River Cauvery

Environment and Fishery

Central Inland Fisheries Research Institute
(Indian Council of Agricultural Research)
Barrackpore, Kolkata - 700 120, West Bengal

RIVER CAUVERY
ENVIRONMENT AND FISHERY

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Foreword

The river systems, which have traditionally supported the inland fishery base of the country, are being subjected to increased environmental perturbations due to population explosion, increased abstraction of water for various purposes, discharge of industrial effluents and domestic sewage and wastes. This has resulted in habitat modifications affecting the biodiversity of the systems.

The Central Inland Fisheries Research Institute, Barrackpore has taken up exploratory survey of all the major river systems of India in order to assess the present status of environment and fisheries. As part of this survey, river Cauvery has been studied by Reservoir Division of the Institute. The present study, it is hoped, will provide the baseline information to monitor future modifications, if any. The study has brought out clearly that though the environment by and large is fairly in good condition throughout the course, the fisheries are in an over fished state leading to the reduction of certain indigenous fish stocks. There is a strong case to reduce fishing intensity by diverting part of the fishermen population to other vocations. I hope the information provided in the Bulletin will be useful to State governments, planners and research workers interested in riverine fisheries.

Director
CIFRI

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Contents

PHYSIOGRAPHY OF THE RIVER CAUVERY

River Cauvery, the third largest river in peninsular India, takes its origin in the Brahmagiri hills of Western ghats at an elevation of 1355 m (MSL) in Coorg district of Karnataka. It traverses about 850 km draining an area of 89,600 km^2 enroute before it joins Bay of Bengal. The river course can be broadly divided into 1) Mountainous zone – from the origin up to Sivasamudram, 2) Plateau zone - from Sivasamudram up to Hogenakkal and 3) the plain zone - from Hogenakkal to its confluence in Bay of Bengal. The mountainous and plateau zones lie in Karnataka state and the plain zone in Tamil Nadu state.

The river at its origin called Talacauvery is a small channel emanating from a perennial spring. It traverses as a narrow channel of about 3 m width through a deep gorge of thick evergreen jungle for about 19 km up to Bhagamandala where it is joined by its first tributary, the Kannige river. The upper course of the river is swift, flowing through deep gorges and steep ravines with a number of rapid falls. This is witnessed up to Krishnarajasagar dam, the first man-made barrier across its course. At Srirangapatnam, the river bifurcates into two branches only to unite 5 km below. Further down, near Sivasamudram, the river plunges through a succession of falls and rapids to a total drop of about 85 m. Thereafter, the river flows through gorges, the most famous being Mekedatu. Further down at Hogenakkal, the river loses 18 m height and is considered as the end of plateau course.

In Karnataka stretch, important tributaries are Harangi, Hemavathi, Lakshmanathirtha, Kabini, Shimsha and Arkavathi. Except Shimsha and Arkavathi, all the tributaries rise in Western Ghats characterized by dense forest and high rainfall. Dams have been constructed across all the tributaries except Lakshmanathirtha.

The river stretch in Tamil Nadu is characterized by sluggish flow as the river traverses through a monotonous plain. Important tributaries in this stretch are Bhavani and Amaravathy. The dam at Mettur is the first barrier across the river in this stretch. Other barriers are the Upper anicut near Mookumbai which divides Cauvery into a northern branch called Coleroon and the southern branch retaining the original name, Cauvery. Both these rivers run parallel to each other upto Grand Anaicut (Kallanai) from where four distributaries viz. G.A. canal, Vennar, Cauvery and Coleroon originate. The Cauvery further branches off into several minor rivers, streams and canals, irrigating the vast delta in Tanjore, Thiruvarur, Nagapattinam and Pudukkottai districts on account of many man-made barriers. The Coleroon, the main distributary, which carries more floodwater than the main Cauvery, joins Bay of Bengal at Palaiyar. The other important distributaries of Cauvery are the Kodamuruttiaru, Arasalaru and the Vettaru. Cauvery joins the sea at Kaveripattanam, the site of ancient port city of Poompuhar. The river in Tamil Nadu stretch has been much utilized for irrigation and very little water goes into the sea.

SAMPLING PROGRAMME AND PROCEDURE

The river was divided into two - the Karnataka stretch and - the Tamil Nadu stretch. In each stretch, 9-10 centres were chosen for sampling. The centres in Karnataka stretch are - Bhagamandala, Kudige, Ramnathapuram, K.R.Nagar, Srirangapatnam, T. Narasipur,

Talakadu, Mekedatu and Hogenakkal. The centres in Tamil Nadu stretch are Mettur, Bhavani, Thirumukkudal, Upper anicut, Grand anicut, Thiruvaiyaru, Kumbakonam-Coleroon, Kollidam, Palaiyar and Poompuhar. At each centre, sampling was done for various limnological features and productivity. Fishing operations were observed wherever conducted and the fish catch statistics were collected from fish assembly centres.

Each stretch has been sampled simultaneously during three seasons *viz.*, pre-monsoon (May-June), monsoon (August) and post-monsoon (November-December) in the year 1999-2001. Standard methods were followed for sampling and analyses.

PHYSICAL AND CHEMICAL FEATURES OF SEDIMENT

Physical features

Soil texture is generally sandy to sandy-loam in the entire river stretch with predominance of sand in the down stretch. In some sampling sites viz. Ramanathapuram, T. Narasipur, K.R.Nagar and Mettur, the littoral soil is sandy-loam in nature. Both in stretch I and II, the structure of the river bed have been modified due to construction of dams, anaicuts, regulators, canals and other distributaries. Intense agricultural activities around the riverine catchment have their impact to some extent in modifying the texture of basin soil in both the stretches. River bed is rocky at some parts of Kudige, Ramanathapuram, Srirangapatnam, Sivasamudram, Mekedatu and Hogenakkal in the upper stretch.

Chemical features

Soil reacted acidic to near neutral in the upper stretch due to forest origin red soil. Average soil pH was 5.33 (Bhagamandala), 6.47 (Kudige) and 5.97 (Ramanathapuram) in Karnataka stretch after which pH increased towards neutral to alkaline conditions in Tamil Nadu stretch. It was alkaline (pH: 8.03) at Thirumukkudal but declined to 7.29 at Palayar. While the specific conductance of soil (mS/cm) varied (Table 1) between 0.11 and 0.64 in the first stretch following a definite trend of increasing order from Bhagamandala to T. Narasipur, no trend was noticed in the second stretch having mean conductance values ranging between 0.18 (Thiruvaiyaru) and 1.73 (Poompuhar). Organic carbon content varied greatly among the centres and significantly more in upstream (0.79 to 2.02%) as compared to downstream (0.04 to 0.45%). In general, organic carbon content in the entire river stretch was comparatively low during pre-monsoon than post-monsoon or monsoon seasons. Accordingly, C/N ratio, a predictor of productivity, varied widely amongst the centres and the mean range fluctuated between 13 & 28 and 4 & 27 in stretch I and stretch II respectively. Available nitrogen (mg/100 g soil) was significantly more right from Bhagamandala (14.53) to Bhavani (15.90) with exceptionally high value (58.27) at K.R.Nagar. The value declined drastically in the lower stretches between Thirumukkudal (6.1) to Palaiyar (5.03). Even though soil is predominantly sandy, presence of available phosphorus (mg/100 g soil) was well marked in stretch II with a high value of 12.9 (Upper Anicut) probably due to leaching of a part of phosphate fertilizers applied in the agricultural lands for crops. However, the value declined to 1.8 at Kollidam. Free calcium carbonate content was very meagre in the entire river course.

Table 1. Sediment characteristics of river Cauvery (range & mean)

Centres	Soil type	pH	Sp. cond (mS/cm)	Org-C (%)	Tot-N (%)	C/N	Avail-N (mg/100g)	Avail-P (mg/100g)	Free $CaCO_3$ (%)
				Stretch-I					
Bhagamandala	Sandy loam	4.08-6.18	0.06-0.17	0.66-0.92	0.03-0.08	12-23	10.00-22.40	0.80-2.42	0.30-0.85
		5.33	**0.11**	**0.83**	**0.05**	**19**	**14.53**	**1.37**	**0.54**
Kudige	Sandy loam	6.15-6.80	0.25-0.48	0.54-1.16	0.030-0.032	18-38	7.60-8.80	2.20-9.73	0.68-1.32
		6.47	**0.33**	**0.79**	**0.031**	**26**	**8.27**	**4.67**	**0.99**
Ramnathpuram	Sandy loam	5.59-6.36	0.11-0.39	0.62-1.60	0.02-0.15	11-31	8.20-42.0	0.32-0.66	0.76-0.95
		5.97	**0.27**	**1.02**	**0.066**	**24**	**19.57**	**0.45**	**0.87**
K.R.Nagar	Sandy clay	5.95-8.20	0.22-0.66	1.75-2.26	0.10-0.32	7-18	37.50-92.50	0.73-12.47	0.80-1.00
		6.86	**0.41**	**2.02**	**0.193**	**13**	**58.27**	**4.73**	**0.89**
T.Narasipur	Sandy loam	5.90-7.60	0.18-0.75	0.72-1.21	0.02-0.09	8-40	8.50-28.00	0.47-2.94	0.72-1.06
		6.77	**0.52**	**0.91**	**0.047**	**28**	**15.10**	**1.32**	**0.89**
T.Narasipur-Kabini	Sandy loam	6.5-6.95	0.24-0.80	0.82-1.18	0.03-0.09	9-39	8.50-25.40	0.98-3.81	1.25-1.38
		6.73	**0.64**	**1.00**	**0.06**	**24**	**16.95**	**2.39**	**1.94**
				Stretch -II					
Mettur	Sandy loam	7.20-7.97	0.33-1.72	0.34-0.67	0.029-0.090	4-19	8.30-25.20	3.98-5.46	1.40-1.85
		7.62	**0.88**	**0.45**	**0.05**	**12**	**14.30**	**4.53**	**1.68**
Bhavani	Sandy	7.16-7.96	0.28-0.52	0.36-0.49	0.025-0.110	5-18	8.40-30.8	7.35-14.75	1.26-1.35
		7.59	**0.37**	**0.44**	**0.055**	**12**	**15.9**	**9.89**	**1.30**
Thirumukkudal	Sandy	7.50-8.32	0.14-0.15	0.08-0.09	0.010-0.023	4-8	5.30-6.60	5.20-8.31	2.00-2.40
		8.03	**0.14**	**0.085**	**0.018**	**6**	**6.10**	**6.37**	**2.17**
Upper Anicut	Sandy	7.20-8.06	0.13-0.26	0.14-0.21	0.006-0.021	10-24	2.50-6.50	8.50-16.97	2.00-2.30
		7.69	**0.19**	**0.18**	**0.011**	**19**	**4.13**	**12.90**	**2.16**
Grand Anicut	Sandy	7.16-8.13	0.14-0.22	0.04-0.34	0.005-0.30	2-42	3.50-8.50	2.20-4.67	1.40-1.60
		7.72	**0.19**	**0.16**	**0.014**	**21**	**5.40**	**3.73**	**1.49**
Thiruvaiyaru	Sandy	7.13-7.87	0.15-0.22	0.03-0.36	0.007-0.020	2-51	2.80-6.50	0.99-5.00	1.58-1.65
		7.50	**0.18**	**0.20**	**0.014**	**27**	**4.65**	**3.00**	**1.62**
Kumbakonam - Coleroon	Sandy	6.91-7.93	0.09-0.42	0.02-0.26	0.008-0.017	1-26	4.80-5.20	1.85-2.27	1.60-2.00
		7.55	**0.26**	**0.12**	**0.012**	**12**	**5.00**	**2.04**	**1.80**
Kollidam	Sandy	7.27-7.90	0.10-4.20	0.02-0.07	0.006-0.008	3-10	3.50-3.8.0	1.20-2.64	1.62-2.00
		7.52	**1.50**	**0.045**	**0.007**	**6**	**3.63**	**1.80**	**1.84**
Palaiyar	Sandy	6.68-7.80	0.14-1.26	0.02-0.08	0.008-0.020	3-4	4.20-6.50	3.90-10.97	1.40-1.70
		7.29	**0.72**	**0.04**	**0.014**	**4**	**5.03**	**6.48**	**1.55**
Pumpuhar	Sandy	6.25-7.13	1.51-1.94	0.07-0.29	0.007-0.015	5-41	3.20-5.50	1.78-2.00	1.70-1.80
		6.69	**1.73**	**0.18**	**0.011**	**23**	**4.35**	**1.89**	**1.75**

