

Water quality Appraisal of Achankovil river with special reference to seasonal inconsistency, Pathanamthitta, Kerala

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Abstract

The present study deals with the water quality of Achankovil River, which enriches the Pathanamthitta district of Kerala state. It joins with the Pamba River at Veeyapuram, in the Alappuzha district of Kerala. The physico chemical parameters like Temperature, pH, Conductivity, Turbidity, Dissolved oxygen, Biological Oxygen Demand, Salinity, Nitrate, Nitrite, Phosphate and Silicate were analyzed. The physico chemical characteristic of Achankovil River was found to be highly fluctuated between the thirteen sampling stations selected during the present investigation. The study revealed that the station Attuva showed highest pollution during premonsoon season. The parameters such as salinity, total dissolved solids and conductivity shown increase in concentration towards the downstream stretches of the river. Though, the quality of water is deprived in majority of the sampling stations towards the downstream indicates the severity of pollution in the river.

Key words: Achankovil River, Physico chemical parameters, Pollution

Introduction

Rivers, integral parts of human civilization, are heritage resources however our record in managing these essential resources particularly over the past hundred years has been riddled with short-sightedness. Progress of civilization, growing urbanization and apparent decline in direct dependence of human being on river systems has contributed to changing perspective of use of river resources. Rivers are viewed as source of water and sediment, which are minable economic goods. Interfering within river's domain has a long history, perhaps as old as human civilization itself. Today, many of the world's rivers and catchments are degraded due to intensive human impacts including damming, diversions, storages, clearing of vegetation and other habitat removal, introduction of invasive species and pollution.

The study area, Achankovil is a river in Kerala, India, created towards the southern tip of the peninsula by the confluence of the Rishimala, Pasukidamettu, and Ramakkaltheri Rivers. The Achankovil enriches the Pathanamthitta district of Kerala state. It joins with the Pamba River at Veeyapuram, in the Alappuzha district of Kerala. Achankovil is also the name of the forest area, which is the catchment area for this river, and of a small town situated in the Achankovil forest area. The Achankovil village is not easily accessible; however, it can be reached through forest routes. The river also passes through the village Vazhuvadi. The Achankovil River (76°25'-76°75'E and 8°75'-9°5'N) is one of the major rivers of the state with an area of 1484 km² and a

total length of 128 km. It is bounded by hills on three sides on the south (Bala Krishna Prasad, 2002). The river discharges into the Vembanad Lake, which extends from Cochin (Kochi) to Alleppey (Alappuzha) for a distance of 83 km and is the largest estuary in Kerala. Its width varies from 0.25 to 2 km. It is elongated and oriented in a NW-SE direction. The Achankovil River receives discharge from two important rivers, viz. the Pamba and Manimala. Plantation and agriculture activities are intense in these regions. This river basin is intensely and actively farmed with cash crops such as rubber, oil palm, and cashew. The agronomic practices in these farms call for application of natural and chemical fertilizers, soil conditioners and pesticides (Thrivikramaji and Joseph, 2001). So the impact of pollution may be very huge in the surface waters of Achankovil River. In this view point the present study tries to focus on the physico chemical characteristics of Achankovil River.

Materials and Methods

Achankovil is one of the major rivers in Southern Kerala. It descends from Western front of the Western Ghats and is located between 76°24' to 77°18' E longitudes and 9°2' to 9°19' N latitude. It drains an area of 1381km². The Achankovil is a river in Kerala, India, created towards the southern tip of the peninsula by the confluence of the Rishimala, Pasukidamettu, and Ramakkaltheri Rivers. The Achankovil enriches the Pathanamthitta district of Kerala state. It joins with the Pamba River at Veeyapuram, in the Alappuzha district of Kerala. There are 13 sites were selected for water sampling (table 1). The water samples were collected monthly for a period of 2017-2018. All water samples were analyzed for physico chemical parameters by using methods suggested by APHA (2005).

