

## CHAPTER 2

### AREA OF STUDY AND ENVIRONMENTAL FEATURES OF RIVER PERIYAR

River Periyar is considered to be the longest river in Kerala, traversing 244 km within the State (PWD, 1974; CESS, 1984). It originates from the Sivagiri group of hills situated at Sundaramalai in the Western Ghats at an elevation of 1830m above M.S.L. and flows westwards. The river meanders through hilly terrain for about 48 km before it receives the tributaries such as Mullayar, Perumthurai Aar, Cheruthoni Aar, Chittar, Perinjakutty Aar, Muthirapuzha, Thotti Aar and Edamalayar (Figure 1).

The river flows along almost virgin forests in places such as Kokaripara, Neriamangalam, Edamalayar and Malayattoor. At Alwaye the river bifurcates into two, Marthandavarma and Mangalapuzha branches. The Mangalapuzha branch joins Chalakudy river and empties into the Arabian Sea at Munambam while the Marthandavarma branch flows southwards, through the Udyogmandal area and joins the Cochin backwater system at Varapuzha (PVIP, 1972).

The Cochin backwater system is a part of the Vembanad lake, a tropical estuary along the south-west coast of India. It has access to Arabian Sea at Cochin and Munambam. As a result, the Cochin backwater and the lower reaches of river Periyar are subject to tidal influence. The salinity incursion