PHYSICO-CHEMICAL FEATURES OF WATER

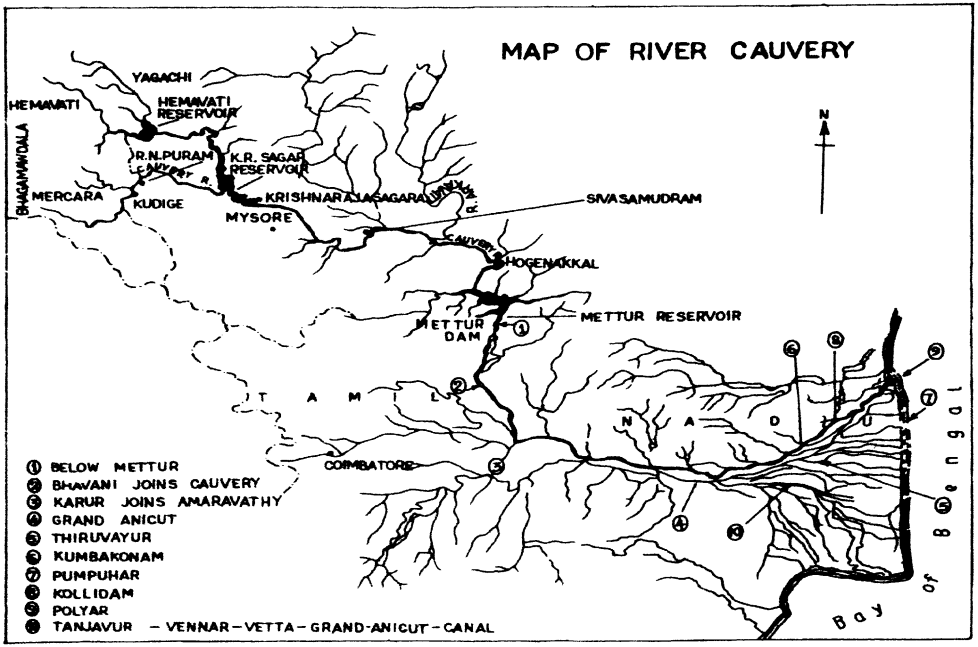
Physical features

Tables (2a & 2b) reveal the physico-chemical features of water at different centres of Cauvery system. Of the physical features, heat and light are of prime importance for photosynthetic activity, being basic to productivity. Temperature may not be a constraint for productivity as the entire river course is situated in tropical belt. Water temperature fluctuated sinusoidally and varied from a low range of 20 - 26°C to a high of 30°- 30.5°C in the first and second stretches respectively. However, the mean annual temperature fluctuated over a wide range between 22°C and 29.5°C in the entire river system of Cauvery. Transparency (Secchi-depth) was very low (22 cm) in monsoon at Ramanathapuram in stretch I and 30 cm at some sampling sites in stretch II. Due to low flow of water during summer in some sampling sites both in the up and down-streams, bottom of the river was visible. However, transparency was very high in pre-monsoon in most of the sampling sites especially in the upstream due to reduced flow and undisturbed conditions without addition of runoff containing red soil (colloidal micelles). Though the tourist activities are bound to have some impact at Hogenakkal, it recovered within a short distance in the down stream due to self-purification.

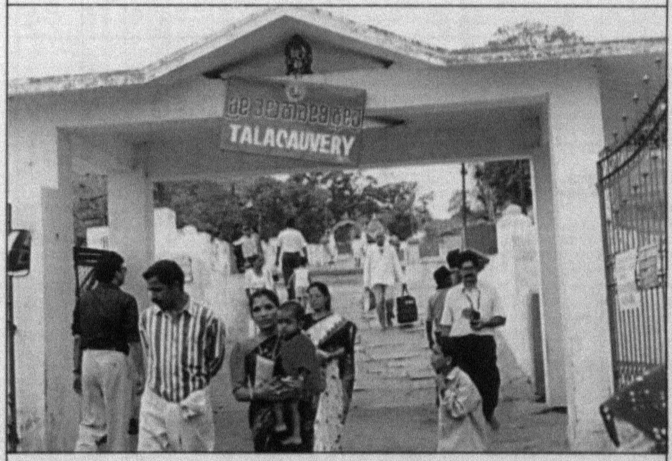
Chemical features

Dissolved oxygen (DO) is of prime importance as a regulator of metabolic processes of biotic communities and it is also an indicator of the suitability of water for healthy life. DO (mg/l) was comparatively low during monsoon and the concentration increased in the subsequent seasons (post-monsoon and pre-monsoon). However, the mean annual DO content in the entire Cauvery system was to the tune of 5.0 to 7.8, a quite favourable range for productivity. Even, submerged macrophytes also helped particularly at Kudige, Ramanathapuram, Srirangapatnam, T. Narasipur, Mekedatu and Talakadu in increasing DO content in water in the upstream during pre-monsoon months. A rise in pH during post-monsoon and pre-monsoon seasons followed by a substantial drop in monsoon due to dilution was noticed in the whole Cauvery course with a mean annual variation ranging between 6.6 (Kudige) and 8.5 (Poompuhar & Thiruvaiyaru) barring extreme upper site near origin at Bhagamandala where it was slightly acidic (pH in Cauvery 6.3, in Kannige 6.1). Due to acidic nature of bottom sediment in the upstream, water reaction was slightly acidic to near neutral from the origin to Ramanathpuram and even strong buffering capacity of water did not able to buffer it substantially due to absence of carbonates. Free CO_2 was present in a few upstream sampling sites, but disappeared in the entire downstream. Specific conductivity was phenomenally increased in pre-monsoon months compared to its values in monsoon in the entire river course. The average sp.conductivity (µS/cm) values fluctuated widely between a low of 59 (Bhagamandala) and a high of 503 (Hogenakkal) in the upstream barring Mekedatu-Arkavathy (1230-1470) and Mekedatu-Cauvery (600-710) and ranged between 588 (Mettur) and 2170 (Poompuhar) in the downstream. The high values are due to the loading of Bangalore city sewage in Arkavathy, which gets reflected in water qualities of Arkavathy at Mekedatu Sangam. Possible effect of slight incursion of saline water up to Thiruvaiyaru in the lower stretch of Cauvery was the root cause of increased conductivity as well as TDS values.

Alkalinity, the acid combining capacity of natural freshwater, is generally caused by carbonates and bicarbonates of calcium and magnesium with dissolved CO_2, carbonates and


MAP OF RIVER CAUVERY
N
YAGACHI
HEMAVATI
HEMAVATI RESERVOIR
BHAGAMANDALA
R.N.PURAM
K.R. SAGAR RESERVOIR
MERCARA
KUDIGE
KRISHNARAJASAGARA
MYSORE
SIVASAMUDRAM
HOGENAKKAL
METTUR DAM
METTUR RESERVOIR
T A M I L
N A D U
COIMBATORE
Bay of Bengal
① BELOW METTUR
② Bhavani JOINS CAUVERY
③ KARUR JOINS AMARAVATHY
④ GRAND ANICUT
⑤ THIRUVAYUR
⑥ KUMBAKONAM
⑦ PUMPUHAR
⑧ KOLLIDAM
⑨ POLYAR
⑩ TANJAVUR – VENNAR – VETTA – GRAND-ANICUT – CANAL

Cauvery origin at Talacauvery, Coorg, Karnataka



Talacauvery Temple

Table 2(a). Physico-chemical characteristics of water in Karnataka stretch of Cauvery (range & mean)

Sampling stations	Transp (cm)	Temp (°C)	DO (mg/l)	Free CO_2 (mg/l)	PH	Sp. cond (µS/cm)	TDS (mg/l)	CO_3 (mg/l)	HCO_3 (mg/l)	Tot. Alk (mg/l)	Tot. Hard (mg/l)	Ca^{++} (mg/l)	Mg^{++} (mg/l)	Chloride (mg/l)
Bhagamandala	45-Upto Bottom	20.0 - 25.0 **22.0**	5.8 - 8.8 **6.9**	5 - 12	6.2 - 6.7 **6.3**	28 - 90 **59**	18 - 59 **38**	Nil	6 - 34 **23**	6 - 34 **23**	4 - 22 **15**	1.3 - 4.0 **2.9**	0.2 - 2.8 **1.7**	12.7-14.2 **13.2**
Bhagamandala -Kannige	45-Upto Bottom	20.5 - 25.5 **22.7**	6.8 - 8.0 **7.3**	6 - 8	6.1 - 6.2 **6.1**	28 - 90 **59**	18 - 59 **38**	Nil	16 - 34 **24**	16 - 34 **24**	6 - 28 **15**	1.8 - 4.8 **3.3**	0.4 - 3.9 **1.7**	10.9-14.2 **12.6**
Kudige	43 - 120	21.0 - 28.0 **23.8**	5.6 - 8.8 **7.1**	3 - 6	6.3 - 6.8 **6.6**	43 - 250 **151**	28 - 163 **98**	Nil	20 - 72 **51**	20 - 72 **51**	16 - 60 **39**	3.2-12.0 **8.3**	1.9 - 7.3 **4.4**	14.2-19.8 **17.0**
R.N. Puram	22 - 120	21.5 - 28.5 **24.4**	7.0 - 8.4 **7.8**	2	6.6 - 7.2 **6.9**	50 - 370 **227**	33 - 241 **147**	Nil	24 - 112 **73**	24 - 112 **73**	20 - 88 **59**	4.8-98.2 **13.8**	1.9 - 9.7 **6.1**	17.0-22.7 **20.8**
K. R. Nagar	42 - 100	22.0 - 30.0 **25.3**	6.6 - 7.7 **7.1**	Nil -2	6.8 - 7.3 **7.1**	75 - 630 **368**	48 - 409 **239**	Nil-16	36 - 164 **108**	36 - 180 **115**	28 -154 **97**	6.4-98.2 **16.6**	2.9-25.7 **13.4**	12.8-28.4 **23.2**
S. R. Patnam	70 - 110	23.2 - 29.0 **25.3**	6.8 - 7.6 **7.2**	Nil -2	6.9 - 7.5 **7.2**	96 - 740 **409**	62 - 480 **265**	Nil-28	46 - 180 **115**	46 - 208 **129**	30-162 **97**	6.4-21.6 **14.7**	3.4-29.6 **14.7**	11.4-34.1 **24.6**
T. Narasipur	30 - 100	23.6 - 29.0 **25.5**	5.2 - 8.2 **6.4**	Nil -2	6.9 - 7.5 **7.3**	110 - 650 **453**	71 - 422 **294**	Nil-8	50 - 198 **145**	50 - 206 **151**	40-160 **119**	9.6-33.6 **24.4**	3.9-19.4 **13.9**	17.0-36.9 **28.3**
T. Narasipur - Kabini	25 - 80	23.4 - 29.5 **25.6**	5.4 - 8.8 **7.2**	2 - 3	6.6 - 7.6 **7.2**	89 - 640 **440**	57 - 416 **286**	Nil-40	48 - 200 **137**	48 - 202 **150**	36-152 **111**	8.0-30.5 **22.4**	3.9-18.4 **13.3**	17.0-36.9 **28.4**
Muduthere	30 - 130	23.5 - 28.0	5.1 - 7.6	2 - 4	6.8 - 7.4	120 - 610	78 - 396	Nil	50 - 186	50 - 186	38-139	9.8-25.7	3.3-18.2	17.0-36.9
Talakadu	65 - 200	24.0 - 28.5 **26.0**	5.6 - 6.8 **6.2**	Nil -3	6.6 - 7.7 **7.3**	110 - 620 **423**	71 - 403 **275**	Nil-44	52 - 160 **117**	52 - 204 **141**	40-146 **105**	9.6-32.1 **24.0**	3.9-17.0 **10.8**	17.0-38.6 **30.9**
Sivasamudram	> 130	25.5	6.6	Nil	7.5	550	357	32	140	172	124	28.9	12.6	36.9
Mekedatu	100-Upto Bottom	25.0 - 29.0	6.3 - 6.6	Nil	7.9 - 7.9	600 - 710	390 - 462	40	150-170	190-210	136-140	23.3-32.1	13.6-19.9	40.3-44.6
Mekedatu - Arkavathy	Upto Bottom	25.5 - 29.5	6.6 - 7.3	Nil	8.1 - 8.2	1230 - 1470	800 - 956	72-80	220-252	292-332	208-228	20.0-51.3	19.4-43.2	127.8-138.0
Hogenakkal	90 - 110	25.0 - 30.0 **27.3**	6.6 - 8.7 **7.3**	Nil -3	7.4 - 7.9 **7.7**	190 - 690 **503**	124 - 448 **327**	Nil -24	90 - 248 **171**	90 - 264 **185**	60-142 **114**	16 -32 **25.9**	4.8-16.5 **11.9**	25.6-42.0 **35.6**

bicarbonates form an equilibrium which is of paramount importance for biological productivity. Alkalinity below 20 mg/l is said to be less productive than productive waters having alkalinity values above 100 mg/l. Total alkalinity (TA, mg/l) with predominance of bicarbonates was on an average ranging from 51 (Kudige) to 185 (Hogenakkal) in stretch I barring Bhagamandala (23-29) and from 152 (Palaiyar) to 247 (Poompuhar) in stretch II. It also increased to a great extent during summer months in the entire river course. Carbonate was mostly absent in upstream barring its presence (8.44 mg/l) in some sites only in pre-monsoon and in Arkavathy at Mekedatu where it was found to range from 72 to 80 mg/l. While in stretch II, its presence was ranging from 10 to 39 mg/l. So, substantial degree of variation in TA values was encountered in different seasons in the Cauvery system, primarily due to rains, volume of water flow, and intense anthropogenic activities particularly after cessation of rains.