Results and Discussion

The results of physico-chemical analyses of water samples from Achankovil River are given in tables 2, table 3, table 4, table 5, table 6 and table 7. During the monsoon season the highest air temperature was noted at Murippara, Venmony, and Attuva (31°C) and the least were noted at Kollamkadavu and Veeyapuram (27°C). Water temperature at Konathumula and Venmony finds to be highest (29°C) and least at Kodunthara, Pramadam, Kaippuzha and Attuva (27°C). The highest DO value was recorded at Vettiayar (7.78) and the lowest at Attuva with value 4.39. The highest PH value of 6.70 noted at Pramadam and least of 6.02 at kurithara. The conductivity founds to be lowest at Konnathummoola with value of 0.05 μ s and highest at Veeyapuram (1.44 μ s). Total dissolved solids value of Kodunthara seems to be lowest and highest at Veeyapuram (0.09 mg/l and 2.26 (mg/l)). Turbidity founds to be highest at Konni (6 NTU) and lowest at Kodumthara (2 NTU) and Pramadam (2 NTU). DO content of Konni, Kodunthara, Kaipuzha found to be least (1 mg/l) and highest at Attuva (9.25 mg/l), similarly salinity founds to be highest at Veeyapuram (5.58 mg/l) and lowest at Konni (1.32 mg/l). Nitrite value found highest at Kodunthara with 2.23 mg/l and least at kollankadavu with 0.83 mg/l. Phosphate content founds to be highest at Attuva (0.98 mg/l) while the least phosphate content was at Konni (0.14 mg/l). Silica content founds to be lowest at Pramadam (1.54 mg/l).

During the post monsoon season the highest air and water temperature was noted at Attuva (32.5 °C and 30.5°C) and lowest at Kaipuzha (28 °C and 26.5 °C). The highest DO value was recorded at Konni (7.80 mg/l)

and the lowest at Kodunthara (6.24 mg/l). The highest PH value of 6.8 noted at Pramadam, Manjanikara, Kaipuzha and least in Attuva with 6.3. The conductivity founds to be lowest at Kaipuzha with value of 0.75 μ s and highest at Veeyapuram (2.14 μ s). TDS value of Konni seems to be lowest and highest at Koorithara (1.2 mg/l and 5.53 mg/l). Turbidity founds to be highest at Veeyapuram (5NTU) and lowest at kaipuzha (1NTU). Dissolved oxygen and Salinity noted high at Konni (0.51 mg/l and 1.25 mg/l) and lowest at Veeyapuram (6.5 mg/l and 18.5 mg/l). Nitrite value found highest at Attuva with 3.51 mg/l and least at kollankadavu and manjanikara with 1.02 mg/l. Nitrate value founds to be highest at Attuva (1.85 mg/l) and lowest at Konni (0.51 mg/l). Phosphate content founds to be highest at Veeyapuram with 1.87mg/l), while the least phosphate content was at Veeyapuram with 1.87 mg/l. Silica content founds to be lowest at Konni (1.87 mg/l) and highest at Veeyapuram (3.32 mg/l).

During the pre monsoon season the highest air temperature was noted at Kodunthara, Venmony, Kurithara and Veeyapuram (32 °C) and the least were noted at Murippara and Pramadam (30°C). Water temperature at Veeyapuram finds to be highest at Veeyapuram (29.5°C) and least at Konni. The highest DO value was recorded at Konni (8.10 mg/l) and the lowest at Attuva with value 6.12 mg/l. The highest PH value of 6.7 noted at Pramadam and least of 6.1 at Attuva. The conductivity and Turbidity founds to be lowest at Kaipuzha with value of 0.87 μ s and 1 NTU respectively and lowest at Veeyapuram with a conductivity value of 2.81 μ s and Turbidity 4 NTU, in addition Turbidity at Vettiyyar also found to be lowest with 1 NTU. TDS value of Kaippuzha seems to be lowest and highest at Veeyapuram (1.42 mg/l and 16.53 mg/l). DO content of Konni found to be least (0.41 mg/l) and highest at Veeyapuram (9.25 mg/l), similarly salinity founds to be highest at Veeyapuram with a value of 7.1 mg/l and least of 1.38 mg/l at Kaippuzha. Nitrite and nitrate value found highest at Attuva with 4.37mg/l and 2.87mg/l and least at Vettiyyar with 1.23mg/l and 0.92mg/l respectively. The Phosphate and Silica content founds to be highest at Veeyapuram and Attuva respectively while the least phosphate content was at Konni (0.28mg/l) and silica with 1.72mg/l.

