



Study of Seasonal Variations in the Physical-chemical Features of the Cauvery Estuary, Southeast Coast of India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Water is a vital element of the environment, supporting life on Earth and being necessary for all living creatures to live. Between rivers and the ocean, estuaries are places with distinctive ecological traits, an abundance of flora and fauna, and a crucial role in hydrological processes and biodiversity. The biological and physico-chemical aspects of aquatic habitats are intertwined. Investigating seasonal fluctuations in the physico-chemical characterisation of the east coast Cauvery estuary in Tamil Nadu is the goal of the current study. The Cauvery Estuary's physical and chemical properties are known and have an effect on the estuary. Seasonal fluctuations in the climatic and physico-chemical parameters pH, DO, ammonium, nitrate, BOD, sodium, chloride, sulfate, and fluoride content were noted in the waters of the Cauvery estuary. In the future,

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research on the ecology, biodiversity, and cultural aspects of the estuary species, as well as the determination of the permissible limit for fisheries and aquatic life, may benefit greatly from the initial data on the physical and chemical properties of the Cauvery estuary. In order to protect the Cauvery Estuary, conservation initiatives are started in collaboration with local non-governmental organizations after a thorough understanding of the various factors influencing these ecosystems is obtained.

Keywords: Cauvery estuary; physico-chemical analysis; estuaries ecology.

1. INTRODUCTION

Estuaries are dynamic ecosystems that host one of the highest biodiversity and biological production in the world. They have been increasingly vulnerable to anthropogenic inputs in recent decades, undergoing complex biogeochemical and hydrological processes. They are vulnerable aquatic ecosystems due to the constant influx of contaminants, mostly from land runoff, agricultural and industrial discharges. Indian estuaries are known as monsoonal estuaries because of their unique characteristics, which are a result of the rainy Indian Summer Monsoon's occurrence. In these estuaries, there are notable temporal variations in salinity and velocity fields due to high runoff during the wet season and reduced runoff during the 8-month dry season. The estuaries have a variety of habitats that have adjusted to these changes. The habitats would be negatively impacted by climate change [1]. The study of ecotoxicology focuses on how harmful physical and chemical agents can be to living things, particularly to people and communities that are part of certain ecosystems. Urbanization and industrialization pose a severe danger to coastal habitats, particularly estuaries. Estuaries are known for their high biological productivity, which enables them to support a wide variety of creatures throughout their whole life cycle or only the larval stage. Numerous pollutants, including metals, herbicides, hydrocarbons, and persistent chemical compounds, continuously strain these delicate ecosystems. Although heavy metals are naturally occurring components of the environment, there has been much documented evidence of an increase in their concentrations in many coastal areas [2].

Good quality of water resources depends on a large number of physicochemical parameters, the magnitude and source of any pollution load; and to assess that, monitoring of these parameters is essential. Researches are being carried out till present [3,4]. These include seasonal variations in the physico-chemical

characteristics and nutrient dynamics in the network of water bodies found across the country. Seasonality in estuary water salinity is a characteristic shared by estuaries in all three types. It results from variations in the amount of freshwater that rivers are bringing into the estuaries in season. India's monsoonal climate, which features two distinct seasons—a wet and a dry one is the cause of this seasonality. India receives roughly 80% of its yearly rainfall during the Indian Summer Monsoon, which typically lasts from June to September. River runoff reaches its peak during this time of year. The remaining months of the year are dry. After the rains, river runoff rapidly diminishes [1]. During the eight months of the dry season, there is typically very little to no runoff into the estuaries. According to Vijith et al. [5], Indian estuaries are frequently referred to as monsoonal due to their seasonality [1].

Tamil Nadu's varied estuary and marine environments support a wide variety of fish species [6,7,8]. In all, 1656 fish species classified into two classes, 40 orders, 191 families, and 683 genera have been found in Tamil Nadu's coastal and estuary waters. The checklist showed that 581 fish species were diadromus, while 1075 fish species were found in primary marine water. A total of 128 species—11 orders, 36 families, and 70 genera—and 1528 species—29 orders, 155 families, and 613 genera—under the classes Elasmobranchii and Actinopterygii have been reported. Tetraodontiformes (99 species), Pleuronectiforms (77 species), Clupeiformes (72 species), Scorpaeniformes (69 species), and Perciformes (932 species; 56.29% of the total fauna) were the top five orders with a diversified species composition. There are 86 species in the Gobiidae family, which is the largest number within the family. The Carangidae, Labridae, and Serranidae are the next highest with 65, 64, and 63 species respectively. According to an assessment of the state of the fishery, there are 1029 species worth of fish for capture, 425 species worth for aquarium fisheries, 84 species

worth of fish for culture, 242 species worth of fish for sport, and 60 species worth of bait. The IUCN Red List's threat status assessment includes 3.75% of vulnerable fish species, 50.25% of non-threatened fish species, and 46.01% of fish species for which the IUCN has not yet determined the conservation status [6]. In view of the present study has been undertaken to Physico-chemical analysis of Cauvery estuary, Southeast cost of India.

