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# STUDIES ON THE PHYSICOCHEMICAL PARAMETERS OF LOWER ANICUT (ANAKKARAI) THANJAVUR DISTRICT, TAMIL NADU, INDIA

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## ABSTRACT

Water is a scarce and valuable resource for the survival of mankind. It is absolutely essential not only for survival of human beings, but also for animals, plants and all other living beings. Physio-chemical parameters of reservoir were analyzed every month for a period of one year, from July-2012 to June-2013, to understand the fishery pattern of the reservoirs. Physical parameters such as humidity, wind velocity, temperature, pH, turbidity and rainfall were recorded. The chemical parameters such as alkalinity, nitrite, nitrate, total phosphate, hardness, sulphate, fluoride, sodium, potassium, salinity, and dissolved oxygen and carbon dioxide were analyzed. In annual rainfall (75.6mm), humidity (68.9%) and wind velocity (10.4-14.6 km/h). while lower anicut recorded temperature (30.0ºC). Maximum turbidity of 8.9 NTU was observed during summer months in lower.The studies of physico-chemical parameters are used to detect the effects of pollution on the water quality

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## INTRODUCTION

Water is one of the most precious natural resources needed by all living things for their survival. It maintains an ecological balance between various groups of living organisms and their physical and chemical environments. Aquatic ecosystems provide nurturing shelter to the ancestral life of the living world on the land today. Water bodies cover about 73% of surface and provide the most extensive medium for aquatic life .Aquatic ecosystems are particularly vulnerable to environmental change and many are, at present, severely degraded (Williamson *et al*., 2008). The availability of good quality water is an indispensable feature for preventing disease and improving quality of life. The physico-chemical properties will also help in the identification of sources of pollution, for conducting further investigations on the ecobiological impacts and also for initiating necessary steps for remedial actions in case of polluted water bodies (Ekwenye and Oji, 2008; Singh and Singh, 2008; Simeonov *et al*., 2005).

All great civilizations in world have evolved around the rivers .Rapidly increasing population, indiscriminate urbanization and rapid industrialization along the rivers have put tremendous pressure on water resources and their quality. Water quality monitoring has one of the highest priorities in environmental protection policy (Sargaonkar and Deshpande, 2003).The quality of water is identified in terms of its physico-chemical parameter. The healthy aquatic ecosystem is depended on the physico-chemical and biological characteristics (Venkatesharaju *et al*., 2010).

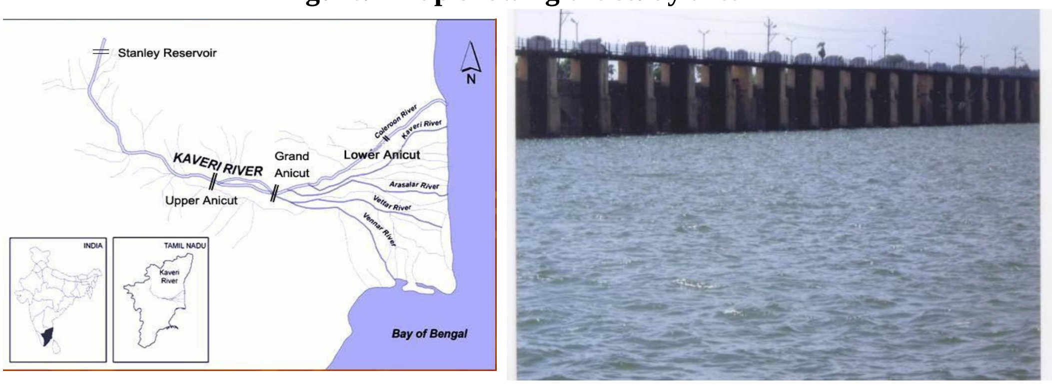
Fresh water is necessary for healthy living. River water is used for various purposes such as drinking, bathing, irrigation etc. The quality of water is described by its physical, chemical and microbial characteristics. But if, some correlations were possible among these parameters, then significant ones would be fairly useful to indicate the quality of water. The quality of water in any ecosystem provides a significant information about the available resources for supporting life in that ecosystem (Venkatesharaju *et al*., 2010). All known life forms on earth depend on water and hence hydrological studies are essential to understand the relationship between its trophic levels and webs (Govindasamy *et al*., 2013).The objective of this paper is to study various water pollutants available in Narmada River followed by literature review.