From these results, it is found that some of the stations such as Veeyapuram, Attuva etc is comparatively much polluted than the others. Veeyapuram Station is the point where the Achankovil River joins with the Pampa River. Hence, there is great chance of salt intrusion in that site. This accounts for the increased salinity in the waters collected from that site throughout the three seasons. In addition to this, the cumulative effect of all the pollutants from the upstream stations can be found at Veeyapuram. The station, Attuva is near the temple side and so bathing and religious rituals usually done in the waters of Attuva. The river water here seems to be stagnant during the dry seasons. Irrespective of the seasons, the major nutrients were found to be high at Attuva station. The cause for this trend might be due to the activities such as bathing, washing, sand mining, stagnation etc. During all the three seasons, In the Stations 1 to 12, distribution of parameters such as Conductivity, TDS and Salinity showed an anomalous behavior. But in Veeyapuram these three parameters had a considerable rise in the values. This clearly indicted the estuarine property of the station. It is also found that these three parameters are positively correlated throughout all the stations in all seasons. Seasonal variations of BOD and

DO were found to be marginal in most of the stations. But in Veeyapuram station, the BOD values showed a marginal increase in the three seasons, which clearly indicates the extent of Pollution at that site. Increase in the concentration of BOD is an excellent indicator of the presence domestic and industrial pollutant in the aquatic system (APHA, 1998). The high BOD values might be due to the mixing of high oxygen demanding substances from the industrial wastewater (Remadevi and Abdul Aziz, 995). Hence, we can conclude that human interventions are the major cause for the deterioration of water quality of the Achankovil River.

The analysis of the correlation coefficient of water quality parameters demonstrates clearly the type and degree of relationship among them. Correlation between the parameters during the present investigation is shown in table 8. Dissolved oxygen showed significant negative correlation at 5% level with biological oxygen demand, nitrate and nitrite. Electrical conductivity showed significant positive correlation at 5% level with total dissolved solids and salinity. Biological oxygen demand showed significant positive correlation at 5% level with nitrate. Nitrate showed significant positive correlation at 5% level with nitrite.

Summary and Conclusion

The present study highlights the water quality aspects of Achankovil River. Thirteen heterogeneous sites were selected for the present study. For water quality analysis, 12 parameters were selected which comprises Temperature, pH, Conductivity, Turbidity, Dissolved oxygen, Biological Oxygen Demand, Salinity, Nitrate, Nitrite, Phosphate and Silicate. The preliminary study reveals that the Achankovil River is facing various environmental problems particularly anthropogenic, which is several folds higher than the natural replenishments. The samples analysis shows that the quality of water is very poor particularly at Veeyapuram and Attuva stations. If the quantum of pollution increases or persists in the present status, the quality of water will be altered adversely and the bio resources associated with the lake will be deteriorated at a greater magnitude. Therefore immediate control measures are essential to protect the Lake from further degradation.

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Table 1. Water sampling locations of Achankovil River

Sl: No	Stations	Location		
		Latitude	Longitude	Altitude(ft)
1	KONNI	9 ⁰ 14'56"N	76 ⁰ 50'14"E	35
2	KODUNTHURA	9 ⁰ 14'47"N	76 ⁰ 46'53"E	28
3	PRAMADOM	9 ⁰ 15'22"N	76 ⁰ 47'35"E	32
4	MANJANNIKKARA	9 ⁰ 14'10"N	76 ⁰ 45'13"E	12
5	MURIPPARA	9 ⁰ 13'48"N	76 ⁰ 43'25"E	11
6	KONATHUMMOOLA	9 ⁰ 13'42"N	76 ⁰ 41'41"E	15
7	KAIPUZHA	9 ⁰ 13'54"N	76 ⁰ 40'19"E	18
8	ATTUVA	9 ⁰ 14'39"N	76 ⁰ 37'56"E	13
9	VENMONY	9 ⁰ 14'35"N	76 ⁰ 37'55"E	12
10	VETTIYAR	9 ⁰ 13'52"N	76 ⁰ 36'52"E	6
11	KOLLAMKADAVU	9 ⁰ 15'41"N	76 ⁰ 34'38"E	13
12	KOOREETHARA	9 ⁰ 15'52"N	76 ⁰ 30'14"E	2
13	VEEYAPURAM	9 ⁰ 19'29"N	76 ⁰ 27'54"E	1