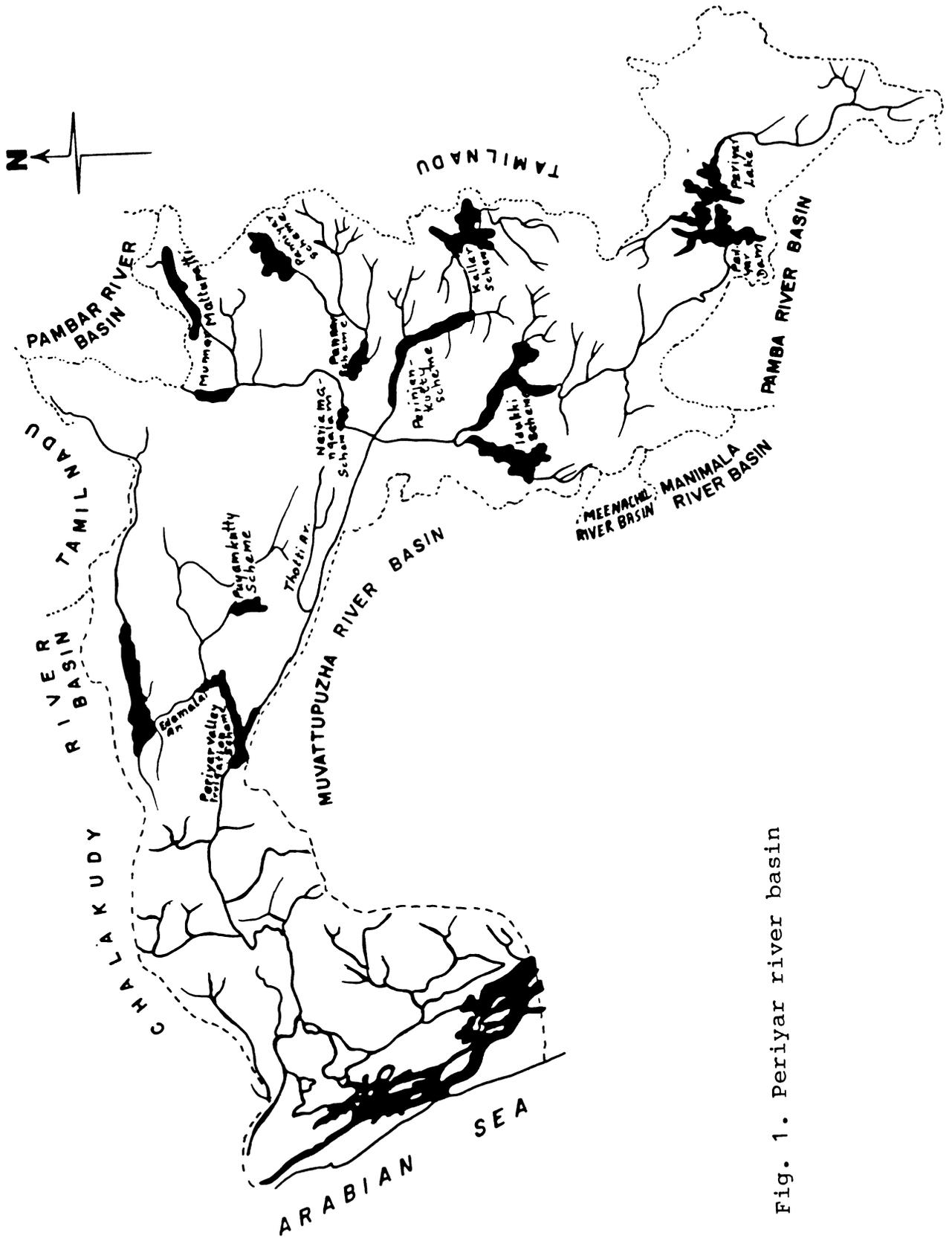


Fig. 1. Periyar river basin

reaches about 15 km upstream. Investigations show that a fresh-water discharge of 14 to 16 m<sup>3</sup> sec<sup>-1</sup> is required to keep the salinity within the prescribed limit of 50 ppm at and around the industrial belt of the river (PVIP, 1972).

Table 2 gives the catchment area, the water potential and extent of utilization of the river (PVIP, 1972; BE&S, 1978; KSPCB, 1985a; PWD, 1986).

TABLE 2

Main features of river Periyar

Origin	Sivagiri hills in Tamilnadu
Length	244 km
Direction of flow	Westwards
Catchment area in Kerala	5284 km <sup>2</sup>
Catchment area in Tamil Nadu	114 km <sup>2</sup>
Average rainfall in catchment area	400 cm year <sup>-1</sup>
Rate of flow : Minimum	9.66 m <sup>3</sup> sec <sup>-1</sup>
: Maximum	1364.66 m <sup>3</sup> sec <sup>-1</sup>
Width at Kalady	405 m
Width at Alwaye	220 m
Width at Udyogmandal	50 m
Utilization : Domestic	260 Mm <sup>3</sup>
: Irrigational	450 Mm <sup>3</sup>
: Industrial	1844 Mm <sup>3</sup>
Number of impounded reservoirs	14
Number of hydroelectric schemes	6

The Periyar river is of utmost significance in the economy of Kerala as it is the site of the largest hydroelectric project (Idukki) in the State and it flows along a region of industrial and commercial activity. The river also provides water for irrigation and domestic use throughout its course besides supporting a rich fishery. The Cochin city, in the vicinity of the river mouth draws its water supply from Alwaye, an upstream site sufficiently free of seawater intrusion. Twenty five percent of the State's industries are located along the banks of river Periyar and these are mostly crowded within a stretch of 5 km in the Eloor-Edayar region (Udyogmandal) which is only 10 km north of Cochin harbour (Figure 2). These factories depend on the river for intake of process water and disposal of effluents. A list of the major industries, the raw-materials used and their products of manufacture is given in Table 3 (KSPCB, 1985a; 1985b).

TABLE 3

Major industries located on the banks of river Periyar

Industry	Year of Establi- shment	Raw-materials	Products	Waste water discharge $\times 10^6 \text{L day}^{-1}$
Indian Aluminium Company Ltd. (IAC) Udyogmandal	1943	Alumina, Pitch, Aluminium fluoride, Cryolite	Aluminium wire rode, Aluminium ingots, Aluminium extrusion	4110

Industry	Year of Establi- shment	Raw-materials	Products	Waste water discharge $\times 10^6 \text{L day}^{-1}$
Travancore Chemical Manufacturing Company Ltd. (TCMC) Kalamassery	1943	Copper scrap, Bauxite, Sul- phuric acid, Hydrochloric acid, Washed garnalite, Caustic soda, Sodium chloride	Copper oxy- chloride, Copper sulphate, Sodium aluminate, Aluminium sulphate, Sodium chlorate, Potassium chlorate	239.08
Fertilizers and Chemicals Travancore Ltd. (FACT) Udyogmandal	1947	Sulphur, Rock phosphate, Naphtha, Hydrochloric acid	Ammonia, Ammonium sulphate, Ammonium phosphate, Ammonium chloride, Sulphuric acid, Phos- phoric acid, Super phos- phate, Liquid sulphur- dioxide, Cryolite	20658
Travancore Rayons, Rayonapuram, Perumbavoor	1949	Cotton hinter, Sulphur, Caustic soda, Sodium sulphide, Zinc chloride, Wood pulp	Cotton pulp, Sulphuric acid, Cellu- losic conti- nuous viscose filament yarn, Carbon disul- phide, cellu- lose film	5360.7
Travancore Cochin Chemicals Ltd. (TCC) Udyogmandal	1951	Sulphur, Soda ash, Barium carbonate, Caustic lime, Common salt	Caustic soda, Sodium sul- phide, Sodium- hydro sulphite, Liquid chlo- rine, Hydro- chloric acid	3504