## MATERIAL AND METHODS

### STUDY AREA

Lower Anicut (Kollidam river) is one of the major freshwater fishery resources available, where in the northern region of Tamil Nadu (11° 15' N latitude and 79° 30' E longitude) which is selected for the present study (Figure 1). The river flows from west to east forming the northern boundary of this block. The total catchment area of this reservoir is 29,693 square miles (sqm2) and capacity to store 150.13 MCFT of water to use agricultural irrigation and fishing activities.It is a main commercial landing centre for fish fauna where the Tamil Nadu State Fisheries Department (TNSFD) has the sole authority for landing and marketing of fishes throughout the year.

**Figure.1 Map showing the study area**




### Sample collection

The water samples were collected from the surface layer (0.2 m depth) of reservoirs once in a month as recommended by Saad (1979) for the estimation of environmental variables. A precleaned and rinsed polythene watercans of 5 litre capacity and a 500 ml BOD bottles (which were used for the dissolved $O_2$ fixation) were used for collection of water samples for the analysis of physicochemical characteristics. Samples were protected from direct sun light and immediately transported to the laboratory for further analysis.

### Physico-chemical characters

### Rainfall, humidity and wind velocity

Rainfall, humidity and wind velocity data were collected from Meterological Department of Tamil Nadu Water Board, Thanjavur.

Temperature, Turbidity, pH, Alkalinity (Total, Carbonate and Bicarbonate), Nitrite, Nitrate, Total phosphate, Hardness (Total, Calcium and Magnesium), Sulphate, Fluoride, Sodium and Potassium, Dissolved oxygen (DO), Dissolved $CO_2$, Salinity, was estimated in laboratory by adopting the standard procedures APHA (1989)

### Dissolved oxygen (DO)

The Alsterberg (Azide) modification of Winkler's method was adopted Michael (1986).

## RESULTS

Monthly observations on the physico-chemical factors at the Lower Anicut, are presented here.

### Rainfall

Average rainfall at the reservoir was (76.1 mm). Maximum rainfall (274.4 mm) was recorded in the month of December, 2012, while in the months February – May, there was no rainfall at all. Sporadic rains could be observed in June – August months.

### Humidity

Atmospheric humidity fluctuated between 69.6 and 98 per cent during the study period. Maximum humidity could be observed during September 2012 – January 2013 period, however, humidity was less during March – June 2013.

### Wind velocity

Wind velocity at the reservoir was June, July and August were the windy months (Speed: 10.5 – 13.7 km/h), while rest of the year was relatively calm.

### Water Temperature

Monthly variations in water temperature followed a similar trend in the reservoirs. Lower anicut had yearly average of 30.32°C. In general, water was cooler in October 2012 – January 2013.

**Turbidity**

Turbidity represented as NTU showed identical pattern of variations in the reservoir. Water was least turbid in October – December (3.0 – 3.8 NTU), and high turbidity could be observed during summer months (March – June 2013). Maximum turbidity of 8.9 NTU could be observed in Lower anicut in June 2013.

**pH**

pH of the water varied between 6.5 and 9.2. Higher values of pH could be observed from December 2012 to June 2013, while near neutral values could be observed for the rest of the study period .

**Total Alkalinity**

Total alkalinity ranged from 183.6 mg/l in December 2012 at Lower anicutg. Alkalinity values were significantly higher during November 2012 – February 2013, in the reservoir, but the values were very low during March 2013 – June 2013.