Table 2. Physico chemical features of Achankovil River during monsoon

Sl: No	Location	Temperature		DO (mg/l)	P ^H	Conductivity (µs)	Turbidity (NTU)	TDS (mg/l)
		Air (°C)	Water (°C)					
1	KONNI	28	28	6.86	6.43	0.07	6	0.14
2	KODUNTHARA	29	27	7.23	6.50	0.09	2	0.09
3	PRAMADAM	29	27	7.21	6.70	0.05	2	0.10
4	MANJANIKKARA	30	28	6.92	6.40	0.06	3	0.12
5	MURIPPARA	31	28	6.34	6.30	0.06	4	0.19
6	KONATHUMoola	30	29	7.29	6.40	0.05	3	0.17
7	KAIPUZHA	30	27	7.74	6.50	0.07	3	0.26
8	ATTUVA	31	27	4.39	6.40	0.38	4	2.34
9	VENMONY	31	29	7.28	6.30	0.16	3	1.54
10	VETTIYAR	30	28	7.78	6.40	0.11	3	0.16
11	KOLLAM KADAVU	27	28	6.88	6.30	0.08	3	0.18
12	KOORITHARA	26	28	5.43	6.02	0.17	4	0.14
13	VEEYAPURAM	27	28	5.62	6.32	1.44	3	2.26

Table 3. Chemical parameters of Achankovil River during monsoon

Sl: No	River location	BOD (mg/l)	Salinity (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Silicate (mg/l)
1	KONNI	1	1.32	1.26	0.38	0.14	1.79
2	KODUNTHARA	1	1.48	2.23	0.45	0.28	2.67
3	PRAMADAM	2	1.38	1.72	0.36	0.42	1.54
4	MANJANIKKARA	2	1.40	1.08	0.23	0.29	1.74
5	MURIPPARA	3	1.43	1.67	0.31	0.23	1.89
6	KONATHUMoola	2	1.41	1.29	0.29	0.49	2.07
7	KAIPUZHA	1	1.44	1.05	0.40	0.57	2.62
8	ATTUVA	5	1.43	2.45	1.56	.98	3.02
9	VENMONY	2	1.57	1.23	0.32	0.92	1.82
10	VETTIYAR	3	1.41	1.09	0.36	0.63	2.13
11	KOLLAM KADAVU	2	4.22	0.83	0.37	0.59	1.76
12	KOORITHARA	2	3.25	1.92	0.79	0.91	1.94
13	VEEYAPURAM	4	5.58	1.89	0.75	0.86	2.87

Table 4. Physico-Chemical Features of Achankovil River during post monsoon

Sl: No	Location	Temperature		DO (mg/l)	P ^H	Conductivity (µs)	Turbidity (NTU)	TDS (mg/l)
		Air (°C)	Water (°C)					
1	KONNI	25.5	26	7.80	6.7	1.08	2	1.2
2	KODUNTHARA	31.5	29	6.24	6.5	1.12	3	2.15
3	PRAMADAM	30	28.5	7.10	6.8	.93	2	1.97
4	MANJANIKKARA	30.5	29	6.84	6.8	.98	2	1.80
5	MURIPPARA	31	29	6.75	6.7	.85	2	1.82
6	KONATHUMoola	31.5	29	6.81	6.6	.88	2	1.73
7	KAIPUZHA	28	26.5	7.51	6.8	.75	1	1.52
8	ATTUVA	32.5	30.5	5.18	6.3	1.28	5	2.46
9	VENMONY	31.5	29	7.52	6.5	.93	3	1.35
10	VETTIYAR	30	28	7.21	6.7	.87	2	1.89
11	KOLLAM KADAVU	31	29	7.15	6.6	.92	3	4.76
12	KOORITHARA	32	30	6.85	6.7	1.23	3	5.53
13	VEEYAPURAM	31	29	6.50	6.8	2.14	5	1.87