Industry	Year of Establi- shment	Raw-materials	Products	Waste water dis- charge $\times 10^6 \text{L day}^{-1}$
Indian Rare Earths Ltd. (IRE) Udyogmandal	1951	Monazite sand, Caustic soda, Hydrochloric acid, Chloride, Nitric acid	Trisodium phosphate, Rare earths oxide, Cerium oxide, Rare earths chloride	705.1
Hindustan Insecticide Ltd. (HIL) Udyogmandal	1958	Benzene, alco- hol, Chlorine, Oleum	DDT, BHC	65.6
Cominco Binani Zinc Ltd. (CBZ) Binanipuram	1967	Zinc concentrate	Zinc, Sulphu- ric acid, Cadmium	844.98
Periyar Chemicals Ltd. Binanipuram	1969	Caustic soda, Sulphuric acid, Stack gas con- taining 30% Cobalt	Formic acid, Sodium sulphate	43.2
United Catalysts India Ltd. (UCI) Binanipuram	1970	Alumina, Copper, Zinc, Iron scrap, Sulphuric acid, Graphite, Sodium chloride, Ammonia, Carbon dioxide	Catalysts for fertilizer and petro- chemical industries	126

The concern about the quality of water in the lower reaches of the river began to be felt in the 1970s. Occasional reports of mass mortality of fish focussed public attention and induced scientific investigations on the causes and effects of the degradation of environmental quality in the river and its associated canals and backwater. The river being subject to tidal influx from Cochin backwater the hydrobiology of its

