Assessment of the Hydrographical Features of Ayiroor River in Kerala

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Abstract: *The present study was carried out to determine the hydrographical characteristics of Ayiroor river water in South India for a period from February 2014 to January 2015. Ayiroor river (8.75'N&76.71'E) is the smallest river in Southern Kerala, lies between 8.75'N latitude and 76.71'E longitude and drains an area of 66 Sqr.Km. It is about 17 Km in length, originate from Vilangara in Navayikulam, flowing through Thiruvananthapuram district and empties in to the Edava- Nadayara Kayal. Water samples collected from three sampling stations (Station1-Panayara, Station2-Ayiroor and Station3-Nadayara) were analyzed for various physicochemical parameters like temperature, pH, total dissolved solids, salinity, alkalinity, dissolved oxygen, dissolved carbon dioxide, nitrate phosphate and sulphate. The study revealed that the hydrographical parameters of water exhibited considerable seasonal variations and the river water is not severely polluted and useful for various purposes.*

Keywords: Ayiroor river, Edava- Nadayara Kayal, hydrographical parameters, salinity, alkalinity

1. Introduction

The ecological study has a direct link between the physicochemical characteristics of the river water environment. Water quality is the physico chemical characteristics of water and it determines the goodness of the water for particular purposes. For effective maintenance of water quality through appropriate control measures, continuous monitoring of a large number of quality parameters is essential. The studies of water quality parameters are used to detect the effect of pollution on the water bodies. Deteriorating quality of aquatic systems is a major concern faced by the modern society especially in the developing countries. A variety of problems are created by point and non point sources of pollution, including deleterious effects on aquatic biota. Non point source pollution like storm-water runoff has the potential for depositing a wide range of contaminants in to aquatic systems. These pollutants represent short term and long term environmental perturbations that affect the ecology of the aquatic systems. However a general understanding of the basic water quality attributes is necessary to assess the effects of these perturbations in the water bodies.

Physicochemical analysis is of prime importance to assess the quality of water for its usage like drinking, bathing, fishing, industrial processing etc, and to get an idea about the pollution load of domestic sewage and industrial wastes on receiving water bodies. It determines the quality of water favourable for fish and other aquatic organisms and governs the diversity, distribution, abundance and behaviour of organisms in them (Joshi, 1995). Knowledge on the spatial and temporal variations in the physicochemical parameters is highly useful in formulating the management strategies for the water body. The physicochemical and biological parameters of the water body are interdependent and they vary with seasons and its study provides different sorts of information, needed for the full assessment of an ecosystem such as nutrient dynamics, productivity, standing stock and energy transfer. The abundance and diversity of biotic communities are influenced by various physicochemical and biological parameters of the environment. The water quality parameters determined seasonally in the water samples of Ayiroor river are temperature, P^H, Total dissolved solids, salinity, alkalinity, dissolved oxygen, dissolved carbon dioxide, nitrate, phosphate and sulphate.