Total hardness (TH, mg/l) went in hand in hand with TA and the values never exceeded the corresponding TA values in the upstream. TH was predominantly more in the estuarine zone at Palaiyar (1765) and Poompuhar (950). Barring the estuarine sites, TH hardly exceeded the corresponding TA values in downstream also in most of the occasions. The overall mean range of TH in stretch I and stretch II was 15-114 (barring Arkavathy at Mekedatu) and 120-275 (barring Palaiyar and Poompuhar) respectively. Total dissolved solids (TDS, mg/l) in the entire river system ranged from 98 to 450 between Kudige and Grand anicut barring Arkavathy at Mekedatu. TDS was estimated to be more ranging between 791 and 1085 in the estuarine zone of lower Cauvery complex. A substantial content of Mg was noticed in downstream as compared to upstream. Both Ca and Mg were very meagre (2.9-8.3 & 1.7-4.4 respectively) in the extreme upstream sites. However, the mean annual values of Ca and Mg between Kudige and Thiruvaiyaru were 8.3 to 26.0 and 4.4 to 28.0 mg/l respectively. Barring Arkavathy at Mekedatu Sangam (127.8-138.0 mg/l), chloride content in the upstream was in the normal range (12.6-35.6 mg/l) signifying that the river Arkavathy is not contributing substantially so far as pollution load is concerned in the downstream of Cauvery in Karnataka stretch.

Nutrient status

The role and significance of dissolved nutrients such as nitrate, phosphate and silicate in aquatic productivity have been widely studied. Nitrogen occupies a major place in aquatic system as a constituent of protein. Dissolved inorganic nitrogen (DIN) to the tune of 200 to 500 µg/l and dissolved inorganic phosphate (DIP) in the range of 50 to 200 µg/l have been considered to be favourable for medium to high levels of productivity.

Nitrate-N was in trace quantity in pre-monsoon in the upper stretch but its presence was significantly more in lower sampling sites of stretch I in the range of 10 to 172 µg/l during monsoon and post-monsoon due to loading of this nutrient from fertile and crop fields through inflow. K.R.Nagar, Mekedatu and Hogenakkal experienced phenomenal concentration of nitrate-N in post-monsoon periods. A noticeable presence of phosphate-P (µg/l) was observed at Kudige (140), Talakadu (80), Mekedatu (230) and Hogenakkal (45) in pre-monsoon months with a high value of 940 µg/l recorded in Arkavathy at Mekedatu Sangam. Total inorganic-N fluctuated between 33 and 170 µg/l on an average in this stretch barring Arkavathy at Mekedatu. Silicate silicon (mg/l) was found to be more in pre-monsoon (2.05-9.99) followed by post-monsoon (2.0-5.75) and monsoon months (0.3-4.35) in this stretch (Table 3).

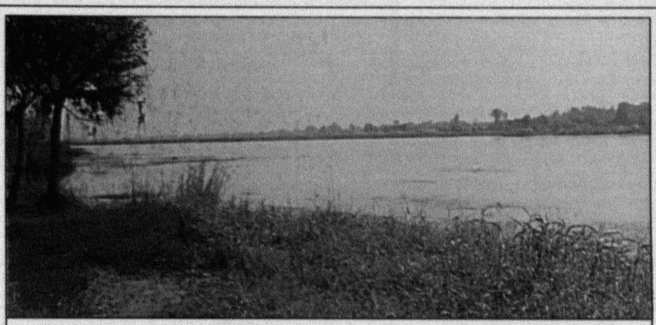
Table 2(b). Physico-chemical characteristics of water in Tamil Nadu stretch of Cauvery(range & mean)

Sampling stations	Transp (cm)	Temp (°C)	DO (mg/l)	pH	Sp. cond (µS/cm)	TDS (mg/l)	CO_3 (mg/l)	HCO_3 (mg/l)	Tot. Alk (mg/l)	Tot. Hard (mg/l)	Ca^{++} (mg/l)	Mg^{++} (mg/l)
Mettur	75-170 117	26.7-27.9 27.4	4.2-6.1 5.0	6.6-7.6 7.2	413-700 588	268-455 382	8-13 10	66-199 144	74-209 154	17-123 120	21.4-27.3 24.9	12.4-15.4 13.9
Bhavani	97-135 112	28.0-29.3 28.8	5.1-7.2 5.9	7.2-8.2 7.8	660-730 693	429-475 450	12-20 15	139-225 178	159-238 193	112-166 143	21.4-32.3 27.8	1432-20.7 17.9
Thirumukkudal	70-120 98	28.0-29.1 28.7	3.2-7.6 5.1	7.3-8.4 7.8	590-725 665	384-471 432	12-16 15	161-208 186	177-224 200	106-250 164	19.2-32.9 26.5	14.1-39.5 23.4
Upper Anicut	50-103 79	27.0-28.2 27.4	6.4-7.4 6.9	7.6-8.1 7.9	510-700 623	332-455 405	8-22 13	150-232 178	160-240 190	126-500 275	16.0-33.7 24.6	16.1-112.2 52.2
Grant Anicut	30-126 79	26.2-28.9 27.3	4.6-8.4 6.9	7.6-8.2 7.8	530-710 638	345-462 415	8-28 17	136-234 189	164-242 206	176-208 196	20.8-31.3 25.9	23.9-38.0 32.0
Thiruvaiyaru*	30-90 55	26.2-29.1 27.5	7.2-8.4 7.8	8.4-8.6 8.5	1730-1780 1755	865-890 878	19-26 22	130-221 176	156-240 198	160-200 180	19.2-32.9 26.0	19.0-37.0 28.0
Kumbakonam - Coleroon	30-90 62	26.0-29.0 27.1	7.0-8.4 7.7	7.6-8.5 8.2	1480-1740 1597	740-870 798	8-32 22	152-164 159	170-190 181	98-208 155	17.6-34.5 27.5	13.2-32.2 21.9
Kollidam	40-140 105	27.0-29.9 28.8	6.6-7.1 6.8	7.0-8.0 7.4	1450-1730 1582	725-865 791	10-37 22	45-246 144	55-263 166	132-232 175	12.8-32.1 21.8	20.0-48.8 29.8
Palaiyar	110-500 240	28.5-30.0 29.5	6.0-7.8 6.7	7.4-8.5 8.0	1731-1950 1842	866-970 920	9-46 25	96-162 127	115-171 152	680-3580 1765	60.5-336.6 157.2	206.5-668.1 437.3
Pumpuhar*	60-105 82	26.4-30.5 28.8	7.0-7.6 7.3	8.4-8.6 8.5	2130-2210 2170	1065-1105 1085	13-64 39	159-256 208	172-320 247	860-1040 950	67.3-917.8 492.6	74.5-168.6 121.6

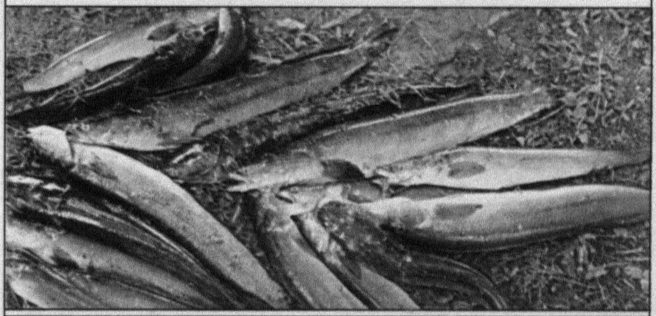
* Dry up during pre-monsoon

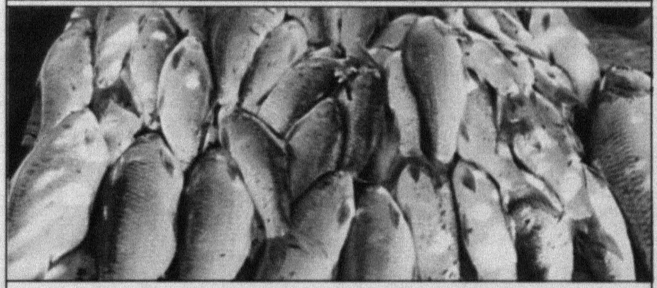
Table 3. Nutrient status of water in Cauvery river (range & average)

Sampling stations	NO_3 -N (µg/l)	To.Inorg.N (µg/l)	PO_4-P (µg/l)	SiO_2-Si (mg/l)	Sampling centres	NO_3-N (µg/l)	Tot.Inorg.N (µg/l)	PO_4-P (µg/l)	SiO_2-Si (mg/l)
Bhagamandala	Tr - 20	20 - 50 **33**	10	0.30 - 4.12 **2.14**	**Mettur**	17 - 42 **28**	30 - 68 **48**	28 - 68 **45**	3.85 - 6.76 **5.19**
Bhagamandala - Kannige	Tr - 20	20 - 60 **40**	10	0.36 - 2.50 **1.69**	**Bhavani**	17 - 58 **36**	32 - 82 **57**	37 - 92 **62**	3.97 - 6.19 **4.89**
Kudige	Tr - 15	30 - 55 **40**	1- 140	0.50 - 5.00 **2.70**	**Thirumukkudal**	20 - 45 **29**	42 - 90 **63**	20 - 148 **90**	4.74 - 8.18 **6.04**
R.N. Puram	Tr - 20	30 - 65 **47**	1 - 20	0.50 - 3.24 **2.18**	**Thirumukkudal - Amaravathy**	20 - 48 **30**	45 - 85 **62**	30 - 165 **105**	3.24 - 6.56 **4.71**
K. R. Nagar	Tr - 100	30 - 210 **113**	3 - 30	2.05 - 5.75 **3.60**	**Upper Anicut**	10 - 52 **31**	30 - 97 **63**	20 - 180 **75**	3.85 - 5.66 **4.80**
S. R. Patnam	Tr - 20	30 - 60 **43**	2 - 20	1.80 - 4.01 **3.19**	**Grand Anicut**	10 - 43 **25**	28 - 95 **61**	50 - 130 **89**	3.92 - 6.49 **4.80**
T. Narasipur	Tr - 30	30 - 65 **42**	2 - 30	3.75 - 5.00 **4.43**	**Thiruvaiyaru**	10 -40 **24**	25 - 89 **57**	40 - 85 **58**	5.00 - 6.74 **5.63**
T. Narasipur - Kabini	Tr - 20	30 - 60 **41**	7 - 28	4.25 - 6.12 **5.37**	**Kumbakonam - Coleroon**	12 - 35	60 - 75	43 - 78	4.80 - 5.51
Muduthere	Tr - 20	30 - 60	5 - 30	5.92 - 6.35	**Kollidam**	10 - 33 **19**	23 - 78 **50**	30 - 165 **110**	5.25 - 6.85 **5.89**
Talakadu	Tr - 20	30 - 65 **40**	2 - 80	4.25 - 8.24 **5.91**	**Palaiyar**	10 - 30 **18**	22 - 80 **52**	40 - 390 **260**	1.39 - 2.00 **1.73**
Sivasamudram	1	15	1	5.0	**Pumpuhar**	25 - 38	60 - 88	68 - 102	3.10 - 3.14
Mekedatu	Tr - 90	30 - 160	4 - 230	5.75 - 9.99	**Vettaru**	10 - 38 **24**	22 - 85 **54**	30 - 145 **87**	5.25 - 10.2 **7.34**
Mekedatu - Arkavathy	20 - 272	80 - 610	25 - 940	7.72 - 9.50	**Vennar**	10 - 40 **24**	23 - 88 **56**	30 - 165 **107**	4.20 - 7.15 **5.29**
Hogenakkal	10 - 172	40 - 320 **170**	5 - 45	4.35 - 5.75 **5.17**					



Deep pool at Muduthere near Talakudu, Karnataka





Murrels and carps from Deep pool, Muduthere

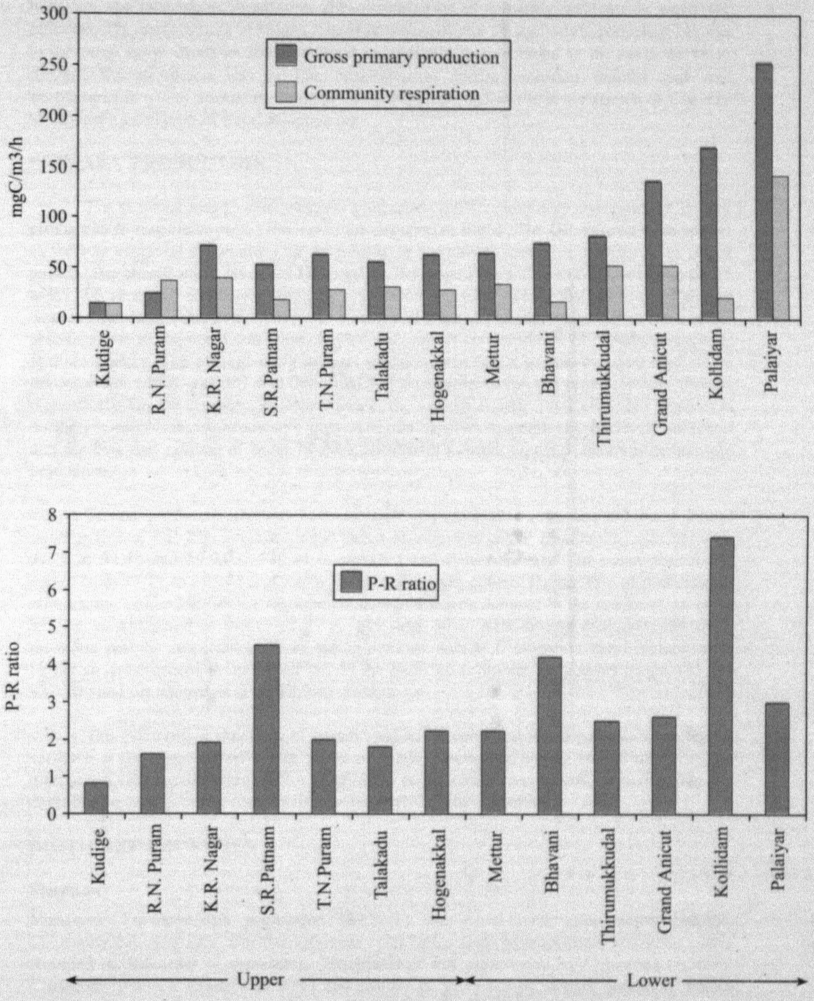


Fig. 2 : Primary productivity in river Cauvery

In downstream, where agricultural activities are at full swing in the catchment during monsoon and post-monsoon seasons, the concentration of available nutrients in water are reflected. The mean nitrate-N values ranged between 18 and 36 µg/l while phosphate -P was in the mean range of 45 to 260 µg/l. Total inorganic-N was recorded in the range of 48 to 63 µg/l. Silicate-silicon was in low concentration during monsoon months and was encountered in a very normal mean range of 1.73 to 7.34 mg/l in the lower stretch of Cauvery to support a good crop of Bacillariophyceae.

