ECOLOGY OF SEDIMENTS IN A POLLUTED TROPICAL CANAL IN KERALA, INDIA

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ЭКОЛОГИЯ ОСАДКОВ ЗАГРЯЗНЕННЫХ ТРОПИЧЕСКИХ КАНАЛОВ ШТАТА КЕРАЛА, ИНДИЯ

Паравур и Эдава-Надаяра – самые большие водохранилища штата Керала, Индия. Канал Паравур длиной 2,45 км соединяет эти два водохранилища. Основная цель данной стати – представить данные об уровне pH, органического углерода и питательных веществ в водах Паравурского канала за период с января по июнь 1999 г., а также о влиянии этих показателей на качество воды. Органический углерод, pH, суммарные азот, фосфор и калий – это основные факторы, которые принимались во внимание. Данное исследование показало, что вымачивание тканей и прочие антропогенные воздействия повлияли на наличие питательных веществ в донных отложениях канала.

Ключевые слова: Паравурский канал, питательные вещества, загрязнение.

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Paravur and Edava-Nadayara backwater are two largest backwater systems in the State of Kerala, India. A canal having a length of 2,45 km, namely Paravur canal, connects these two backwaters. This paper mainly deals with the pH, organic carbon and nutrients status of Paravur canal during the period from January 1999 to June 1999 and their influence on the water quality. Organic carbon, pH, total nitrogen, total phosphorous and potassium were the important parameters analysed. Present study revealed that the retting and other anthropogenic activities in the canal have affected the nutrient status of its bottom sediments.

Keywords: Paravur canal, Nutrients, Pollution.

Sedimentation is a spontaneous natural process and the analysis of sediments has greater attention in the world due to the growing awareness of environmental pollution and its impact on ecosystems. The present study is quite relevant in the context of the ever increasing threat to aquatic ecosystems of tropics from various causes such as industrial effluents, domestic waste, Coconut Husk Retting, etc., and it is intended as a base line study, which would be helpful to plan out programmes of fish culture and better management of any aquatic system in tropics in general.

MATERIAL AND METHODS

The study area, Paravur canal situated in Kollam district of Kerala, India has a length of 2,41 km. It is located between 8°45'–8°50'N Latitude and 76°35'–76°41' E Longitude (Fig. 1). It is a connecting link between the Paravur and the Edava-Nadayara Backwater situated at south of Paravur town. Four sampling stations were selected for monthly inves-

tigation for a period of six months from January 1999 to June 1999. Station I, is situated at Edava-Nadayara Backwater, which is polluted with wastewater from the municipality and the domestic waste flowing from the neighbouring area. The average depth of this region is 194 m. StationII, is near a coir dying factory, from which the waste of dye materials are directly discharged. The average depth of this station is 1,5 m. Station III, is a highly polluted zone due to Coconut Husk retting. It has a depth of 1,84 m and is being used for fish catching as well. Station IV, is near to the bar mouth where the *Ithikkara* River joins the canal. The water here is highly saline in nature and is one of the major areas for fishing.