2. Materials and Methods

2.1 Study Area

Ayiroor River (8.75'N&76.71'E) is the smallest river in Southern Kerala, originating from Vilangara in Navayikulam, flowing through Thiruvananthapuram district and emptying in to the Edava- Nadayara Kayal. It is the second smallest river in Kerala; about 17 Km in length drains an area of 66 Sq.Km. It is one of the few rivers in Kerala free from any dam or reservoir. It is located more than 100 feet above the sea level with a maximum basin length of 13.68 Km. The average annual rainfall is 2200 mm^3 and average annual stream flow is 1324 mm^3 .The water is mainly used for domestic (169.9 mm^3), agricultural (515 mm^3) and industrial (45 mm^3) purposes. In its course it receives a variety of domestic wastes, sewage and agricultural runoff. Anthropogenic activities are rampant in the river which has resulted in large scale pollution. Disposal of wastes into the river is a serious problem making the water polluted. Domestic wastes, chemicals used for washing the motor vehicles and other waste water runoff are directly flowing into the river. Cattle wading are important source for organic wastes. Agricultural fields in the vicinity are the source of chemical pollution which may lead to deterioration in the quality of water.
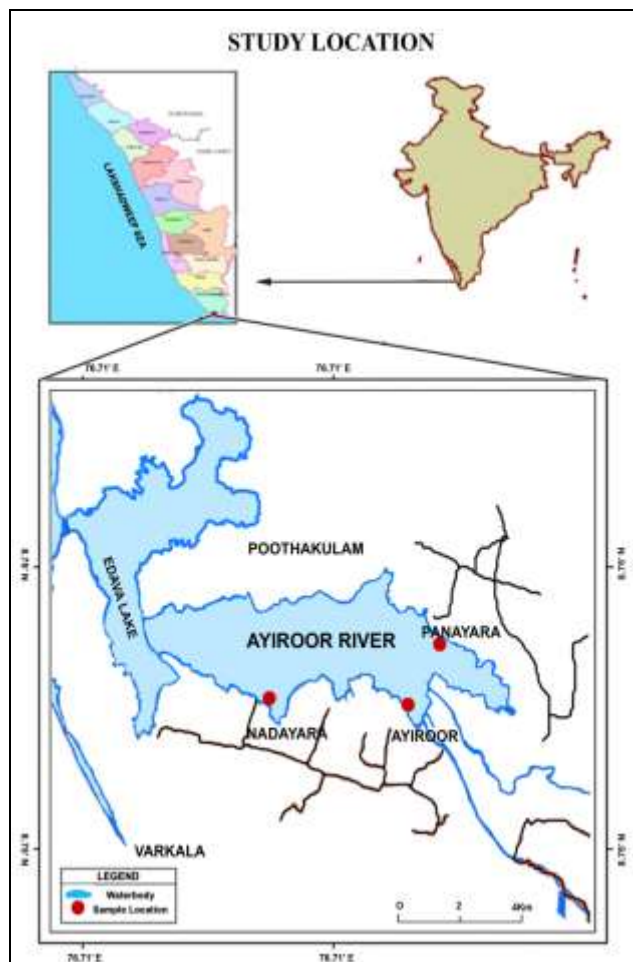
Figure 1: Location map of Ayiroor River in Southern Kerala

2.2   Sampling

Water samples were collected seasonally (Pre monsoon, Monsoon and Post monsoon seasons) from the three stations (Station 1-Panayara, Station 2-Ayiroor and Station 3-Nadayara) of the river for a period of 1 year from February 2014 to January 2015. The samples for the estimation of dissolved oxygen were collected in 300 ml sample bottles with necessary precautions and were carefully fixed at the site itself using Winkler's 'A' and 'B' Reagents. .For the determination of the concentration of nutrients water samples were collected and preserved by adding a few drops of chloroform. All the collected samples were brought to the laboratory for further analysis.

2.3   Field measurements

2.3.1 Temperature (^{0}C) -The temperature of the water was recorded in the site itself using a Celsius thermometer of $\pm$ 0.1^{0}C accuracy.

2.3.2   P^H -The P^H of water samples were measured in the study site by using a digital P^H pen (Elico, Model No. LI - 10, India).

2.4   Laboratory analysis

2.4.1 Total Dissolved Solids (mg/L) - The Total Dissolved Solids of the water was estimated by a Water Analyzer (Systronics-model -371).

2.4.2 Salinity (ppt) - The Salinity of the water was estimated by a Water Analyzer (Systronics-model -371).

2.4.3 Alkalinity (mg/L) - The alkalinity of the water sample was estimated according to the method suggested by Grasshoff *et al.,* (1983) by titration.

2.4.4   Dissolved Oxygen (mg/L) - Dissolved oxygen content of water sample was measured at the laboratory by the Winkler's titration method (Winkler, 1883).

2.4.5 Dissolved Carbon dioxide (mg/L) - Dissolved Carbon dioxide in the water sample was measured at the laboratory by the titration method of Trivedi & Goel (1986).

2.4.6   Nitrate (mg/L): Nitrate concentration was analyzed by the method of Morris & Riley (1963).

2.4.7 Phosphate (mg/L): Phosphate content in the water sample was determined using the method of Murphy & Riley (1962).

2.4.7 Sulphate (mg/L): The concentration of sulphate was measured using the method of APHA (1998). The results were recorded in mg/L.