PRIMARY PRODUCTION

The seasonal mean values of gross production (GP), community respiration (CR) and production to respiration ratio (P-R ratio) are depicted in Fig. 2. The GP showed wide spatial as well as temporal fluctuations in magnitude in the down stretch as compared to upper stretch. The annual mean values of GP ($mgC/m^3/h$) ranged from 25.0 to 62.5 and from 64.85 to 252.08 in upper and lower stretches respectively. Grand anicut, Kollidam and Palaiyar were distinct from other centres in lower stretch and showed phenomenally higher rates of GP probably due to stagnated condition coupled with higher concentration of dissolved nutrients at those centres. The average daily integral production in upper stretch was 566 mgC/m^3 in pre-monsoon which was 337 and 3887 mgC/m^3 during monsoon and post-monsoon months respectively. On the contrary, in lower stretch, the same was 841, 1262 and 1285 $mgC/m^3/d$ during pre-monsoon, monsoon and post-monsoon seasons respectively. It clearly indicates that the flow and volume of water in association with nutrient contents are transformed into production.

The net production (NP) as well as community respiration rates also exhibited similar trend as that of GP. The average annual range of variation of NP ($mgC/m^3/h$) was between 31.25 & 34.38 and 29.95 & 148.44 in stretch I and II respectively. The mean annual CR varied from 17.71 to 142.42 $mgC/m^3/h$ in the entire river course. Higher rate of assimilation efficiencies (AE = NP/GP x 100) were encountered during summer in the range of 44.44 to 85.71% as compared to those of 21 to 40% and 34 to 81% during monsoon and post-monsoon periods respectively in sampling sites of stretch I. However these values were higher in downstream in monsoon (67.57 to 84.07%) followed by post-monsoon (35.71-83.33%) and pre-monsoon (5.88-92.9%) seasons.

The P-R ratio, a predictor of organic pollution, exhibited low amplitude of temporal variation at the same site with wide range of spatial fluctuation having annual means to the tune of 1.6 (Ramanathpuram) to 7.4 (Kollidam) in the entire river course depicting that the contribution to respiration component was basically by phytoplankton.

BIOTIC COMMUNITIES

Plankton

Monsoon: Phytoplankton population (89.54%) dominated over zooplankton (10.46). Chlorophyceae (62.29), Bacillariophyceae (20.56%) and Myxophyceae (6.69%) were recorded in that order of abundance. Zooplankton was represented by Copepoda (8.76%), Cladocera (0.49%), Rotifera (0.30%) and nauplii (0.85%) but in meagre quantity. Forms encountered were *Spirogyra singularis, Hormidium sp. Ulothrix sp. Pediastrum tetras, P. duplex, Anabaena ambigua, Oscillatoria tenuis, Synedra ulna, Navicula cuspidata,*

Gomphonema sphaerophorum and Gyrosigma sp. among phytoplankton and *Cyclops, Diaptomus, Brachionus caudatus* among zooplankton. Plankton varied from 6 u/l at Ramanathapuram to 340 u/l at Kumbakonam. Presence of Chlorophyceae in abundance indicates the freshness of the environment. Chlorophyceae and Bacillariophyceae were almost uniformly distributed in all the centres. The plankton population was abundant in the second stretch (1442 u/l) when compared to the first stretch (202 u/l), probably due to high total alkalinity and nutrient contents in the former.

Post-monsoon: As observed in monsoon season, phytoplankton dominated (88.19%) over zooplankton (11.81%) during this season also. Among the phytoplankton, Bacillariophyceae formed the bulk(59.87%), followed by Chlorophyceae (20.16%) and Myxophyceae (8.15%). Bacillariophyceae was mainly constituted by *Synedra ulna, Synedra rumbens, Gomphonema sphaerophorum, Navicula cuspidata, Navicula exiqua. Diatoma sp. and Asterionella sp. Pediastrum tetras, Spirogyra singularis, Hormidium sp.* and *Oscillatoria tenuis* were the main forms of algae. Specimens belonging to Rotifera (5.70%), Copepoda (3.86%), Cladocera (1.02%) and nauplii (1.22%) were the zooplanktonic forms recorded. *Brachionus caudatus, Cyclops & Moina sp.* with nauplii were encountered in zooplankton. Plankton population ranged from 14 u/l at Bhagamandala to 86 u/l at K.R.Nagar. Diatoms were uniformly distributed in all the centres during post-monsoon season. Nutrients (nitrates, phosphates and silicates) were at higher side at Mekedatu and Arkavathi where a direct relationship between nutrients and plankton was observed. Second stretch depicted more plankton (536 units) when compared to first stretch (446 units).

Pre-monsoon: As seen in the monsoon and postmonsoon seasons phytoplankton population (96.03%) dominated over zooplankton (3.97%) in the premonsoon season too. Among phytoplankton, diatoms (69.12%) were in abundance followed by green algae (16.47%) and blue greens (10.44%). Lower stretch i.e. down stream of Mettur dam had more plankton (52.35%) when compared to upper stretch (47.65%). Higher content of silica (2.05-10.20 mg/l) favoured the growth of diatoms and hence they dominated. Dominant forms encountered in phytoplankton were *Synedra ulna, Gomphonema sphaerophorum, Navicula cuspidata, Spirogyra singularis, Spirogyra submaxima* and *Chaetophora* sp. Among zooplankton, Copepoda (1.18%), Rotifera (0.88%) and nauplii (1.91%) were encountered. *Brachionus angularis* in zooplankton. Lower stretch recorded more plankton due to enhanced nutrient loading. The plankton diversity in Cauvery river is furnished in Table 4.

Periphyton

Periphytic algae have a great importance as primary producers together with phytoplankton and macrophytes. Periphytic communities of river Cauvery are depicted in Fig. 3. Pre-monsoon recorded maximum deposition (49325 Nos/m^2) of periphytic organisms followed by monsoon (25500 Nos/m^2) and post-monsoon (22260 Nos/m^2). Centres with rich periphytic deposits were Talkadu, Bhavani and Grand anicut. Favourable nutrient features and static water conditions during pre-monsoon period appear to have favoured richdeposition of organisms. Periphytic community comprised of Bacillariophyceae and Chlorophyceae.

Table 4. Plankton diversity in river Cauvery

Phytoplankton	Zooplankton
Oscillatoria tenuis	*Brachionus candatus*
Anabaena ambigua	*Brachionus angularis*
Ankistrodesmus sp.	*Brachionus faleatus*
Merismopedia sp.	*Cyclops sp.*
Amphocapsa sp.	*Diaptomus forbes*
Pediastrum tetras	*Bosmina longirostris*
Spirogyra singularis	Nauplii
Spirogyra submaxima	
Ulothrix sp.	
Hormidium sp.	
Scenedesmus dimorphus	
Scenedesmus deniculatus	
Amphora sp.	
Cosmarium biretum	
Cosmarium circulare	
Coloneis sp.	
Frustulia sp.	
Synedra ulna	
Synedra rumbens	
Navicula cuspidata	
Navicula exigua	
Diatoma sp.	
Gomphonema sp.	
Gyrosigma scalproides	
Asterionella sp.	
Tabellaria sp.	
Fragilaria sp.	

Bacillariophyceae remained predominant in periphyton in all the seasons and at all the centres. Its population during pre-monsoon, monsoon and post-monsoon seasons was 86.25%, 97.46% and 98.83% respectively.

Dominant forms were *Mougeotia* during pre-monsoon, *Pediastrum* during monsoon and *Spirogyra* during post-monsoon.

Bottom macrofauna

Benthic community varied between 14854 organisms/m^2 during pre-monsoon and 18788 organisms/m^2 in post-monsoon season (Fig. 4). Nature of the river bed had a profound influence on the quality and quantity of bottom fauna. Centres with rich fauna were T. Narasipur (3524 units/m^2), Talakadu (5526 u/m^2) in the upper stretch and Mettur (7283 u/m^2), Bhavani (2370 u/m^2), Kumbakonam-Coleroon (5635 u/m^2) and Kollidam (12146 u/m^2) in the lower stretch. No sampling was done in the upper stretch during pre-monsoon due to floods.

Bottom fauna was characterised by poor diversity with only molluscs occurring throughout the river course. Chironomid larvae recorded from Mekedatu and Bhavani may be due to stagnant conditions prevailing there. Gastropods formed the major segment of molluscan population and occurred at most of the centres. Common molluscs encountered were *Thiara scabra, T. tuberculata, Brotia costula, Lymnaea* (Gastropods), *Corbicula striatella, Parreysia corrugate* (bivalve).

Aquatic macrophytes

Macrophytes play an important role in the ecological functioning of the aquatic ecosystems. They are the ecological dominants which determine the available energy, whereas the heterotrophs affect the turnover and cycling of matter in an ecosystem. The energy captured by the green plants and stored within chemical substances constituting the plant body is a driving force for essentially all processes in the ecosystems. Mainly three types of aquatic weeds viz., floating, submerged and emergent weeds were observed in the river. Dominant floating weeds were *Azolla pennata, Lemna minor* and *Eichhornia crassipes*. Submerged weeds were *Hydrilla verticillata, Cerratophyllum demersum* and *Nazas indica*. Emergent weeds such as *Potamogeton crispus, Potamogeton indicus* and *Ipomea aquatica* were recorded in good quantity mainly from marginal areas of most of the sampling centres where water stagnated and thus nutrient availability was more.

FISH AND FISHERY OF KARNATAKA STRETCH

Post-monsoon and summer are the periods of peak fishing activity in main river. In the head waters of reservoirs of K.R.Sagar and Stanley (Mettur), heavy fishing is conducted during the period of first floods of South-West monsoon when the fishes ascend upstream from the main river. No full-time fishermen are resident on the river course in the upper stretch up to Ramanathpuram. The areas declared as sanctuaries along the course are Ramanathapuram, Muttothi, Mekedatu and Alambodi to Karnamali. Some portions of the river have been leased to co-operative societies.

The fishery is constituted by indigenous fishes, Gangetic major carps and exotics like Tilapia (*O. mossambicus)* and Common carp *(C. carpio).* Silver carp *(H. molitrix)* and Grass carp *(C. idellus)* occur in stray numbers occasionally in the catches. Of these, Tilapia is well established throughout the course from Bhagamandala to the various distributaries of Cauvery. Fry and fingerlings of Tilapia (12-50 mm) occurred throughout the upper and lower stretches. Tilapia contributes significantly to the commercial fishery in K.R.Sagar and other