2. MATERIALS AND METHODS

Location of sample collection: The study was carried out at Cauvery estuary located along the Southeast coast of India in Mayiladuthurai district, Tamil Nadu, Southern India. The Cauvery estuary is formed by the tributaries of Cauvery River and opens into estuary on the Southeast coast of India. During the study period (2022-2023), samples of water were collected fortnightly; the data were pooled seasonally to understand the seasonal effect. The three distinct seasons were pre-monsoon (March to May), monsoon (June to Sept.) and post-monsoon (Oct. to Dec.) periods. The samples were collected from five different points of each site and were mixed together to prepare an integrated sample. The water pH were analyzed immediately on the spot.

Physico-chemical parameter: The methods used for the analysis of various physico-chemical parameters were the same as given in Standard Methods for the Examination of water

[9,10,11,12] and National Environmental Engineering Research Institute [13] and compare with Fisheries and aquatic life standard value [14]. Temperature and pH were determined by using calibrated thermometer with a resolution of 0.1 and Elico portable water quality analyser respectively.

3. RESULTS AND DISCUSSION

Estuaries are an essential component of marine ecosystems, and they are crucial to both the hydrological processes and biodiversity of coastal regions. The movement of weathering materials from the land to the ocean, which alters the physico-chemical characteristics of water, is essential for the creation of estuaries [15]. For a year, from 2022 to 2023, seasonal fluctuations in the climatic and physico-chemical parameters pH, DO, ammonium, nitrate, BOD, sodium, chloride, sulfate, and fluoride content were noted in the waters of the Cauvery estuary. The results are shown in Table 1.

The Cauvery River, which empties into the Bay of Bengal in Tamil Nadu, forms the estuary. In the deltaic region of Tamilnadu, the Cauvery River splits into the Cauvery proper in the south and the Coleroon in the north. The Cauvery Estuary's fishing potential is not well understood. Mulletts, clupeids, perches, Lates, Polynemus, prawns, crabs, and other species are frequently found in this estuary (<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=146944>).

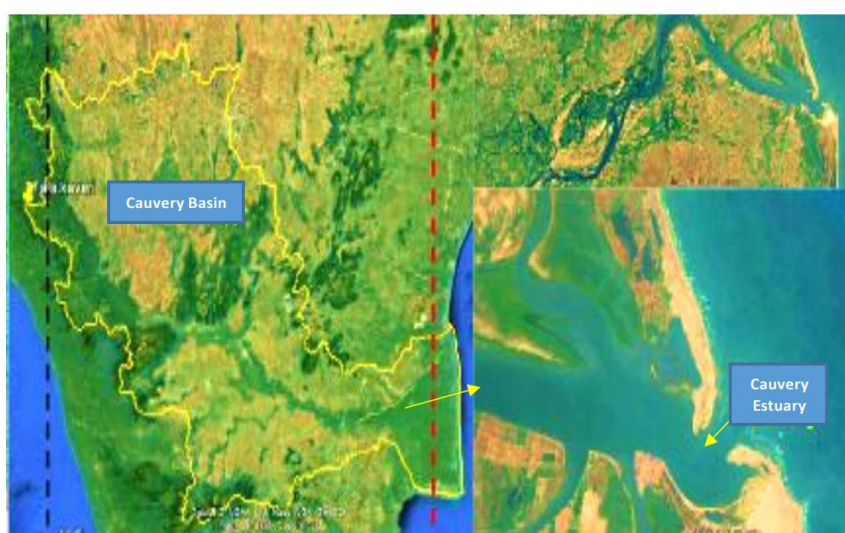


Plate 1. Study area of Cauvery estuary

Table 1. Physico-chemical analysis of Cauvery estuary, Southeast coast of India

Parameters	Season			* Fisheries and aquatic life Std.
	Pre-monsoon	Monsoon	Post-monsoon	
pH	8.93	8.66	8.71	6.0-9.0
DO (mg/L)	5.62	5.87	5.09	4.0-6.0
Ammonium (mg/L)	0.55	0.62	0.57	0.5
Nitrate (mg/L)	42.67	37.55	34.98	40
BOD (mg/L O ₂)	1.74	2.87	2.53	3
Sodium (mg/L)	135.77	119.13	154.31	120
Chloride (mg/L)	356.89	279.46	302.97	300
Sulphate (mg/L)	97.85	91.45	87.63	100
Fluoride (mg/L)	0.76	0.68	0.85	0.75