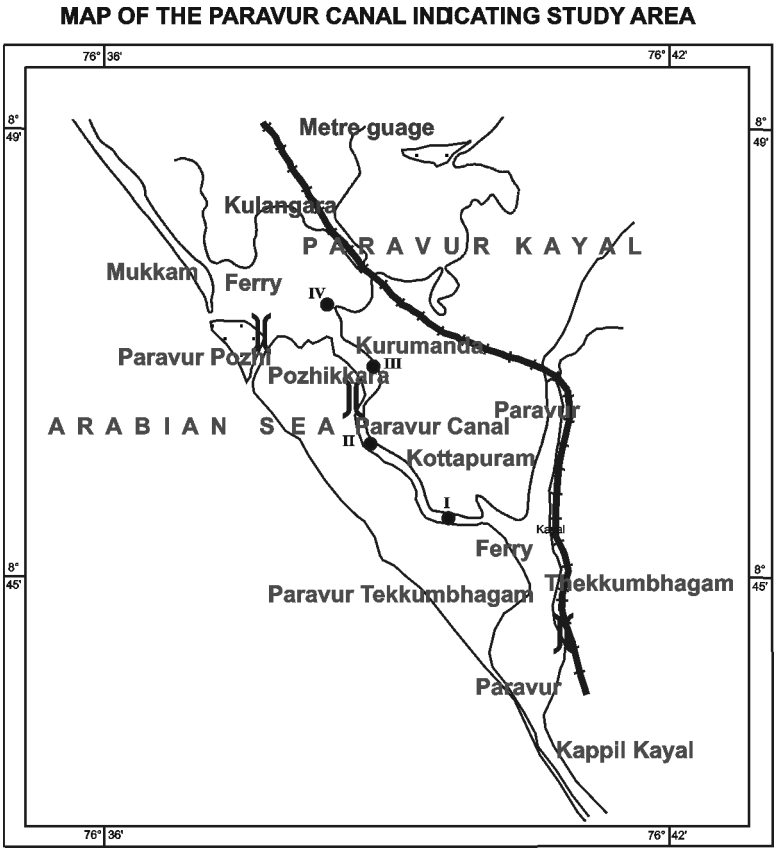

Fig. 1. **Map showing the selected stations from the Paravur canal**

The pH of the sediment samples was noted at the time of collection using portable pH meter. Sediments were scooped up from the sampling locations by using a Van Veen Grab. A part of the sediment samples was oven dried at 100–105 °C overnight and finely powdered. The organic carbon content of the sediments was estimated by the method of EI-Wakeel and Riley (1957). The total nitrogen, total phosphorous of sediments samples were analysed by Khjeldhal digestion method by using $HF–HClO_4–HNO_3$ acid mixture and the potassium were analysed by using flame photometer.

RESULT AND DISCUSSION

As industrialization and urbanisation progressed the aquatic ecosystems become loaded with enormous quantities of nutrients, sediment and toxic materials. For the assessment of the environment quality and protection, monitoring of the materials present in the environment is highly essential. Hydrogen ion concentration of soil depends largely on relative amounts of the absorbed hydrogen and metallic ions. Sediments form a good source for

measure of the chemical content of aquatic systems. Hydrogen ion concentration of sediments samples gets drastically changed due to disposal of industrial waste, acid mine drainage, retting activity etc.

pH of the sediments in the canal varied from 3 (during January) at station III to 6,9 (during June) at station II. Madhukumar and Anirudhan (1995) also noted maximum hydrogen ion concentration (6,9) in Paravur backwater, which is in accordance with the maximum value of pH at station II of the present investigation. Organic carbon content and nutrients in recently deposited sediments of aquatic ecosystem have received much attention in environmental monitoring and management programmes owing to their strong bearing of physical, chemical and biological process operating in this environment. The nutrient economy of aquatic ecosystems is mainly governed by the sediment. Knowledge of the role of sediment nutrient content is especially useful in determining the sediment water interactions which eventually affects the productivity. The organic carbon and the nutrients of sediments in Tropical Backwater environments depends on several factors such as degree of conservation/preservation, rate of sedimentation, contribution from decayed vegetable parts of plants, other anthropogenic activities like retting, livestock management in and around the aquatic system. In the literature we find considerable attempts to estimate the level of variability and the geochemical behaviour of organic carbon in Sediments of aquatic systems (Murty and Veerayya, 1972; Balakrishnan *et al*, 1983; Seratharan *et* al, 1993) and nutrients (Balakrishnan *et al* 1984, 1987; Sankaranarayanan and Panampunnayal, 1979).

The organic carbon content in Paravur canal varies from 0,46 and 7,9 mg/g. The seasonal and monthly distribution of organic carbon in the sediment blanket of the Paravur canal is shown in the table.1 and Fig 2.The organic carbon content in the sediment is mainly derived from primary production within the water body and also from terrigenous runoff. In the present investigation high amount of organic carbon content fluctuated without any order but seasonal average values recorded maximum at station I, II and IV during pre-monsoon. This is in agreement with the values obtained for *Ahstamudi* estuary (Balakrishnan,et al 1983). Sivakumar *et al* (1987) also recorded high values during pre-monsoon season in the velar estuary. However, the samples from the retting area (Station-III) contain maximum concentration of organic carbon, when compared to the other station. The intensive Coconut Husk retting and disposal of coconut pith from the adjacent coir industry influence the organic carbon input to this zone. This organic carbon content may influence the other water quality parameter like dissolved oxygen, hydrogen ion concentration, alkalinity, turbidity, total dissolved solids etc due to the aerobic respiration of micro organism and decaying of husk (Santhosh, 2002). But the values of organic carbon obtained from the sediment samples of *Kollore* Lake (Ramamoorthy, 1972), Vembanadu Lake (Murthy and Veerayya, 1972) and *Pulicate* Lake (Durgaprasad Rao, 1971) remained lower than the values of the present investigation.