2.5 Statistical Analysis

Statistical Analysis- three way ANOVA and Correlation analysis were used to analyze the variations, effects and interactions of different hydrographical parameters Gomez and Gomez (1984).

3. Results and Discussions

The seasonal average of temperature was highest (28.37±0.82) in 2014 pre monsoon and lowest (26.17±0.34) in 2014 monsoon. The statistical analysis (three way ANOVA) showed very significant seasonal variations (**$P<0.01$) and F cal is 7.761902861). Water temperature appears to be high during pre monsoon in all the study sites. High temperature in pre monsoon may be due to open nature of the site, hot climate, low water level and clear atmosphere. Similar observations were also recorded by Saksena *et al.*, 2008 and Sujitha *et al.,* 2011.

The seasonal mean of P^H was maximum (7.1±0.8) during 2014 pre monsoon with a range of and minimum (6.53±0.01) during 2014 monsoon. The statistical analysis (three way ANOVA) showed significant seasonal (**$P<0.01$ and F cal is 18.2444444**) variations. The P^H was found to be slightly acidic in all the stations. Heavy rainfall, dilution of water and reduction of temperature decreases the pH in monsoon (Kaushik *et al.,* 1991).

The seasonal average value of TDS was highest (73.3±4.88) in 2014 pre monsoon and lowest (69.3±23.35) in 2014 monsoon. The statistical analysis (three way ANOVA)

showed significant seasonal (**P<0.01 and F cal is 7.17008**) and station wise (**P<0.01 and F cal is 363.61096**) variations. Minimum TDS values in monsoon may be due to the dilution of water by surface runoff (Charkhabi and Sakizadeh, 2006).

The seasonal average of salinity recorded maximum (0.14±0.04) during pre monsoon and minimum (0.03±0.01) during monsoon. The statistical analysis (three way ANOVA) showed significant seasonal (**P<0.01 and F cal is 10.35**) variations. During monsoon salinity was low due to low temperature, heavy rainfall, dilution of water by freshwater inflow and low rate of evaporation. Similar observations were made by Shastri (2000).
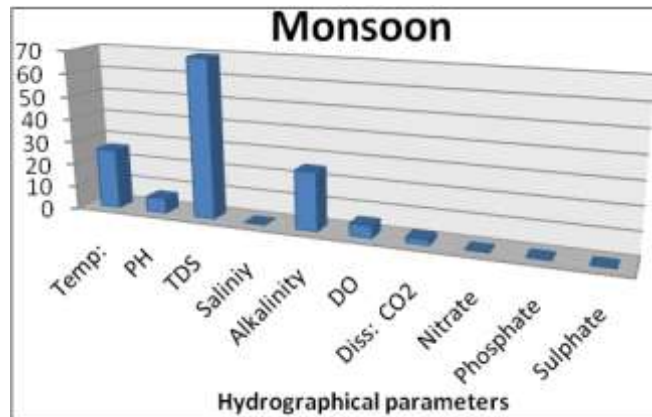
The seasonal average of alkalinity was maximum (33±5.10) during 2014 pre monsoon and minimum (25.33±4.79) during 2014 monsoon. The statistical analysis (three way ANOVA) showed significant seasonal (**P<0.01 and F cal is 11.286808**) and station wise (**P<0.01 and F cal is 150.124195**) variations. Increased rate of decomposition at high temperature, low water flow and low rate of evaporation, leads to high values of alkalinity in pre monsoon (Singhal *et.al.,* 1986).

The seasonal average of Dissolved oxygen was maximum (5.47±0.05) during 2013 monsoon and minimum (4.73±0.17) during 2013 pre monsoon. The statistical analysis (Thee way ANOVA) showed significant seasonal (**P<0.01 and F cal is 12.8758065**) variations. The minimum DO in pre monsoon may be due to the highest temperature and utilization of oxygen for the fast decomposition of the settled organic matter. (Aravind Kumar and Singh, 2002).

