basin. The only police station nearby is the one at Vettilappara. This station is functioning in a rented building having three rooms. There are 23 police constables,the but lock-up facility is not available. So the police used to sent the

accused persons everyday before evening. There are no lady constables in this station .

Most of the building constructions made in Athirpilly are by encroaching the land along the road side. There is a clear order by the District Collector not to construct building which obstruct the 'falls view'. But most of the buildings built at Athirapilly junction directly obstruct the falls view. The concerned Panchayat authorities have not taken any action against the same.

There is a common practice by the Forest Department to provide the forest land here for film shooting. The water falls and the scenic beauty of the area encourage the film producers to select this area for this purpose. However they never care for the sensitive environment of the area and even cut small trees, make slight change of the landscape etc for their convenience. This also was not found to be opposed by the authorities.

The Forest Department received approximatly Rs-6 lakhs/year from tourists by selling admission tickets at Vazhachal. But this money is directly going into the Main Head of the Government Treasury. Almost nothing in being done by the Government to plan the development of tourism in the area. More than 200 persons got drowned during the last couple of decades at Athirapilly and Vazhachal. Now the authorities have made a fencing near by Vazhachal falls. An Information Centre built in 1991 at Vazhachal has not even worked for one day. Such Information Centers should contain adequate information about the landscape history, ecological sensitivity of area, threat to wildlife, need for conservation, ethics of tourism etc. Tourism enhancement in these areas should be with the objection of promoting conservation consciousness among visitors and these ecologically sensitive areas should not be developed in to typical holiday resorts.

For the proper development of tourism in a hilly area, the quality of environment should be considered as the basic foundation. Extreme care is needed to retain the calm, serene and pristine environment as much as possible.

# SOCIATAL RESPONSE TO ISSSUES RELATED TO THE RIVER

For the past 20 years there is a strong social response to certain issues related to Chalakkudy River. Some of the important ones are mentioned below.

**Inter Basin Transfer:**

It is understood that certain Beneficiary Farmers Associations of the Chalakkudy River Diversion Scheme has sent several representations to the Government of Kerala regarding the reconsideration of the Parambikulam Aliyar Project. This project as per the agreement should have been reconsidered in 1988 itself. These farmers believe that the excessive share of water used by Tamil Nadu from the Parambikulam Group Dams is the major reason for the occasional reduction of water available for irrigation in Chalakkudy river. These farmers also complained that there was no response from the Kerala Government in this regard.

**Dams across the river :**

The two proposed schemes namely Athirapilly Hydro Electric project as well as the Kuriarkutty –Karapara multi-purpose projects has been severely objected by certain people's organisations. The Chalakkudy River Protection Council has already filed a case inorder to revoke the clearance given by the Minister of Environment and Forests for constructing the Athirapilly dam. As per the argument of the Chalakkudy River Protection Council, the Environment Impact Assessment in incomplete, highly biased and not conducted according to the prescribed guidelines of Ministry of Environment and Forests. The case is now in progress in the High Court of Kerala.

Another people's organisation called 'Nilanilpu' , Kodungalloor has filed a case against the implementation of Athirapilly Hydro Electric Project as it will result in acute drinking water shortage in the downstream.

Many Farmers Association which are beneficiaries of some of the irrigation schemes in the basin have sent memorandums to the Government of Kerala, that implementation of Karapara-Kuriarkutty project will result in acute shortage of water for irrigation from the river. The water shortage will be due to the inter basin transfer from Chalakkudy basin to Bharathapuzha basin.

**Sandmining from the river:**

While making a random survey along the course of the river regarding the sandmining problem, we found that enormous number of protests and complaints have been field by the people along the course of the river to the concerneed local bodies regarding various issues related to sandmining. The issues include lowering of water table among the nearby domestic wells, river bank erosion etc. These complaints have been fieled in the local bodies namely Pariyaram, Meloor, Chalakkudy, Kadukutty, Annamanada, Mala, Kuzhoor, Parakadavu, Kunnukara and Puthenvelikkara. It was interesting to note that in certain local bodies there is a section for keeping these complaints regarding sandmining called "Sandmining Complaint Section".

**River Water Pollution:**

Several tonnes of BHC (1kg/plant) was used by the Plantation Corporation in the oil palm plantation in 1991 mainly for securing the tender oil palm plants against the attack of pests. Major portions of this organochlorine pesticide reached the river due to the steeply slopping terrain of this area. Kerala Sastra Sahitya Parishat (KSSP) strongly protested against this which led to the winding up of this practice by the Plantation Corporation .

Large quantities of cattle farm wastes dumped into the river by the 'Divine Cattle Farm' at Muringoor is still a serious problem in that area. Bathing in this area

causes immediate irritation for the skin. Local people have become united against this problem and a 'Pourasamithi' has been formed. A series of protest were sent to several Government agencies. They have now field a case against this farm at Chalakkudy Munsiff Court.

There were several agitations against Chalakkudy Municipality which is sending sewage wastes through Pallithodu, a branch of Parayanthodu which is a tributory of Chalakkudy River. The Head Master and Parent - Teachers Association of Carmel High School Chalakkudy has field a case against at the Munsif Court, Chalakkudy while the 'Chalakkudy Citizen Council' has field another case about the same issue at the Sub-Court Irinjalakuda.

The effluents of the Kerala Chemicals and Proteins Ltd, is sending their effluents into the river and this made a series of agitations in the area. Many of the wells near by the effluent point are contaminated and the factory management have provided money for taking Panchayat Water Supply connections to several affected houses in the area. But still this problem is very much there. People used to make serious protests before the company office, especially in the summer months when the flow in the river become low.

## Clay mining from the basin:

Series of protests by Kuzhoor Pourasamithi (citizen organisation of Kuizhoor) have field both with the District and State administration regarding the indiscriminate mining of clay from the fertile paddyfields. Regarding certain complaints there was good response from the officials. Because of the local people's pressure the Revenue

Divisional Officer was force to exhibit notices in some of the clay mining areas indicating no more mining shall be done from a few areas of the Panchayats.

**Drinking Water Scarcity :**

Due to the acute drinking water scarcity experienced in most of the areas of Puthenvelikkara Panchayat, the local people conducted several protests strike including fast before the Panchayat.

The Malaya tribal people of Pillapara Colony in Pillapara is an area facing acute drinking water scarcity. After conducting several agitations for drinking water at the local area, they gheraoed the Block Panchayat Office at Chalakkudy.

**Salinity Intrusion in the river and the regulator at Kanakankadavu:**

Salinity intrusion into the far inland areas of the river has caused serious damage to the several farm crops, primerily nutmeg and banana. This was most severe in Kuzhor and Puthenvelikkara Panchayat. The local people have raised several protests against the same. Complaints have been filed at the Agriculture Department as well as the Irrigation Department who controls the operation of the reguator. The regulator is situated within Puthenvellikara Panchayat which is in Ernakulam District whereas its operation is to benefited for the Thrissur District. Therefore the operational failures always make adverse effects in the areas of Thrissur District. But the District Administration of Thrissur is not having sufficient powers to rectify the salinity intrusion problems faced by the farmers of the area. On the other hand it seems that the Ernakulam District Administration is least bothered about the problem as it is not affecting their area.

The affected farmers had insured their crops against natural disasters. But their claim was rejected with the explanation that this instance of crop failure due to

intrusion of salinity is not a ‘natural disaster’ but a ‘mechanical failure’ of the regulator. The affected farmers organised “Harthal” in the area a few times.