**Carbonates**

Carbonates varied from 7.00 to 9.96 mg/l during the study period. Irrespective of the locations, carbonates were low during March – June 2013. Carbonate level was significantly high during November 2012 – February 2013 period. Compared to other months of the year, in August 2012, carbonate levels were very high in the reservoir (9.89 – 9.96 mg/l).

**Bicarbonates**

Bicarbonate values varied between 108.0 mg/l (March 2009) and 171.55 mg/l (November 2012). While observing the monthly variation of bicarbonates, it was obvious that March – June 2013 period had the least levels of bicarbonates, while November 2012 – January 2013 period had significantly higher amounts of bicarbonates.

**Nitrites**

Nitrites ranged between 0.05 and 0.23 mg/l during the study period. Although higher nitrite values were apparent during the non-rainy months of the year, the variations were not statistically significant.

**Nitrates**

Nitrates were in the range: 0.57 – 0.935 mg/l. On a monthly basis, significantly higher nitrate values could be observed for November 2012 – February 2013, further it was noted that the nitrate level of February 2013 was exceptionally high (0.935 mg/l).

**Total Phosphates**

Total phosphates of the reservoirs varied from 0.04 to 0.19 mg/l, during the entire study period (Fig.2.9). Among the months, July – October 2012 show the highest level of phosphates, while in the months of March and April 2013 the values were the lowest.

**Total hardness**

Variations in the total hardness of the water of the reservoir are depicted in Fig.2.10, and the values showed a range of 110.91 to 148.36 mg/l for the study period. July and August 2012 showed least water hardness, while December 2012 and January 2013, maximum hardness.

**Calcium hardness**

Calcium hardness of the reservoir varied between 45.6 and 48.77 mg/l for the entire study period. Although it could be observed that March and April 2012 were the months of highest hardness, and October 2012, the least.

**Magnesium hardness**

Magnesium hardness was in the range: 62.8 – 98.0 mg/l, during the study period. Closely following the pattern of total hardness, magnesium hardness also showed significant variations the Lower anicut had the highest magnesium hardness of 77.38 mg/l. Monthly magnesium hardness levels were also found to vary with one another significantly, although a definite seasonal pattern in variation was not evident. Irrespective of the reservoirs, in July 2012 lowest level of magnesium hardness could be observed in the water, and the highest level, in January 2013.

**Sulphate**

Sulphates of the water showed remarkable variations in their concentration among the reservoir, and the annual range of sulphates was 13.6 – 19.98 mg/l. Sulphates of Lower anicut were significantly of highest level (mean: 17.42 mg/l). Among the months of November 2012 to February 2013 study period a significantly high concentrations of sulphate was recorded, while July to October 2012 show only very low concentrations.

**Fluoride**

Annual variations of fluorides in the reservoir are presented in. Fluorides were of trace quantities and varied between zero and 0.0009 mg/l. Hence no statistical analysis of the data was possible. Fluorides were totally absent in the reservoir during July 2012 – October 2013.

**Sodium**

Sodium levels in the reservoirs varied between 36.0 and 47.81 mg/l, during the study period. However, it could be observed that in January and February 2013, the concentrations were significantly the highest and the concentrations were very low during July – October 2012.

**Potassium**

Annual potassium variations were in the range, 4.66 – 7.54 mg/l . Monthly observations on the potassium levels of water showed that the values were noticeably more during July 2012 – February 2013.

**Dissolved Oxygen**

The dissolved oxygen concentrations in the water of the reservoirs were in the range of 4.2 – 6.2 mg/l . Monthly oxygen values, when compared, showed that November and December 2012 maintained highest dissolved oxygen, while February, March and May 2013, the lowest.

**Carbon dioxide**

Carbon dioxide levels were meagre in the reservoir and the levels varied between 0.00026 and 0.00061 ppm during the study period.

**Salinity**

Salinity levels were in the range: 0.007 – 0.193 ppt.