The seasonal mean value of Dissolved carbon dioxide was highest (2.87±0.05) in 2014-15 post monsoon and lowest (2.43±0.05) in 2013 monsoon. Statistical analysis -three way ANOVA) showed significant seasonal (**P<0.01 and F cal is 17.9363958**) variations. The high value of CO_2 recorded in pre monsoon is related to the rise of temperature, high quantity of phytoplankton and the high rate of decomposition of organic wastes.
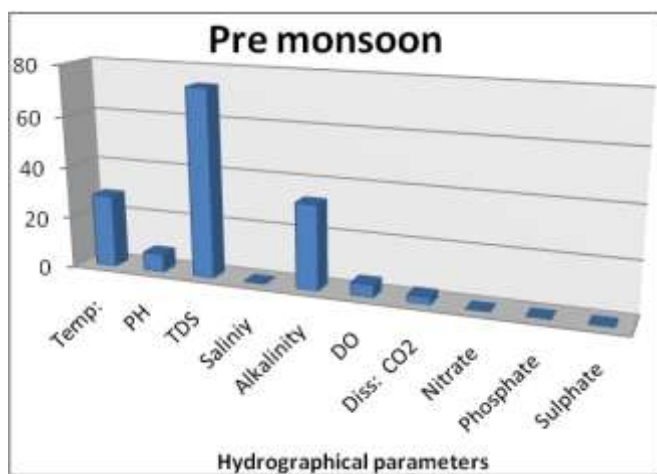
Figure 2: Variation of hydrographical parameters in Pre monsoon

Figure 3: Variation of hydrographical parameters in Monsoon
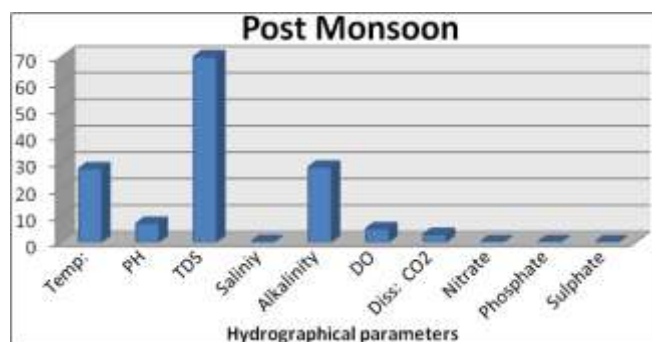
Figure 4: Variation of hydrographical parameters in Post monsoon

Seasonal average of nitrate was maximum (0.04±0.01) in 2014 monsoon and minimum (0.02±0.01) in 2013 pre monsoon and 2013-14 and 2014-15 post monsoon seasons. The statistical analysis (three way ANOVA) showed significant seasonal (**P<0.01 and F cal is 12**) variations. Heavy rain fall lead to river run-off, land drainage and input of fertilizers from the adjacent agricultural fields which results in the high concentration of nitrate observed during the monsoon season (Joseph *et al.,* 2009).

Seasonal average of phosphate ranges from 0.02±0.01 in 2013 pre monsoon to 0.04±0.01 in 2013 monsoon. The statistical analysis (three way ANOVA) showed significant seasonal (**P<0.01 and F cal is 18**) variations. Land runoff from agricultural fields and mixing of freshwater coupled with increased anthropogenic activities causes higher quantities of phosphate in monsoon (Senthil kumar *et al.,* 2002; Rajasegar, 2003).

Seasonal mean value of sulphae indicated high value (0.06±0.01) during 2014 pre monsoon and low value (0.01±0.01) during 2013-14 post monsoon. The statistical analysis (three way ANOVA) showed significant seasonal (**P<0.01 and F cal is 12**) variations in sulphate content of the river water. In pre monsoon - low rainfall and subsequent runoff water are the reason for minimum sulphate concentration. Similar results have been reported by Reddy *et al.,* (2009).