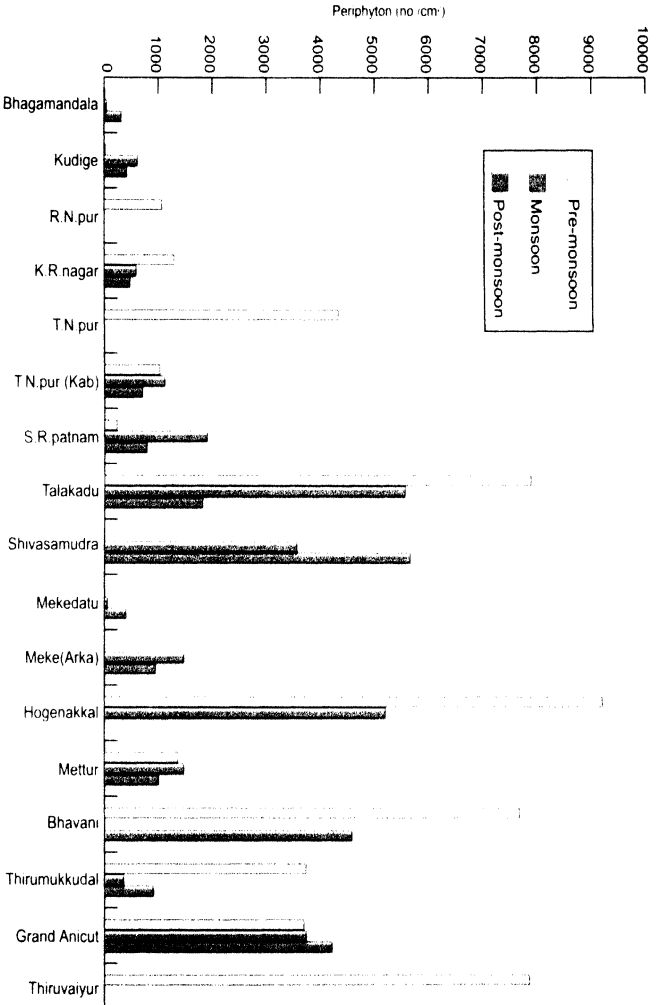


Fig. 3 : Periphyton abundance of river Cauvery

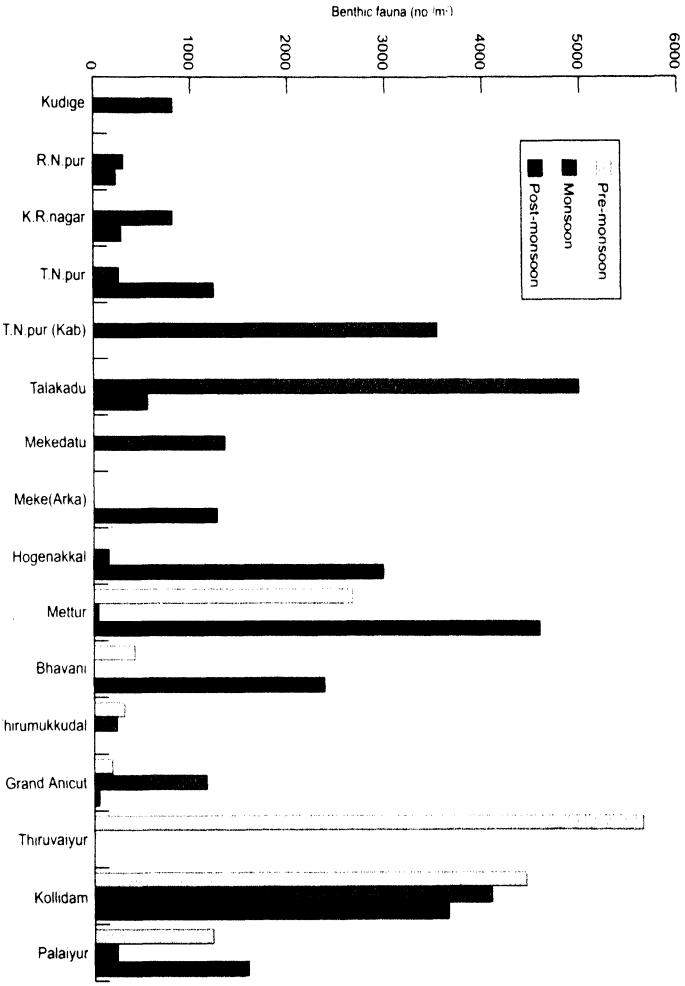
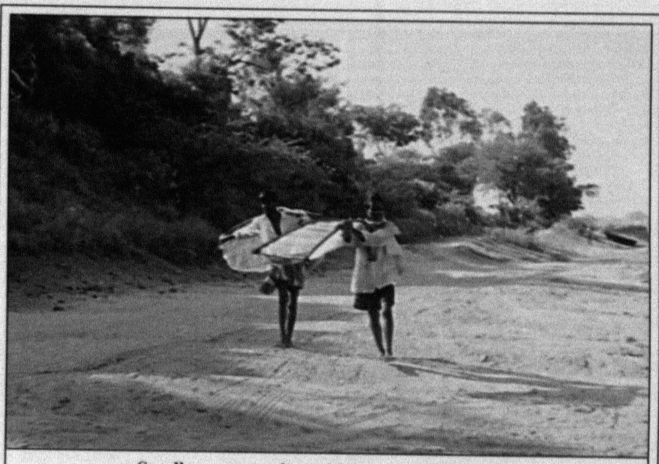
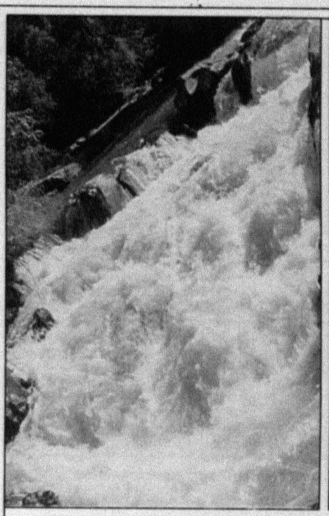


Fig. 4 : Benthic fauna of river Cauvery

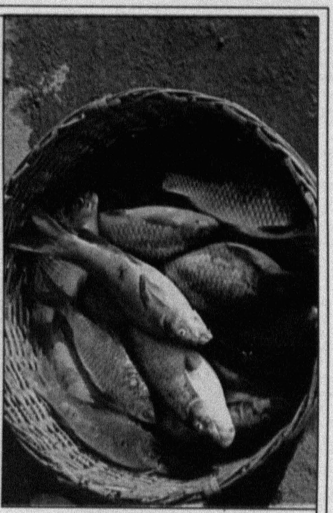


Small prawn catcher with nets at T. Narasipur

Small prawns caught from Cauvery at T. Narasipur

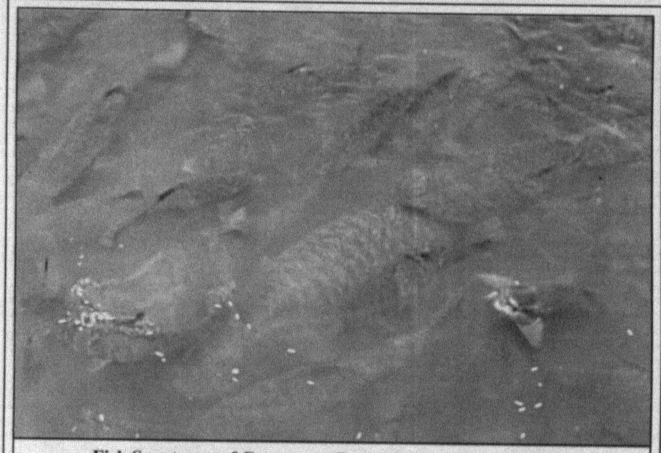


Hogenakkal falls of Cauvery,
Tamil Nadu

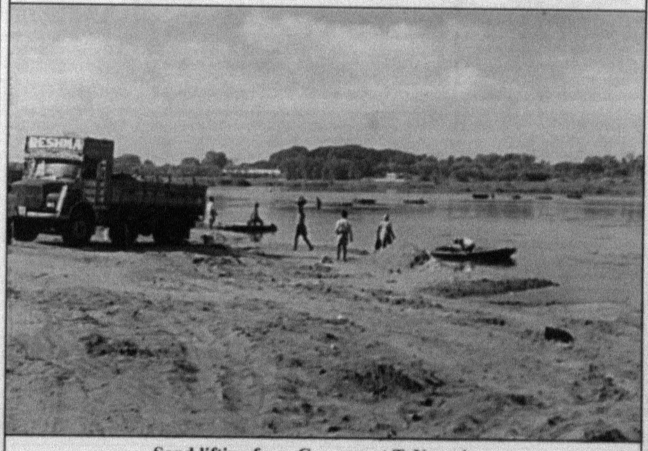


A haul of fish from Cauvery
at Hogenakkal

Women folk engaged at Hogenakkal fish Market



Fish Sanctuary of Cauvery at Ramanathpuram, Karnataka



Sand lifting from Cauvery at T. Narasipur

Migratory Tamil fishers with Marivele (Dragnet) at Hosur Kalahalli

Tilapia catch from Hosur Kalahalli, lotic of KRS reservoir

reservoirs across the tributaries. The stocking of Gangetic major carps and Tilapia in reservoirs of Cauvery and its tributaries has improved the fishery of these fishes in the water bodies. But it had its adverse effect on the native species.

The important fish landing centres in upper stretch are K.R.Nagar, T. Narasipur, Talakadu and Hogenakkal. Among these, Hogenakkal is the most important centre with highest landings and the fishery is influenced by the Stanley reservoir whose lotic zone extends up to Hogenakkal. Indigenous fishes such as *L. ariza, P. kontius, L. calbasu, P. carnaticus, P. sarana, G. nukta* and *P. dubius* form a significant proportion (up to 40%) of the landings. Large catfishes like *W. attu* and *M. aor,* which are rare in the upstream, regularly appear in the catches here. The daily landings here has been around 100 kg and the estimated fish yield works out to 10 kg/km. Major carps made significant contributions at Muduthere near Talakadu. The fish catch composition was represented significantly by major carps (32.3%). Among major carps, rohu formed the major share (23.29%) followed by calbasu (8.6%), mrigal (4.64%) and catla (0.77%). The medium carps contributed 9.06% to the catches (sarana : 3.88%, carnaticus : 2.24%, reba : 2.05%, nukta : 0.77% and thomassi : 0.12%). Common carp alone contributed 26.69% to the total catches. Thus, major carps together with common carp formed more than 50% of the total landings. Catfishes (*O. bimaculatus, M. punctatus* and *M. cavasius*) were of minor importance (2.86%). It is disturbing to note that tilapia formed 6.89% and the size range was not encouraging with a mode around 15 cm. The estimated fish yield was around 4.0 kg/km stretch of river and the CPUE was around 0.5 kg. Dynamiting was rampant in this stretch and it affected the brood fish (carps, catfishes and prawns), juveniles, fish food organisms ,etc.

Fish catch of deep pool at Muduthere near Talakadu depicted dominance of large size major carps (catla up to 75 cm / 12.5 kg, rohu up to 82 cm / 6.5 kg and calbasu up to 68 cm /4 kg) indicating that large fishes take shelter in deep pools and that the fishing is different compared to shallow river stretch.

In other centres like T. Narasipur and K.R.Nagar, the major carps and medium carps represented in sizeable quantities in the catches. The size range (weight) of important fishes recorded in the catches are given below :

Fish Species	Weight range (kg)
Catla catla	1.5 - 20.0
Labeo rohita	0.3 - 9.0
Cirrhinus mrigala	2.0 - 4.0
Cyprinus carpio	0.3 - 12.0
Cirrhinus reba	0.3 - 0.5
Labeo calbasu	0.5 - 2.5
Puncttus nukta	0.3 - 0.5
Puncttus carnaticus	0.1 - 0.2
Oreochromis mossambicus	0.2 - 0.5
Puncttus kontius	0.5 - 1.5

Crafts

There are no fishing crafts in the mountainous stretch between origin and Kudige where river Harangi joins the main course as there is no regular fishing activity and no settlement of fishermen populations. Down stream of Kudige, all along Cauvery, coracle locally called ***Harigolu*** is the most important craft used for fishing. Apart from fishing, harigolu is also used for transportation. Most of the fishermen own coracles while a few share the coracles owned by others. A special fishermen community called *Burude Bestharu* who are too poor to own coracles used dried ash gourd for keeping themselves afloat and to operate the gill nets called *belachi bale* to catch weed fishes.

Gears

The most important gear used for fishing is gill net. Other gears used are drag net, cast net, hook and line, etc. Plastic cans, thermocole pieces and dry wood are used as floats.

Gill nets

Gill nets of various sizes (2.5 to 25 cm mesh size) are employed for fishing. Nylon has been replaced by monofilament polyethelene as material for gill nets and such nets are referred to as *disco nets* by the fishermen. Though these nets are more efficient than nylon gill nets, they cannot be repaired by mending the damaged portion. Gill nets of small mesh size (10 to 15 mm), length 20-25 m and width 0.75 m locally called *Belachi Bale* are used to catch *Salmostoma* and other weed fishes. Nets with larger mesh sizes which are locally called *Bidu Bale* are operated to catch large fishes including major carps.

Drag net

Yela bale or *Goru bale* are the locally called drag nets. While *Yelabale* has bigger mesh size (20 to 30 mm) and the fishes caught are common carp, catfishes, minor carps and murrels, *Gorubale* has small mesh size (10 to 20 mm) and the fishes caught are weed fishes. The length of these nets vary from 12 to 20 m with 3-4 m height. Commercial catches are very less in the main river using these gears. However, large drag nets called *Maribale* (400 m length, 4 m height and 1 cm mesh size) are operated in Krishnarajasagar (KRS) dam during summer. The riverine fishermen in the upstream of KRS strongly feel that the introduction of *maribale* has drastically affected riverine catches.

Cast net

Beesu bale is the local name for cast net. They are operated in the shallow areas of rivers. The material used is nylon. There are two types of cast nets. One with small mesh size of 2.5 cm used for catching small fishes such as minor carps, minnows and weed fishes and the other is of 5 cm mesh size used for catching minor and medium carps. These nets are popular in the riverine stretch especially below the dams.

Hook and line

Hook and Line fishing with long lines are prevalent in the lotic sector of KRS as well as in stretches like S.R.Patnam. The baits used are earthworms, weed fishes, ragi balls, etc. The catch consists of catfishes, murrels, minor carps, etc.

Rod and line

This gear is locally known as *Chadi gala*. This gear has a long pole to the end of which is tied a nylon thread with hook. Baits used are similar to that of hook and line. Using this gear, catfishes, gobies, murrels, etc. are caught.

Traps

Kuli and *Kodame* are the two types of local traps used. *Kuli* traps use split bamboo and *Kodame* traps use split coconut stems. *Kuli* is operated manually in very shallow waters by observing the movement of fish. Mainly murrels and cat fishes are caught and rarely carps. *Kodame* is used in small creeks and bays, where there are narrow/restricted passages, against the water movement. Once the fish enters the *Kodame*, they cannot come out or escape. Only small fish are caught using *kodame*. This trap is used mainly to catch weed fishes.

Socio - economic status of fishers in the Karnataka stretch

A study of socio-economic status of the fishermen communities inhabiting the upper stretch of river Cauvery was made (Table 5). Several communities, such as Besta (OBC), Nayaka (ST) and Upper Ranga (OBC) were involved in fishing in this stretch of the river.