Nitrogen content in aquatic sediment is usually associated with organic matter of the sediment aggregate. This particulate bonded nitrogen reaches the over laying water during the digenetic decomposition of organic matter by heterotrophic bacteria. The total nitrogen concentration in the sediment samples varies from 0,015 mg/g (June) at station II to 1,92 mg/g (may) at station III (retting area). The nitrogen distribution does not exhibit much variation within the sedimentary blanket of the Paravur canal except in the station III, which is influenced by organic matter due to the prevalence of intensive husk retting at that zone. Sivakumar et al, (1983) recorded higher values during summer and pre-monsoon season which agrees with the value obtained at Station IV of the present study. Balakrishnan Nair et al, (1983) observed high seasonal values of nitrogen during monsoon season at Ahstamudi backwater, which may attributed to be due to the heavy disposal of effluent from *Punalur* paper mills. Over all studies of nitrogen concentration of station I, II and II exhibited high seasonal average values during monsoon, which may be due to the influence of intensive husk retting, anthropogenic influences and effluent discharge from the nearby coir dying factory.

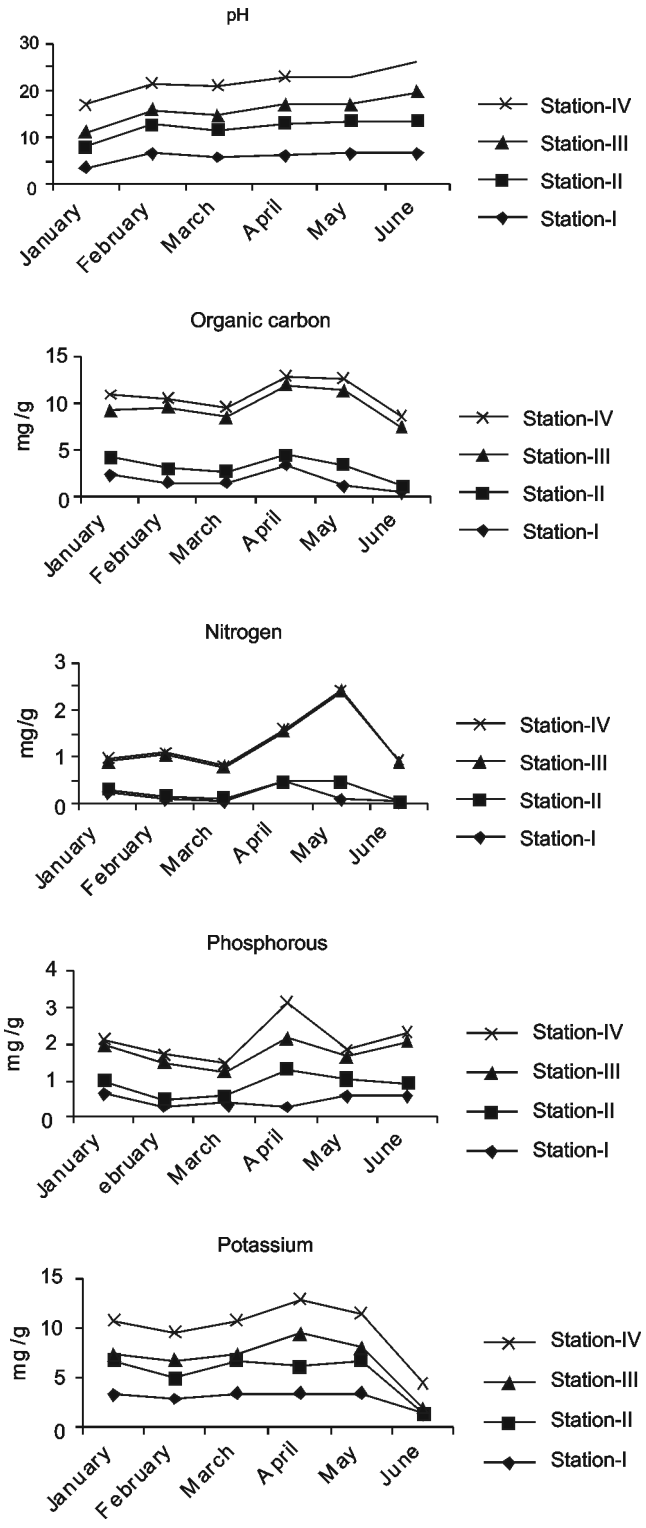

Fig. 2. **Showing the variation of geochemical parameters of different stations at Paravur canal**