## DISCUSSION

The present study on the seasonal rainfall, atmospheric humidity and wind velocity revealed that the study period (July, 2012 – June, 2013) represented the typical climatic conditions of the region, primarily governed by the monsoon and the hot months of summer. Pre-monsoon period was comparatively windy. While rainfall in the upstream Karnataka also would have contributed to the water inflow, wind speed, summer heat and low humidity prevailing at the study zones might have increased the water evaporation of the reservoir.

Temperature variations of the reservoir were about seven degree Celsius approximately, depending on the seasonal rains and the summer and these fluctuations were of a lesser magnitude compared to the shallow lotic stretches of the river. Jayaram observed narrower fluctuation of water temperature in the reservoir zones of Cauvery compared to the flowing water stretches, and he attributed this to the depth and turbidity of the standing water. In the present study also,compared to shallower Lower Anicut (Jayaram, 2000). Jerald also observed similar high temperature pattern in the Lower Anicut in his study on the fishery of the reservoir (Jerald, 1994).

In a similar fashion, the turbidity of the reservoir varied according to the seasons. Water was least turbid during rainy season (3.0 – 3.8 NTU), while in summer months, the values varied between, 6.3 – 8.9 NTU. These values were comparable to the earlier observations of Jerald in Lower anicut. Water pH varied between 6.5 and 9.2 with values more alkaline in the post-monsoon and summer months. In the present study pH range fell well within the normal limits (annual average pH 8.1) ideal for better productivity. The relation between water pH and fish population of Lower Anicut was deduced by Jerald.

Water alkalinity is primarily governed by the concentrations of bicarbonates, and the present study on bicarbonate levels of the reservoir revealed that the values closely conform to a trend identical to that of alkalinity variation. However, the bicarbonate levels of the reservoir did not exceed the threshold limit prescribed by ISI (200 mg/l) thus indicating the practically unpolluted nature of the reservoir, in spite of many of the tributaries of the river remaining apparently polluted due to industrial effluents (Jayaram, 2000). Rao *et al.* (1999) recorded similar levels of alkalinity (142.7 mg/l) in Nelligudda reservoir, Banglore, however, the alkalinity values were well below 50 mg/l in the waters of the reservoir of the upstream Cauvery (Sukumaran and Das, 2005). Similar to the bicarbonate levels, carbonate levels (7 – 9.96 mg/l) also varied reservoir. Lower level of carbonates during that period may be due to higher level of its utilization by phytoplankton population. Identical patterns of variations in carbonates and bicarbonates probably indicate the frequent inter-conversions of these radicals in the freshwater environment.

Dissolved oxygen levels of the reservoir varied between 4.2 and 6.2 mg/l, and this range falls within the range prescribed by WHO (1971) for the sustenance of fisheries and wildlife. However, this range was below the levels (7.0 – 8.3 mg/l) observed by Sukumaran and Das (2005) for the reservoirs of the Karnataka section of Cauvery. In the present study, higher level of dissolved oxygen was observed the lowest value was observed for Lower Anicut. Warmer temperature of the Lower Anicut (Fig.2.1) might have been the reason for lower solubility of oxygen in the water. Further, in the warmer months (February – May) of the study period,

Nutrients play a vital role in the productivity of water bodies. Major nutrients analyzed in the present study included nitrates, sulphates and phosphates. Nitrates varied from 0.42 – 0.95 mg/l and their concentrations were significantly higher in the Lower Anicut. Similarly phosphates (0.01 – 0.19 mg/l) were observed to be higher in Lower Anicut. Sulphates (13.6 – 19.98 mg/l) also showed significantly higher concentrations in Lower Anicut. In general, nitrates and sulphates were higher in post monsoon months, while phosphates were exceptionally high during monsoon months. Role of monsoonal inflow and agricultural runoff in bringing these nutrients to the reservoir bodies is pertinent in this context. Concentrations of nitrite (Fig.2.7), a toxic intermediate radical of ammonia oxidation, were negligible in the present investigation. The concentrations of nitrates and sulphates were at an optimum level according to BSI (1982) for the promotion of fisheries and wild life. Nitrates (0.01 – 0.14 mg/l) and phosphates (0.01 – 0.03 mg/l) of Kabini, Harangi, Nugu and Hemavathy reservoirs were reported to be at a lower level (Sukumaran and Das, 2005), than those obtained in the present study. Along with other anions like carbonates and bicarbonates, nitrates and sulphates also contribute to the hardness of water (Trivedy and Goel, 1984), although the hardness of water is chiefly determined by the concentrations of calcium and magnesium (Jayaram, 2000).