The average age of fisherman (head of family) was 33 years and the average family size was 4.41. The literacy rate was very low and only in a couple of fisherman families (out of 33 families sampled), children were attending school. As regards to housing, only about 12% of fishermen had *pucca* house, about 76% *kutcha* house and the remaining (12%) had no dwelling place of their own. Majority of the fishermen (76%) had their own coracles and reared birds in their household. In 40% of the fishermen families, cow and/or goat were being reared along with birds.

Gill net (nylon and disconet) was the dominant gear among the fishermen. Besides, cast nets and traps (made of bamboo) were also used. During the peak fishing season (November to March), each fisherman was getting about 15-20 kg of fish per day which fetched them Rs. 15-30/kg. Fish catches were moderate (5-10 kg/day) during September-October and was low (1-2 kg/day) during July-August.

Table 5. Socio-economic status of fishers of Karnataka stretch of Cauvery river

Characteristics	
No. of families sampled	33
Average age of head of family	33 years
Average family size	4.41
Sex ratio (Male : Female)	1: 0.86
Literacy level	Very low
Housing	
Pucca	12 %
Katcha	76 %
Others	12 %
Craft	
With craft	76 %
Without craft	24 %
Gear	
Gill nets (Nylon)	Almost all
Cast nets & Traps (made of bamboo)	Very few
Fishing seasons	
Peak (November to March)	15 - 20 kg of fish / day @ Rs. 15 - 30 / kg
Normal (September to October)	5 -10 kg / day
Lean (July to August)	1 - 2 kg / day
Castes	
Besta (OBC)	27 %
Nayaka (ST)	18 %
Uppar Ranga (OBC)	48 %
Others	7 %
Rearing of birds and animals	
Birds	76 % of the families
Cows / Goats	40 % of the families

FISH AND FISHERY OF TAMIL NADU STRETCH

Fishing system

Licensing system exists in certain length of the Tamil Nadu stretch of the Cauvery river. In the downstream of Mettur dam, an annual license fee of Rs. 1000/- per unit is collected by the Department of Fisheries. Whereas, there are other stretches where fishing is allowed free of license fee. A private party has been claiming that they have taken the fishing rights of five km upstream and five km down stream of Grand Anicut on lease basis from the Department of Fisheries and has been fishing intensively employing fishermen as per their choice. Most of the full-time fishermen are members of Inland Fisherman Cooperative Societies. Fishing activities are in its low ebb when the flow of water in the river was high and swift, and vice versa when the flow is reduced or stopped from Mettur dam. The crafts

and gears used by the fishermen in Tamil Nadu stretch of Cauvery vary according to the local conditions prevailing therein.

Crafts

Coracle: Locally called ***Parusel*** or ***Parusu*** is the most commonly used craft almost in the entire stretch of the river except estuarine region especially by the full-time fishermen for fishing operations as well as for transporting men and material across the rivers and reservoirs. The size of the coracle varies according to the use to which it is subjected. A smaller coracle with diameter of 6 to 9 feet is used exclusively for fishing, whereas, a larger one with diameter ranging from 10 to 12 feet is used for transport purpose.

Dugout canoes : In the estuarine regions at Poombukar and Palaiyar, dugout canoes are popularly used craft for both fishing and transport purpose. Either a long bamboo pole or a oar is used for moving the craft.

Boat made up of Catamarans : Boat made up of 3 to 5 logs of wood with or without outboard engine is used in the estuarine region for fishing and transportation.

Boat made up of wooden planks or synthetic material : They are common in marine sector. These crafts are also used in the estuarine region.

Gears

Cast net (*Veechuvalai*): Different types of cast nets locally called *'Kavuthuvalai', 'Periya Sarattu valai', 'Chinna Sarattuvalai', 'Maruchu valai', 'Aruncha valai' 'Sera valai'* and *Kallu valai* are used for catching fishes of various size groups. These nets vary in radius, design, code number of twines used for fabrication, etc. according to the targeted fish and environmental conditions.

Potha valai: This net is similar to the cast net in design, but it has no sinkers. It is spread in the river, embedded with some quantity of river sediment and the net ropes are attached to a stick in such a way that by pulling the main rope from a distance, the whole net will be lifted trapping the fishes therein inside. To attract the fishes towards the centre of the net, feed balls made out of fried and powdered millets mixed with cow dung are placed at the centre of the net. Observing the movements of the fishes while feeding, the rope of the net is pulled and the fishes are trapped.

Gill nets : *Rangoon valai* and *Udu valai* are the two common types of passive gill nets used in river Cauvery. *Rangoon valai* has more depth and it can be allowed to hang either at the surface or at desired depth by adjusting the length of the rope to which thermocole floats are tied up. Whereas, *Uduvalai* has a depth less than 1 m and it is operated in the shallow areas. The mesh size varies from 35 mm to 105 mm fabricated with nylon twines of code No.0.5 to 2.

Drag nets : *Ari valai* or *Othukku valai* are the two commonly used drag nets in Cauvery river. The mesh size of these nets vary from 25 to 35 mm and the net is normally operated by 5 to 10 persons as a group.

Encircling net : *Thoorimal* is a net of 6 to 10 m long used for encircling the bushes and macrovegetation for catching fishes hiding there. Two persons hold the ends of the net and go round the bush or macrovegetation. Two more persons come from the opposite side and help the first two to bring the net closer and in removing bushes/macrovegetation and in catching the trapped fishes.

Long lines : In a long thick synthetic rope, hooks are attached using a small nylon twine at intervals of 0.75 m. Trash fishes, crabs, shrimps and frogs are used as baits for capturing predatory fishes such as murrels, cat fishes and eels.

Rod and line : Rod and line fishing with hooks and baits is practiced by both professional and non-professional fishers. While a non-professional operates a single rod and line for subsistence and recreation, a professional fishermen operates up to five units at a time for commercial fishing.

Traps at sluice gates : A bamboo frame with a gunny sheet (Thongu valai) is suspended using long coir ropes from the top of the barrage or regulator up to a height above the water level near to the sluice gate(Fig). The fishes jumping against the onrushing current of water landed straight in to the gunny trap. This type of fishing is extensively practiced at Mayanur regulator, Grand Anaicut, Vennaru-Vettaru regulator (V.V.R.), Cauvery-Arasalar Dam (C.A.Dam), Mudikondan-Kodamurutti (M.K.) regulator, Thirumalairaja-Kodamurutti (T. K.) head, Thiruvalangadu regulator and Paminiyar-Vennaru-Koraiyar (P.V.K.) head.

Dynamite fishing : Illegal fishing through use of dynamite is carried out in Tamil Nadu stretch of Cauvery river especially between Bhavani to Trichy, destroying not only adult fish including brooders but also juveniles, yearlings and fish food organisms apart from poisoning the environment inspite of law against the same.

Fisheries

Catch per unit effort (CPUE)

The catch per unit effort in the river during full water level was varying from 1 to 6 kg per day. Whereas, it increased to the range of 10 to 100 kg/day when releasing of water from Mettur dam was either reduced or stopped. A sizeable quantity of fish (50 to 300 kg/day) was caught with a minimum labour of 2 to 3 fishermen through trapping of jumping fishes at the sluice gates in the regulators and anicuts.

Fish catch composition

The fish catch composition in different stretches of the river varied according to the quantum of fish that made downward migration from the near by reservoirs. Over sixteen pucca reservoirs involving engineering skill and hundreds of smaller impoundment in the form of major or minor tanks have been constructed in the Cauvery basin of Tamil Nadu. Extensive culture of carps is regularly done in these water bodies. When water is released from the reservoir for irrigation, a good number of fishes migrated into the river. Thus, the fish catch from the downstream of Mettur dam was dominated by the fishes which escaped from Mettur reservoir. The fish fauna chiefly consisted of carps (*C. mrigala, L. calbasu, L. rohita , P. sarana, P. reba , C. catla , P. dubius* and *P. kontius*) with occasional dominance of

catfishes (*M. aor, M. seenghala, M. vittatus, W. attu* and *Ompok bimaculatus*), exotic fishes (*O. mossambicus* and *C. carpio*). Estuarine fish , *Etroplus suratensis* has well established in this reservoir even attaining the size of 25 cm/515 g. The Bhavani river joins the river Cauvery at Bhavani town. The fish catch in the area consisted of fishes from Bhavanisagar dam along with resident population. In addition to the above mentioned species, *L bata (150 - 350 g)* among carps, *Channa striatus (300 -1200 g)* and *C. marulius* (600-3500 g) among murrels, *Mastacembellus armatus (150 - 650 g), Anguilla sp. (750 -* 4000 g) among eels and *M. malcomsonii(100 -150 g), M. rosenbergii (80- 200 g)* among freshwater prawns were also recorded in the river Cauvery near Bhavani town. Amaravathy river joins Cauvery near Karur town where the fish catch mainly consisted of *L. rohita, C. mrigala, C. catla, O. bimaculatus* and *O. mossambicus*.

Miscellaneous fishes such as *P. filamentosus, Chela sp, Danio sp, Rasbora sp, Esomus sp., Garra sp.*, loaches like *Nemacheilus sp.* occurred almost in the entire stretch of the river Cauvery.

Beyond Kumbakonam and Kollidam, the fish catch was dominated by estuarine and brackish water fishes such as *Liza parsia, Rhinomugil corsula, Anabas testudineus, Anguilla bengalensis, A. bicolor*, etc. *Osteobrama vigorsi, Gerres sp.* and *Arius sp.*

Socio - economic status of fishers of lower stretch

The fishermen who are involved either in full-time or part-time fishing activities live in villages and towns located on both the banks of river Cauvery and it's tributaries. The traditional fishermen belong to several castes such as Padaiyachi Gounder (Vanniyar), Uppiliyar, Chanar, Mooppanar, Kuruchi Sembadavar, Vadamkatti Sembadavar, Kodangi Naicker, Parvatha Rajakula Meenavar and Naicker Sembadavar. Apart from these full time operators, people belonging to a variety of castes such as Vannar (Dobi), Mudaliyar, Thottiya Naicker, Kampeli Naicker, Nechavu Chettiar, Boyar, Vettaikarar, Vettuva Gounder, Valayar (Muthurasakoottam) and Pannadi Pallar also involved in part time fishing.

Majority of the fishermen live in thatched houses (73.5%), the rest in tiled houses (25%) and R.C. buildings (1.5%). Majority of them are illiterates (55%) and others can read and write in mother tongue, Tamil. The earnings of a fisherman during flooded situation ranges from Rs. 20/- to Rs. 90/- per day. Whereas, his income increases during favourable conditions when the release of water from Mettur dam is stopped. Hard working persons earn up to Rs. 1000/- per day. But, such high income is obtained only for a short period of 10 to 20 days. Some of the fishermen family move from one place to other in search of good fishing grounds and stay in temporary huts and lead a nomadic life. The fishermen in Cauvery basin have no assets other than coracles, cast nets, gill nets, etc. The women in fishermen community help their husbands in fishing, repairing the damaged nets, marketing of the fish catches and house-hold work. In majority of the family, the children in their early stages are sent to the local schools for acquiring education but discontinue at primary or middle school level due to many practical difficulties. Hardly, few children from these communities pass

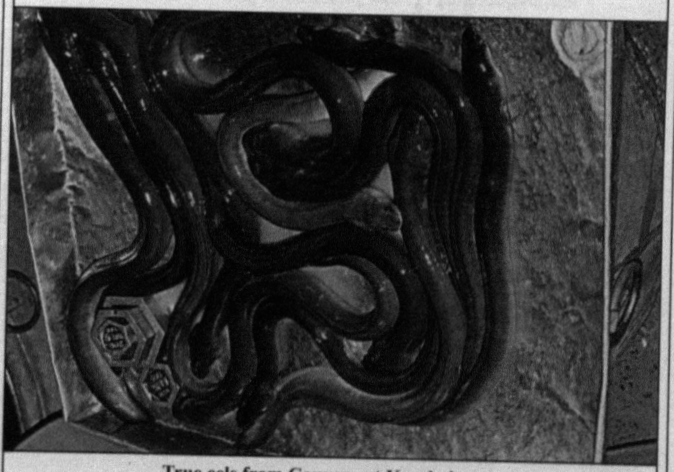
Table 6. Heavy metals (mg/kg) in sediment of river Cauvery (Range)

Location	Zn	Cu	Cd	Pb
Bhagamandala	476.22-5596.70	105.88-411.28	ND	10.85-87.99
Kudige	85.34-2149.25	24.58-48.71	ND	79.37-122.12
R.N. puram	608.42-3569.00	101.51-475.52	ND	161.81-387.90
K.R. Nagar	184.97-187.26	18.91-47.63	ND	56.10-80.07
T.Narasipur	79.33-283.96	24.58-74.45	ND-3.08	55.91-68.10
T.N.Pur-Kabini	10.25-83.01	33.26-78.29	ND	41.53-49.25
Muduthere	25.44-91.20	12.18-16.75	ND	28.45-82.95
Mettur	57.86-257.73	15.46-54.74	ND	59.24-91.86
Bhavani	71.73-571.57	22.77-82.35	ND-2.06	20.05-68.30
Thirumukkudal	81.02-746.22	12.74-28.62	ND	66.68-87.45
Upper Anicut	53.71-108-74	14.57-17.91	ND	23.81-95.16
Grand Anicut	43.51-742.08	10.86-30.85	ND	25.73-71.84
Thiruvalyaru	39.28-2030.05	6.22-56.85	ND	64.05-137.40
Kumba-Coleroon	33.22-107.70	7.50-13.79	ND	61.93-74.07
Kollidam	29.40-638.20	7.88-79.34	ND	58.38-98.24
Palaiyar	30.57-508.80	8.03-53.18	ND-1.35	66.27-85.65
Vettar	79.35-724.30	9.75-82.15	ND-24.93	42.58-67.42
Vennar	65.28-546.11	8.98-63.51	ND	35.62-56.17