* Maximum allowable concentrations of selected water quality variables for Fisheries and aquatic life uses [14]

The pH of the Cauvery Estuary ranged from 8.66 to 8.93, suggesting that the water was somewhat alkaline. Seasons affected pH levels, with pre-monsoon (8.93) being the highest and monsoon season (8.66) being the lowest, and post-monsoon (8.71). The DO (mg/L) varied from 5.09 to 5.87, with the post-monsoon season having the lowest DO (5.09) and the monsoon season having the highest DO (5.87). The pre-monsoon pH was 5.62. Both the pH and DO values were within the Fisheries and Aquatic Life (1996) Standard [14]. The post-monsoon phase was characterized by generally low pH values, while the pre-monsoon period had slightly higher values. Santhanam and Perumal, [16] in the Vellar estuary and Soundarapandian et al. [17] in the Uppanar backwaters have previously noted a similar seasonal trend. According to Upadhaya, [18], minimum pH values during the monsoon in the study area may be influenced by freshwater discharge, rainfall, and the breakdown of organic matter.

The research area's high dissolved oxygen level during the monsoon season may have been caused by the influx of fresh water during the monsoon, which has a higher solubility and lower salinity. Comparable findings regarding DO values have also been documented from the Point Calimere coastal water [19], the Vellar estuary [20], and the Muttukadu backwaters [21]. The monsoon had the highest BOD (mg/L O₂) (2.87). Vasanthi and Sukumaran, [22] found comparable results in their studies in the Muthupet estuary, and Muthukumaravel et al. [23] in the Karaikal estuary.

Similar to Behera and Padhy, [15] observations of lower values during premonsoon and higher values during monsoon, this investigation shows that ammonium levels in the Cauvery Estuary are lowest during premonsoon (0.55 mg/L) and

highest during monsoon (0.62 mg/L) (Table 1). This difference in value may be attributed to increased productivity, decomposition, and denitrification processes during premonsoon and postmonsoon periods. During the study period (2022–2023), nitrate levels varied between 34.98 and 42.67 mg/L. River water that transports nitrate from anthropogenic inputs such industrial effluents and organic wastes from the catchment area is the source of nitrate addition to estuarine water [24]. Similar outcomes were noted by Vasanthi and Sukumaran, [22]. The range of 87.63 to 97.85 mg/L for sulphate is highest in the pre-monsoon season and lowest in the post-monsoon season (October to December), according to Fisheries and Aquatic Life (1996). The acceptable limit for fluoride is 0.68 to 0.85 mg/l.

The lowest sodium concentration (119.13 mg/L) recorded during the monsoon season and the highest sodium level (154.31 mg/l) during the post-monsoon season. Due to rain and river water flow, there is high salinity and low value during the monsoon season [25], while Rita Chauhan et al. [26] found results that were similar. The chloride readings ranged from 279.46 mg/l to 356.89 mg/l. The monsoon season (279.46 mg/L) recorded the minimum, and the pre-monsoon season (356.89 mg/L) recorded the maximum. According to Bhaware et al. [27], there are seasonal fluctuations in the physico-chemical parameters of the water in the Bhatye Estuary. Specifically, the lowest level of chloride was observed in August and the highest level in March.

The east coast of India's Cauvery Estuary was the site of parameter changes and physical-chemical property monitoring. According to Bhaware et al. [27], one of the main variables influencing the physico-chemical parameters,

biota distribution, and abundance in the coastal and estuarine ecosystem is pH variation. Future research on the ecology, biodiversity, and cultural aspects of the species inhabiting the estuary could benefit greatly from preliminary data on the physico-chemical parameters in this section of the Cauvery Estuary.

4. CONCLUSION

The physical and chemical characteristics of the Cauvery estuary are documented and have an impact on the estuarine ecology; in the future, the physico-chemical parameters will be a valuable resource for ecological, biological, and cultural traits. This study helps to know the various factors influencing these ecosystems and there by conservation measures are initiated in collaboration with local NGO's for protection of Cauvery estuary.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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