Table 1

Month and season wise values of organic carbon, pH and nutrients of sediments samples at Paravur canal

Parameters	Stations	January	February	March	April	May	June	Pre-monsoon	Monsoon
pH	I	3,40	6,50	5,80	6,30	6,70	6,70	5,23	6,56
	II	4,70	6,20	5,70	6,80	6,80	6,90	5,53	6,83
	III	3,00	3,20	3,30	3,80	3,30	6,00	3,16	4,37
	IV	5,70	5,70	6,20	6,00	6,40	6,50	5,87	6,30
Organic Carbon, mg/g	I	2,294	1,468	1,468	3,486	1,101	0,459	1,743	1,682
	II	1,973	1,559	1,239	0,872	2,294	0,642	1,590	1,269
	III	5,046	6,514	5,826	7,661	7,936	6,422	5,795	7,339
	IV	1,559	0,963	1,147	0,917	1,330	1,055	1,223	1,101
Nitrogen, mg/g	I	0,217	0,063	0,053	0,461	0,081	0,032	0,111	0,191
	II	0,082	0,082	0,048	0,018	0,368	0,015	0,071	0,134
	III	0,582	0,892	0,673	1,074	1,921	0,851	0,716	1,282
	IV	0,076	0,024	0,043	0,038	0,053	0,023	0,048	0,038
Phosphorous, mg/g	I	0,625	0,272	0,348	0,272	0,563	0,563	0,415	0,466
	II	0,348	0,188	0,223	1,001	0,473	0,348	0,253	0,608
	III	0,973	1,027	0,652	0,875	0,598	1,116	0,884	0,863
	IV	0,152	0,188	0,188	1,001	0,188	0,286	0,176	0,491
Potassium, mg/g	I	3,321	2,884	3,393	3,393	3,393	1,259	3,199	2,682
	II	3,393	2,205	3,392	2,714	3,391	0,012	2,997	2,037
	III	0,679	1,696	0,560	3,393	1,357	0,679	0,978	1,809
	IV	3,393	2,884	3,393	3,393	3,393	2,446	3,223	3,077

Phosphorous is one of the crucial nutrients having a strong bearing on the physical, chemical and biological process operating in the aquatic environments. The increased loading of phosphorous in the system can damage the functioning of the system as it leads to Eutrophication. The phosphorous content of the Paravur canal various between 0,15 mg/g (January) at station IV to 1,12 mg/g (June) at station III. As in the case of organic carbon and nitrogen, the phosphorous concentration at this region was also the maximum. Sivakumar (1983) observed the P content in sediments of *Vellar* estuary to be higher during monsoon and lower during late summer, which is in agreement with the present investigation. The seasonal average values of phosphorus concentrations were the maximum during premonsoon season. This may be due to the pollution by intensive Coconut Husk retting. Balakrishnan (1983) also observed similar increase in phosphorous level in the polluted zone. Under aerobic conditions prevailing in smaller shallow lakes, phosphorous is adsorbed in sediments particle or precipitated as ion phosphates. The ferric hydrophophate is insoluble, as long as the redox potential in the sediment is greater. The release of phosphorous is also assisted by various transport mechanisms at the sediment surface, such as diffusion, wind induced water movements bioturbidation and rising gas bubbles.

Potassium is a major inorganic nutrient in sediments. The main sources of potassium are feldspars, clays etc. The potassium contents of the lake sediments varied from 0,012mg/g (June) at station II to 3,393 mg/g at all station. From fig. 2, it is evident that a greater portion of the canal substratum is floored with sediment content almost uniform distribution of potassium. In general, potassium values fluctuated without any order, and similar type of fluctuations in potassium concentration is found in the study of Balakrishnan (1983) in *Ahstamudi* estuary. Seasonal average values of potassium was recorded a maximum during monsoon at all stations except station III, where the maximum was noted at the monsoon season.

In conclusion, the present study revealed that the most polluted stations are stations I and III (Coconut Husk retting zone), where the hydrogen ion concentration, organic carbon and other nutrients contents were maximum. This may harmfully affect the water quality and the flora and fauna, which lead to the ecological balance of the aquatic environment. Hence it is highly essential to control anthropogenic activities in Tropical Aquatic Systems, so as to exploit these resources sustainable for domestic as well as economic purposes.

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