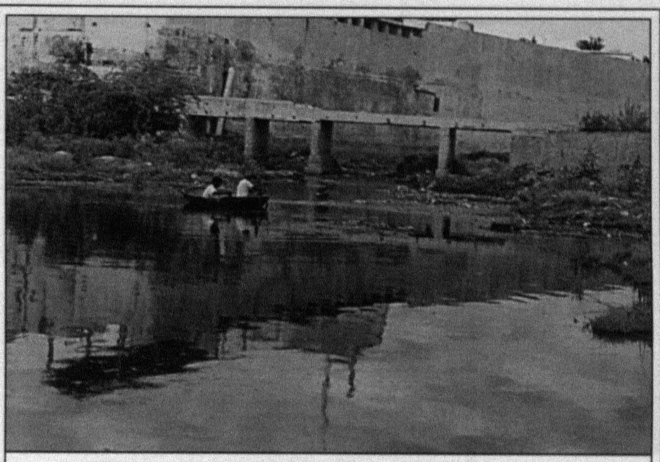
Fish catch from Cauvery at Sivasamudram

A haul of fish at T. Narasipur, Karnataka

Channa striatus catch at Kumbakonam

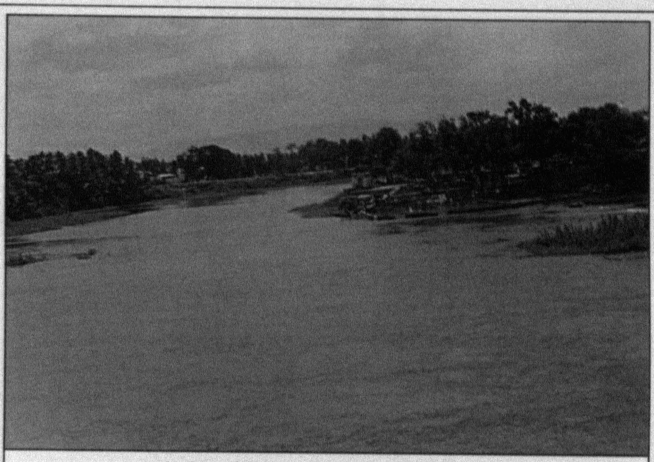


True eels from Cauvery at Kumbakonam



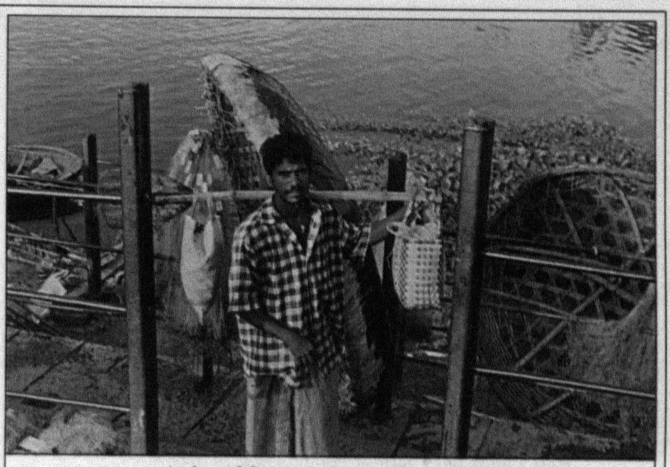
Effluents from dyeing & bleaching units at Komarapalayam

A view of Grand Anicut



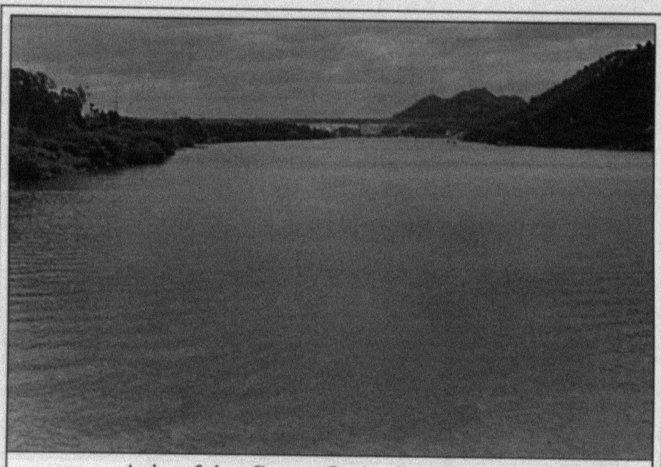
A view of Cauvery river at Bhavani town

Prawns from Cauvery at Bhavani



A view of Cauvery river at Bhavani town

Prawns from Cauvery at Bhavani

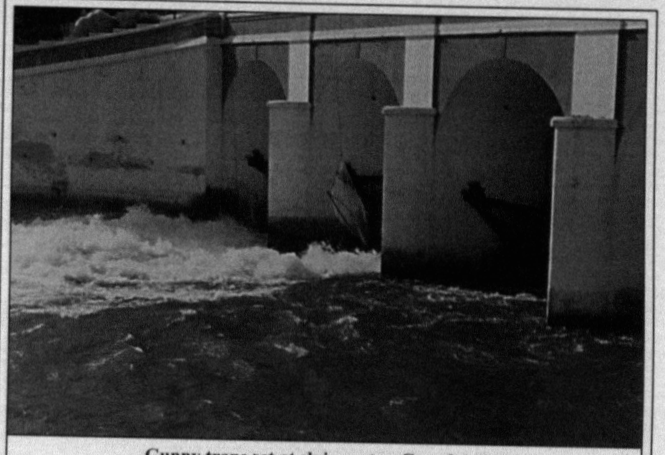


A view of river Cauvery flowing from Mettur Dam

A haul of fish at Mettur

Commercial fish catch from Cauvery at Mettur

Assorted cat fish at Mettur



Gunny traps set at sluice gates, Grand Anicut

Carps trapped at sluice gates, Grand Anicut

Table 7. Heavy metals (µg/l) in the water of river Cauvery (Range)

Location	Zn	Cu	Cd	Pb
Bhagamandala	22-177	ND-4	ND	ND-103
Bhaga-Kaanige	24-34	ND-4	ND-2	ND-8
Kudige	12-20	ND-4	ND	ND
R.N. puram	6-116	ND-203	ND	ND-126
K.R. Nagar	ND-99	ND-21	ND	ND-209
S.R. Patnam	3-151	ND-21	ND	ND-111
T.Narasipur	6-220	ND-28	ND	ND-87
T.N.P.-Kabini	ND-15	ND-4	ND	ND-25
Muduthere	8-66	ND-4	ND	ND-20
Talakadu	1-4	ND-5	ND	ND-32
Mekedatu	6-30	ND-5	ND	ND-24
Meke-Arkavathy	7-21	ND-7	ND-1	ND-44
Hogenakkal	ND-9	ND-8	ND	ND-60
Mettur	18-134	ND-28	ND-1	ND-39
Mettur effluent	77-110	ND-9	ND-2	ND-52
Bhavani	18-85	ND-6	ND	ND-25
Bhavani effluent	90-154	ND-35	ND-2	ND-43
Thirumakkudal	29-132	ND-7	ND	ND-18
Upper Anicut	24-149	ND-7	ND-1	ND-36
Grand Anicut	23-104	ND-8	ND-1	ND-41
Thiruvaiyaru	18-59	ND-3	ND	ND-45
Kumb-Coleroon	15-112	ND-82	ND-1	ND-55
Kollidam	28-156	ND-18	ND-2	ND-68
Palaiyar	70-111	29-74	ND-96	ND-495
G.A. canal	18-32	ND-9	ND-1	ND-33
Vettar	30-96	ND-11	ND-1	ND-34
Vennar	44-79	ND-10	ND-1	ND-48

10th standard and go for higher studies. The school dropouts and the unemployed educated youths join their parents in fishing activities.

Status of Mahseers in main Cauvery river and reservoirs under Cauvery basin

The importance of mahseers as world famous game and food fish is well known. Among the important species of mahseers under the genus *Tor* recorded from India, the species that occur in Cauvery river are *T. khudree* and *T. musullah*. However, there is an opinion that *T. musullah* is an abnormal morph of *T. khudree*. The fish belonging to a different genus *N. hexagonolepis*, popularly referred to as copper or chocolate mahseer, has been recorded in Cauvery river and is also an esteemed game fish. The important sanctuaries on river Cauvery for mahse rs are Ramanathpuram, Ranganathittu bird sanctuary near Mysore, and Muthathi to Mek atu (leased to Wildlife Society, Madikeri). The Department of Fisheries, Karnataka has released 1,50,000 advance fry of *T. khudree* in Cauvery river. The data maintained by WASI, CWLS and Bushbetta fishing Camp shows that Mahseers from 4 to 48 kg are regularly caught by international anglers and released back into the river after recording their size. However, mahseers and other carps are being caught illegally by dynamiting in the areas reserved as sanctuaries.

Overall, mahseers form less than 1% of the commercial fishery of main Cauvery as well as of reservoirs in Cauvery basin. Since adequate information is not available, among the threatened fishes, *T. khudree* has been categorised as 'Indeterminate'. There is need for detailed studies on the biology and fishery of mahseers in Cauvery system

POLLUTION SCENARIO

Urbanization and industrialization at quicker pace coupled with very poor environment management in the catchment make the river course vulnerable to eco-degradation. Barring Arkavathy and a few, the pollution load brought by the tributaries to the main river, is insignificant. No big industry is located in the upper stretch of river Cauvery. Whereas, direct discharge of industrial, municipal and agricultural wastes is emphatically much more in the lower stretch of river Cauvery. Important sources of pollution are: Chemplast Samaran Project I, II & III., Madras Aluminium Company (MALCO), Mettur Thermal Power Station, Mettur Chemical and Industrial Corporation Ltd., South India Viscose Limited, Sirumugai, Mettupalayam, Textile mills, dyeing & bleaching units at Komarapalayam, Dyeing & bleaching units (> 800 nos.) in & around Tirupur, Tamil Nadu News and Paper Limited , Pugalur, Karur, Seshasayee Papers and Boards Limited, Erode, Distillery factory, Ariyankulam, Trichi, Sugar factories at Appakudal and Andakudi, Domestic and commercial waste waters from villages and cities, Pesticides from agricultural lands.

The extent of pollution is normally governed by biological oxygen demand (BOD), chemical oxygen demand (COD) as well as concentration of heavy metals in different matrices. The mean BOD values (mg/l) fluctuated between 0.2 to 1.8 (barring Arkavathy at Mekedatu Sangam) and 0.5 to 2.8 in upstream and downstream respectively, while the corresponding mean COD values were in the range of 4.5 to 28.0 and 20.5 to 38.0 respectively. In Arkavathy at Mekedatu Sangam, BOD was in the range 3.0 to 4.6 while COD was registered at 28.0 to 63.5 year round.

Table 8 (a). Heavy metals (mg/kg) in fishes of river Cauvery (Monsoon & Post-monsoon, 1999)

Location	Fish sp.	Samples	Zn	Cu	Cd	Pb
K.R.Nagar	*C. reba*	Tissue	8.71	1.30	ND	ND
		Gill	10.36	3.58	ND	ND
	G. giuris	Tissue	12.20	5.37	ND	ND
		Gill	31.32	8.93	ND	ND
	O. bimaculatus	Tissue	5.67	1.34	ND	ND
		Gill	8.36	2.82	ND	ND
T.Narasipur	*O. bimaculatus*	Tissue	4.87	2.18	ND	ND
		Gill	6.39	3.51	ND	ND
	M. cavasius	Tissue	5.94	3.97	ND	ND
		Gill	8.81	6.12	ND	ND
Hogenakkal	*L. calbasu*	Tissue	6.23	1.02	ND	ND
		Gill	9.72	2.12	ND	ND
	T. khudree	Tissue	7.24	1.54	ND	ND
		Gill	10.38	3.82	ND	ND
	P. carnaticus	Tissue	12.85	3.85	ND	ND
		Gill	18.78	4.62	ND	ND
	L. aryza	Tissue	14.62	5.68	ND	ND
		Gill	31.81	8.12	ND	ND
Mettur	*E. suratensis*	Tissue	16.14	4.18	ND	ND
		Gill	19.63	7.79	ND	ND
	L. calbasu	Tissue	30.16	8.92	ND	ND
		Gill	48.92	11.72*	ND	ND
Bhavani	*P. sarana*	Tissue	28.76	8.36	ND	ND
		Gill	45.11	9.98	ND	ND
	C. catla	Tissue	10.12	3.12	ND	ND
		Gill	13.46	5.42	ND	ND
Mayanoor	*L. calbasu*	Tissue	35.67	8.88	ND	ND
		Gill	39.85	11.27*	ND	ND
Thiruvaiyaru	*C. mrigala*	Tissue	25.42	6.67	ND	ND
		Gill	38.36	8.98	ND	ND
Kollidam	*C. catla*	Tissue	10.39	2.34	ND	ND
		Gill	12.56	3.59	ND	ND