Total hardness in the reservoirs ranged from 110.91 to 148 mg/l. Monthly variations of total hardness were also significant. Magnesium hardness (62.8 – 98.0 mg/l) closely followed the trend of total hardness, location- wise as well as season-wise. However, such a definite trend akin to that of total hardness was not evident with regard to calcium hardness (45.6 – 58.7 mg/l). Calcium was more or less equal in the reservoir, and their level was slightly more in early summer (March and April, 2013). Calcium is an essential component for the growth of both phytoplankton and zooplankton, and the heavy utilization of calcium was evident in the present study by its sudden decrease during late summer. Compared to the earlier study by Jerald (1994) in Lower Anicut, hardness of water was slightly less in the present study. The present study also showed that hardness of water was well within the permissible limits for maintaining a healthy fishery (WHO, 1971; BSI, 1982), but not so, at least during summer, with regard to potability of water.

Sodium levels (36.0 – 47.81 mg/l) in the present study were lower than those of calcium and magnesium, and potassium levels (4.66 – 7.54 mg/l) were very less. Similar values for sodium and potassium were observed in Lower Anicut by Jerald (1994). Trivedy and Goel (1984) have also observed such phenomena with regard to sodium and potassium in natural freshwaters.

Fluorides were present only in trace quantities (maximum 0.0009 mg/l) and were undetectable during monsoon months. With regard to fluorides, Cauvery water is safe and well within the permissible limits as prescribed by WHO (1971) and BSI (1982). Carbon dioxide levels of the reservoir were negligible (0.00026 – 0.00061 ppm) and hence, a definite pattern was not discernible. Salinity also was meagre, but slightly higher in Lower anicut probably explaining its proximity to sea coast.

From the foregoing discussion, it is evident that the reservoirs of Cauvery maintain ideal levels of hydrological parameters to maintain a good fishery. Fisheries of a reservoir depend chiefly on its planktonic resources (Rao *et al.*, 1988); decreased turbidity (Dubey and Verma, 1966); calcium content (Upadhyaya, 1955); alkalinity (Moyle, 1949) and phosphates (Atkins and Harris, 1924; Wiebe, 1930).

The productive capacity of a body of water depends much on the quantity of available nutrients which form the basic material for structure and growth of living organisms, which in turn form the food for fishes (Bal and Rao, 1984). Hence, functioning of an aquatic ecosystem and its ability to support life-forms depend to a greater extent on the physico-chemical characters of its water (Mittal *et al.*, 1990). In conclusion, the present study suggests that all the parameters dealt with are important for fishery management ventures to be taken up in reservoir. Considering the growing anthropogenic influence on natural water bodies, monitoring of BOD, COD, insecticides and heavy metal levels are also to be considered, in addition. Such environmental surveys will help to maintain the quality of the water in reservoir ideal for human utilization and fishery development.

## CONCLUSION

In the present study it is our efforts to evaluate many physicochemical parameters and its characteristic behavior of a river water samples in different seasons and different sampling stations, the water quality of river is deteriorated due to domestic, industrial effluents direct discharge in to river and various human activities along the banks of the river. So, the seasonal river quality monitoring by analysing various physico-chemical parameters and by integrating them is very much necessary in order to determine and maintain the water quality of the rivers.

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