Table 1: Seasonal variation (Av+S.E) of hydrographical parameters at the three stations of Ayiroor river during 2014-15

Parameters	Pre M	M	Post M
Temp:	28.37±0.82	26.17±0.34	27.67±1.3
P^H	7.1±0.8	6.53±0.01	7.03±0.05
TDS	73.3±4.88	69.3±23.35	70±11.79
Saliniy	0.14±0.04	0.03±0.01	0.05±0.02
Alkalinity	33±5.10	25.33±4.79	28.33±4.9
DO	4.87±0.05	5.3±0.08	5.03±0.05
Diss: CO_2	2.73±0.09	2.43±0.21	2.87±0.05
Nitrate	0.02±0.01	0.04±0.01	0.02±0.01
Phosphate	0.03±0.01	0.04±0.01	0.03±0.01
Sulphate	0.06±0.01	0.03±0.01	0.02±0.01

4. Conclusion

Good water quality of the aquatic ecosystems is necessary for the survival of all living organisms. Many water pollutants cause low oxygen levels in aquatic ecosystems which results in the degradation of water and make it difficult for the survival of aquatic organisms. Many factors of the aquatic habitat are inter-related and inter-dependent and the variation of any one factor would influence the other. The monsoon play an important role in the ecological conditions of the river and affect the physico-chemical as well as biological characteristics of the water bodies. In the present study, the hydrography of Ayiroor river indicated that the ecological parameters vary during the different seasons. Three way ANOVA results reveal that all the water quality parameters show significant seasonal variations. TDS, Alkalinity, and sulphate show significance in seasonal and station wise variations. None of the parameters show significant variations in two way interaction involving station and season and three way interactions involving station, season and depth. Generally the river water is not severely polluted and useful for various purposes.

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Author Profile

Ambili. T received the B.Sc. degree in Zoology from Sree Narayana Womens College, kollam. M.Sc. degree in Zoology from Fatima Mata National College,Kollam. B.Ed taken in Natural Science and awarded SET also. She has taken DCA. In 2012, she took M. Phil in Aquatic Biology and Fisheries from the Department of Aquatic Biology & Fisheries in the University of Kerala, Kariavattom. All the degrees were received from the University of Kerala, Thiruvananthapuram, India. She has published 10 research papers. She now is doing Ph.D in Zoology at Zoology Research Centre, Department of Zoology, Fatima Mata National College, Kollam, University of Kerala, India.

Dr. F. George D'Cruz took his B.sc, M.Sc, and Ph.D degrees from the University of Kerala, India. After Post graduation, he joined Fatima Mata National College (at present a leading Autonomous College in Kerala) under the University of Kerala as Lecturer in 1979. In 1998 he took his Ph.D in Zoology, through Part time Research, while serving as a Professor. In Zoology, his area of specialization was Fisheries and Environmental Toxicology, Biodiversity, Wetland Ecology and Fish Diversity. In 2008, he retired as the HOD of Zoology and at present holds the post of honorary director of the Zoology Research Centre, under the Department of Zoology in the same college. There are about 20 Research papers published in Research Journals and more than 50 scientific papers presented in Seminars, Symposia and other Public functions in his credit. At present he is guiding students for their Ph.D in Fish Diversity and Wetland Ecology. He has authored three books and co-authored three other books on various topics like Fisheries, Environmental Biology and Human Evolution, in addition to Scientific Articles in Popular Journals and Print media. There are 16 Radio talks through All India Radio and 15 talks through Radio Benziger, Kollam on various scientific topics under Fisheries, Biodiversity Conservation, Environmental Biology, etc. Dr. F. George D'Cruz's Contributions as Subject Expert Member in various State Government Bodies like District (Kollam) Monitoring Committee Kerala Forestry Project, Department of Forest (1996-2002), District (Kollam) Forest Extension and Information Centre, Department of Forest (1996-2002), Committee for Project Formulation and Implementation, Department of Fisheries (2002-2004), State Council of Educational Research and Training (1999-2005), Wetland Cell (2004-2006), etc., are noteworthy. He also served as the State Level Programme Co-ordinator of the Kerala State Biodiversity Board in Preparing People's Biodiversity Register (2009-2011). He had completed 3 projects on Research