Table 8 (b). Heavy metals (mg/kg) in various fishes of river Cauvery (Pre-monsoon, 2000)

Location	Fish sp.	Samples	Zn	Cu	Cd	Pb
K.R.Nagar	*M. punctatus*	Tissue	26.04	2.47	ND	5.65*
		Gill	27.69	2.12	ND	4.72
	G. giuris	Tissue	17.10	12.24*	ND	1.68
		Gill	43.93	16.68*	ND	2.02
T.Narasipur	*L. nukta*	Tissue	51.60*	4.80	ND	6.10*
		Gill	75.27*	8.82	ND	8.82*
	P. kolas	Tissue	56.01*	4.67	ND	5.50*
		Gill	65.86*	15.49*	ND	7.52*
Muduthere	*O. marulius*	Tissue	54.18*	1.46	ND	2.86
		Gill	70.72*	2.74	ND	6.77*
	L. gonius	Tissue	38.23	3.76	ND	1.02
		Gill	37.63	8.15	ND	2.54
Bhavani	*L. calbasu*	Tissue	11.85	1.15	ND	4.95
		Gill	26.90	1.21	ND	8.34*
	P. sarana	Tissue	12.67	6.36	ND	4.34
		Gill	16.39	9.74	ND	4.79
	M. aor	Tissue	18.96	3.21	ND	3.65
		Gill	29.30	6.85	ND	4.30
Mayanoor	*Karamba sp.*	Tissue	17.71	6.82	ND	ND
		Gill	39.62	8.01	ND	ND
	L. rohita	Tissue	22.77	3.84	ND	ND
		Gill	29.39	9.31	ND	7.20*
	C. mrigala	Tissue	18.14	4.58	ND	3.65
		Gill	47.95	7.98	ND	4.15
	V. armatus	Tissue	36.78	3.63	ND	4.30
		Gill	70.59*	3.85	ND	5.30*

* Maximum permissible limit (mg/kg) in fish samples (FAO)
Zn : 50, Cu : 10, Cd : 2-3, Pb : 5 (INDIA)

Heavy metal pollution was not alarming, but causes concern as revealed from the data (Table 6 & 7). In sediment, beneficial trace elements like Zn and Cu were encountered at higher levels in the range 10.25 - 2596.70 and 6.22 - 475.52 mg/kg respectively. Higher levels of Zn and Cu were noticed during pre-monsoon months. Among toxic metals, Cd was found mostly below detectable level barring Vettaru (24.93 mg/kg) and Pb was in the range of 20.05 to 387.90 mg/kg in the entire river course.

Higher concentration of heavy metals in sediment was not reflected in ambient water (Table 7) and more concentration was also noticed in pre-monsoon season. Zn content fluctuated between trace and 220 µg/l while Cu and Pb were mostly below detectable levels but Pb content ranged between trace and 209 µg/l (barring Palaiyar at 495 µg/l in pre-monsoon).

In fishes, a substantial increase in concentration (mg/kg) of heavy metals was observed in pre-monsoon samples as compared to their post-monsoon or monsoon counterparts (Table 8 a & b). Bio-accumulation of heavy metals was generally more in gills rather than in fish flesh generally. Presence of Zn was predominant followed by Cu. Cd was not detected in fish samples. Pb was found as high as 8.34 in gills during pre-monsoon but not detected either in monsoon or post-monsoon months. Though, the concentration of heavy metals in fishes was within the permissible limit prescribed by FAO, it is a matter of concern that the values in certain cases are reaching the upper limit.

Mortality of fish was reported at Mathankuttai area in Mettur, Komarapalayam stretch near Bhavani town and Thirumukkudal near Karur especially when there was no flow of water for dilution and self purification during summer probably due to the combined effect of heat and pollution.

EXECUTIVE SUMMARY

River Cauvery, the third largest river in peninsular India, takes its origin in the Brahmagiri hills of Western ghats at an elevation of 1355 m (MSL) in Coorg district of Karnataka. It traverses about 850 km draining an area of 89,600 km^2 enroute before joining the Bay of Bengal. The river course can be broadly divided into 1) Mountainous zone - from the origin up to Sivasamudram, 2) Plateau zone - from Sivasamudram up to Hogenakkal and 3) the plain zone - from Hogenakkal to its confluence in Bay of Bengal. The mountainous and plateau zones lie in Karnataka state and the plain zone in Tamil Nadu.

The important tributaries joining the Cauvery river in the Upper stretch in Karnataka state are Harangi, Hemavathi, Lakshmanatirtha, Kabini, Shimsha and Arkavathi. Except Shimsha and Arkavathi, all the tributaries rise in Western Ghats characterized by dense forest and high rainfall. Important tributaries in Tamil Nadu stretch are Bhavani and Amaravathy. The dam at Mettur is the first barrier across the river in this stretch. Other barriers are the Upper anicut at Mookumbai and the Grand anicut near Trichy town. At Grand anicut, Cauvery splits into northern distributary the Coleroon and the main Cauvery which further splits into several branches forming the fertile Cauvery delta. The river in Tamil Nadu stretch has been much utilized for irrigation and very little water goes into the sea.

Sand dominates the sediment of the entire river course. Organic carbon is significantly high in upper stretch than downstream. Nutrients are also in higher concentration in the lower stretch due to intense agricultural activities in this zone.

Water charateristics generally reflect soil condition. pH was in near neutral to alkaline range and the alkalinity (mg/l) varied between 51 and 247 barring Bhagamandala (23-29). Conductivity, hardness, Ca, and Mg showed similar trend as that of alkalinity. Nutrient content was high in the downstream.

Lower stretch showed higher primary production levels due to stagnant water conditions created by weirs and anicuts. Plankton in general is poor except at weirs and anicuts. Phytoplankton is overwhelming. Green algae occurred predominantly throughout the river course indicating the freshness of the environment. Molluscs dominated bottom macrofauna in the entire river course. Periphyton was rich in Talakadu, Bhavani and Grand anicut.

Fishery is exploited mainly by gill nets followed by cast nets, drag nets, encircling nets, long lines, rod & line and traps. Main gear is 'coracle' being used in both the stretches, plank-built or synthetic boats, dugout canoes, catamarans are also used in the downstream especially estuarine region. Fishing intensity increases from upper to lower stretch with maximum intensity in zones near by dams and anicuts.

Major carps such as *L. rohita, L. calbasu, C. mrigala, C. catla* and common carps, indigenous fishes such as *L. ariza, L. boggut, L. bata, L. kontius, C. cirrhosa, C. reba, P. kontis, P. carnaticus, P. sarana, P. dorsalis, P. dubius, G. nakta, R. corsula,* cat fishes *W. attu, A. seenghala, A. aor, M. cavasius, M. punctatus, M. vittatus and O. bimaculatus,* murrels, tilapia and miscellaneous fishes constituted the catch. Barring major carps, indigenous fishes also form a significant proportion of the landings.

The two large reservoirs, the K R Sagar in Karnataka and Mettur Dam in Tamil Nadu remain undeveloped though great potential exists for fisheries development.

There are several fishermen communities. Several non-fishermen groups have also taken up fishing as a part time job in selective stretch of Cauvery river. With the result, the fishery resource is over exploited depleting certain fish stocks. The increase in effort has led to decrease in the catch per unit of effort and the fishermen remained at hand to mouth existence without perceptible change in their economic condition. Their literacy level too remained low as they migrate to different stretches of the river with their families exploring better fishing grounds, depriving their children the benefits of schooling and other childhood activities. The improvement in socio-economic condition of fishing community appears to hold the key for the conservation of fish stocks in river systems.

At present there is no large scale discharge of pollutants in river Cauvery especially in the upstream. The municipal wastes and sewage at Srirangapatnam, T. Narasipur, Hogenakkal, Karur, Thiruvaiyaru and Trichy, untreated and occasionally treated effluents from chemical factories, paper & sugar mills, bleaching & dyeing industries at the down stretch are the major pollutants discharged. It is good thing that no adverse effect has been observed on the aquatic communities at these points. The concentration of heavy metals in fish flesh has not reached alarming level and it is within the permissible level as prescribed by FAO. It is advisable to take conservation measures from now onwards so that the system is kept clean for a sustained future use.

The rapid increase in the human population during the last few decades and the all round developmental activities such as intensive agriculture, construction of irrigation network, shelters for dwelling, industries, etc. in the catchment area coupled with destruction of forest has been slowly affecting the quality and quantity of water in the rivers. While the demand for water is increasing, the availability of riverine resources per capita is fast declining. The anthropogenic activity like deforestation has led to reduction of rainfall but the chances of erosion of topsoil and silt load into the river has been increased. The increased abstraction of water through construction of dams, barrages, regulators, weirs, check dams has brought a lot of changes in the environment and the biodiversity. Thus, most of the problems pertaining to the riverine environment originate in the catchment. Better understanding of the environment and effective management of their catchment areas with a sense of eco-friendly approach in all the developmental activities will help to reduce the damage. The discharge of huge quantity of untreated effluents from industries and municipalities has resulted in deterioration of water quality in the river. Therefore, the effluent must be treated at source before it is let out, avoiding direct discharge of untreated effluents into the river system.

The children belonging to fishermen community are forced to enter into fishing activities because of their low level of educational qualification and non-availability of employment opportunities in other professions. The increased fishing effort in the rivers and reservoirs over the years coupled with improvement in the fishing gears has resulted in over fishing in the entire river stretch and the CPUE has declined drastically. Therefore, there is a need for regulating the fishing effort. Indiscriminate fishing of all size groups of fishes through intensive fishing methods has affected the population structure itself. Majority of the fishes are caught even before they attain maturity, denying an opportunity to spawn at least once in their life span. Even the brood fish that migrates towards suitable breeding grounds are also captured during the breeding season. Further, the fry and fingerlings get recruited due to spawning by a few fortunate commercial fishes are also trapped by making use of the upstream migration at sluice gates in the irrigation regulators.

RECOMMENDATION

- Dynamite fishing has been banned and declared as punishable offence. Still, certain outlaws use dynamites for scaring and killing the fish. The law is not properly implemented. The punishment for the offence is not sufficient. The punishment must be severe and the law must be enforced strictly so that no one dares to commit the offence.

- In addition to large size major carps, a number of endemic species such as *P. carnaticus, P. dubius, L. fimbriatus,* etc. take shelter in deep pools at Talakadu and Mekedatu. Since they would serve as brood stock, certain regulations in exploitation of these fishes from the deep pools must be imposed to conserve a few fishes in each species so that they would migrate to suitable breeding grounds and spawn during their breeding season under inundated flood condition.

- Observation of closing season for fishing must be strictly followed to avoid capture of brood fish at least during the peak breeding season commencing from July to September so that spawning and recruitment take place to have a sustained fishery.

- Operation of large drag nets (Alivi net) in K.R. Sagar and Mettur dam during low water level in the summer season helps for capturing small fish including minor carps and weed carps which compete with cultivated carps for food and shelter. But this net brings young ones of cultivated carps also, damaging the future fishery of economical varieties. Hence, the drag net operators must be educated to segregate the seed of cultivated carps and release them back into the reservoir for further growth and yield.

- The discharge of untreated effluents from innumerable industries, thermal power plants, sugar and paper mills, bleaching and dyeing units, municipalities, etc. into the river stretch especially the lower stretch right from Mettur to Grand Anaicut damages the river system itself. Deterioration of water and soil qualities due to contamination has adversely affected the fish and fisheries of the ecosystem. Accumulation of heavy metals in the gills, tissues and other organs of fish suggest that the flow in the river is insufficient for dilution of pollutants and self-purification and that mitigation measures are essential to prevent further damage to the aquatic system. To prevent health hazards due to contamination of the river system, industries and municipalities should be strictly instructed to treat the effluents to safer levels before their disposal.

- The fishermen cooperative societies should be formed wherever it is not existing and the existing ones should be strengthened so that the benefits of welfare schemes of the Government and financial institutions reach them without hurdles. The fishermen should be helped to borrow loans through banking sector at reasonable rate of interest for purchase of crafts and gears, consumer goods and other domestic items so that private moneylenders at high rate of interest do not trap them. Similarly, the fishermen cooperative society should purchase the fish catch from the fishermen at a reasonable rate and market the commodity at profitable rate so that the society as well as the member fishermen get benefit, avoiding exploitation by the private money lenders and merchants.

- The existing sanctuaries at Ramanathpuram and Mekedatu must be rejuvenated, protecting fishes which are threatened by over exploitation or illegal fishing

- Excavation of sand for desilting the river bed of Cauvery especially from down to Srirangampatnam up to Talakadu, Bhavani to Grand Anicut in the main river and from Grand Anaicut to Kollidam in Coleroon river is being done regularly. It is a boon to the river as well as fishery in Karnataka stretch, during summer where fishermen are being engaged to desilt the bed thus enabling the river to maintain its normal flow and depth there by sustaining the biological activities of fishes also. On the contrary, excavation of large quantity of sand from the river bed of Tamil Nadu stretch of Cauvery is damaging the feeding as well as breeding grounds of economically important fishes. Hence, removal of sand from the river bed must be prevented by enforcing the law.

Being a rapid survey, the data generated during this study gives only a rough idea about the present status of ecology and fisheries of river Cauvery. However, detailed investigations on all the aspects of hydrology, biology and production dynamics and the changes that have occurred due to other developmental activities must be carried out in depth for at least three years to arrive at logical conclusions.