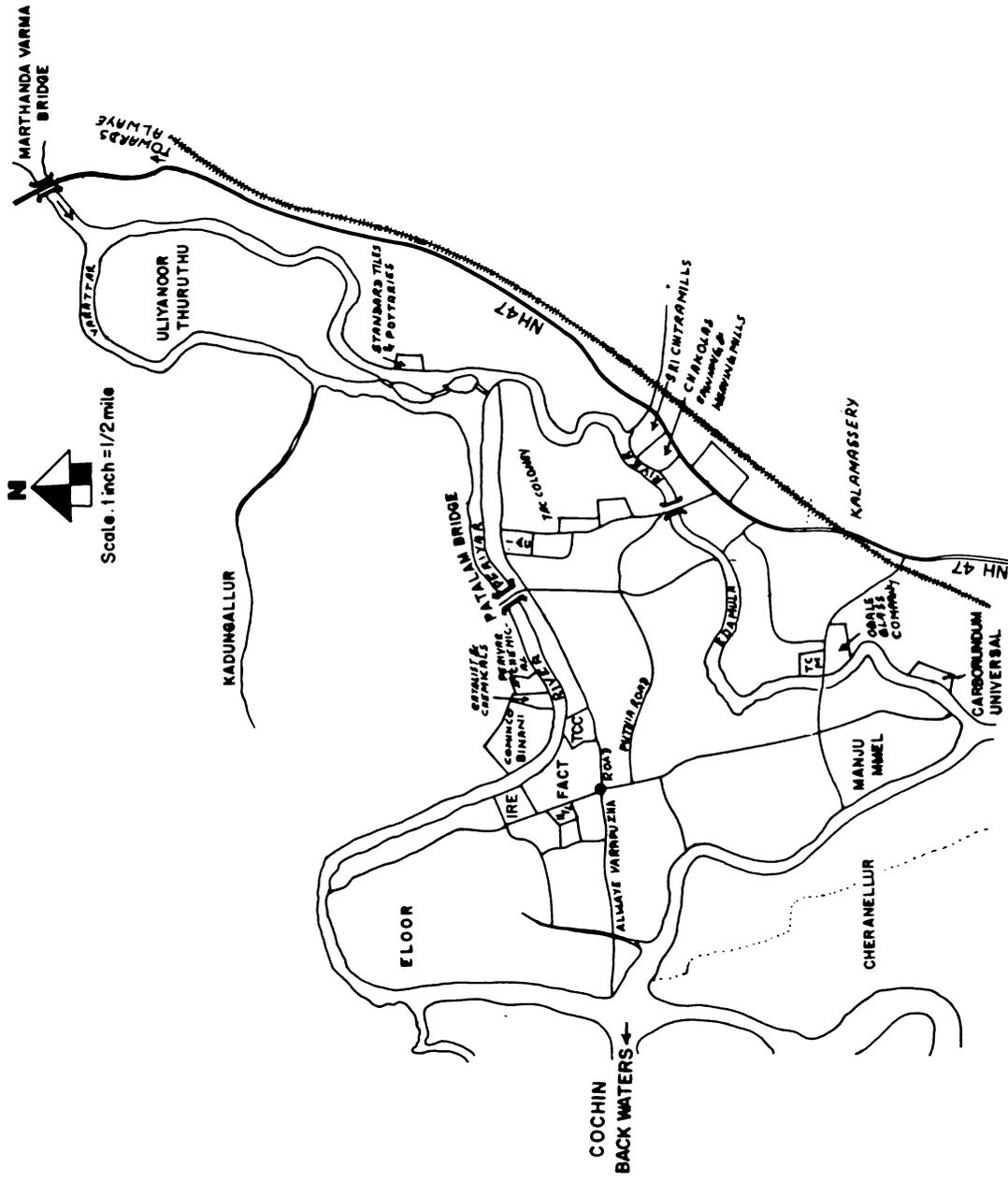


Fig. 2. Industrial zone along the banks of river Periyar

lower reaches is closely associated with that of the latter. The environmental conditions in this estuary centre around the South West monsoon and tidal oscillations. The occurrence of the South West monsoon facilitates the differentiation of the year into three seasons, namely Monsoon (June-September), Premonsoon (February-May), and Postmonsoon (October-January). During the monsoon season, salinity decreases in the Cochin backwater and it becomes freshwater dominated. In the post-monsoon and premonsoon months brackish to marine conditions are restored (Sankaranarayanan and Qasim, 1969).

Estimation of primary productivity in the estuary shows that it is a very productive region with an annual gross production of  $300 \text{ g C m}^{-2}$  (Qasim et al., 1969). Sankaranarayanan and Qasim (1969) investigated the nutrient status of Cochin backwater and reported that during monsoon the concentration of nutrients is quite high in the estuary especially in the bottom, which they reasoned, is due to river discharge and decomposition of organic matter in the bottom sediments. Ramamritham and Jayaraman (1960) had suggested that this increase in nutrients is due to the influx of upwelled water from Arabian Sea. However, recent studies on the distribution pattern of nutrients indicate an external source or rather abiogenic source of input (Joseph, 1974; Manikoth and Salih, 1974; Joseph et al., 1984; Sankaranarayanan et al., 1986; Lakshmanan et al., 1987). These authors have implicated various sources such as sewage effluents, agricultural run-off and effluent discharge

from a fertilizer factory (FACT) located on the banks of river Periyar. Unnithan et al. (1975) and Remani et al. (1983) identified organic pollution due to sewage wastes and retting of coconut husk in localised regions of Cochin backwater.

Remani et al. (1980) observed fluctuation in the composition and nature of sediments caused by industrial effluents discharged into the river Periyar. Sarala Devi et al. (1979) also have reported that the industrial effluents released into river Periyar at the Eloor industrial zone affects the hydrographical features during the Premonsoon and Postmonsoon months. Jayapalan et al. (1976) observed that during summer the river water is characterised by low dissolved oxygen, high temperature and high chloride content, while during monsoon it possesses high dissolved oxygen, has low temperature, high carbon dioxide content and low chloride. The standing crop of plankton was found to be poor in the immediate zone of pollution. Silas and Pillai (1976) and Shynamma et al. (1981) have reported 'fish mortality' in the river. The 'pollution profile' of the river Periyar as represented by Paul and Pillai (1978) reveal high concentrations of pollutants such as  $^{228}\text{Ra}$ ,  $\text{Po}_4$ , Zn and Mn in the water and sediments even at locations 2 km downstream of the industrial outfalls. Balakrishnan and Lalithambika Devi (1983) highlighted the increasing environmental problems in the river Periyar and adjoining Cochin backwater system due to industrial effluents.

Joseph et al. (1984) have studied the seasonal and spatial distribution of phytoplankton in the industrial zone of river Periyar. They observed that at the region of discharge of effluents from FACT phytoplankton is either absent or in poor concentration. This decrease is attributed to the very high concentration of ammonia and phosphate in the effluent-laden water at the site. The authors state that "the effluent was not found to inhibit the rate of production, but controlled the generation time and qualitative distribution of phytoplankton. However, in lesser concentration the effluents enhanced the rate of production". There is no conclusive evidence that the effluents from FACT is responsible for the stimulation of phytoplankton growth, for the river at this spot receives effluents from many other industries. So a detailed study of the effect of effluents from FACT is taken up and also the water quality and phytoplankton standing crop of Periyar is assessed from a sufficiently upstream location through the industrial zone and the estuarine region.