Table 5. Chemical Parameters of Achankovil River during post Monsoon

Sl: No	River location	BOD (mg/l)	Salinity (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Silicate (mg/l)
1	KONNI	.51	1.25	1.45	.51	0.24	1.87
2	KODUNTHARA	0.58	1.37	1.89	0.78	0.35	2.65
3	PRAMADAM	0.52	1.24	1.23	0.65	0.38	1.79
4	MANJANIKKARA	0.63	1.54	1.02	0.70	0.28	1.91
5	MURIPPARA	0.60	1.51	1.95	0.85	0.30	1.95
6	KONATHUMoola	0.55	1.54	1.64	0.78	0.39	2.35
7	KAIPUZHA	0.56	1.38	1.15	0.52	0.27	2.95
8	ATTUVA	4.58	1.58	3.51	1.85	1.18	5.47
9	VENMONY	2.43	1.64	1.35	0.57	1.02	2.48
10	VETTIYAR	2.51	1.58	1.10	0.69	0.85	2.75
11	KOLLAM KADAVU	2.83	6.12	1.02	0.76	0.75	2.48
12	KOORITHARA	2.76	15.2	2.24	1.05	1.25	2.67
13	VEEYAPURAM	6.5	18.5	2.64	1.02	1.87	3.32

Table 6. Physico-chemical features of Achankovil River during pre-monsoon.

Sl: No	Location	Temperature		DO (mg/l)	P ^H	Conductivity (µs)	Turbidity (NTU)	TDS (mg/l)
		Air (°C)	Water (°C)					
1	KONNI	30	27	8.10	6.5	1.10	2	1.45
2	KODUNTHARA	32	29	7.20	6.3	1.30	2	1.80
3	PRAMADAM	30	28	7.14	6.7	1.01	1.3	1.45
4	MANJANIKKARA	31	29	6.95	6.5	1.08	1.5	1.75
5	MURIPPARA	30	29	6.82	6.4	.95	1.4	1.60
6	KONATHUMoola	31	28.5	6.85	6.5	1.02	2	1.50
7	KAIPUZHA	31	29	7.41	6.7	0.87	1	1.42
8	ATTUVA	31	28	6.12	6.1	1.86	4	3.65
9	VENMONY	32	29	7.34	6.3	1.05	2	2.92
10	VETTIYAR	31	29	7.60	6.5	.92	1	1.93
11	KOLLAM KADAVU	31.5	28	7.20	6.4	1.08	2	8.12
12	KOORITHARA	32	29	6.79	6.6	1.34	2	9.43
13	VEEYAPURAM	32	29.5	6.83	6.5	2.81	4	16.53

Table 7. Chemical parameters of Achankovil River during pre monsoon.

Sl: No	River location	BOD (mg/l)	Salinity (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Silicate (mg/l)
1	KONNI	0.41	1.45	1.76	0.78	0.28	1.95
2	KODUNTHARA	3.40	1.56	2.04	1.42	0.42	2.89
3	PRAMADAM	0.52	1.42	1.62	0.94	0.49	1.72
4	MANJANIKKARA	0.59	1.68	1.28	0.78	0.31	2.01
5	MURIPPARA	0.62	1.63	2.28	1.13	0.35	2.09
6	KONATHUMoola	0.65	1.67	1.81	1.24	0.45	2.47
7	KAIPUZHA	0.45	1.38	1.48	0.97	0.32	2.89
8	ATTUVA	5.72	1.89	4.27	2.87	1.98	3.77
9	VENMONY	2.45	1.82	1.48	1.02	1.05	2.58
10	VETTIYAR	2.82	1.94	1.23	0.92	1.13	2.86
11	KOLLAM KADAVU	2.98	1.72	1.34	0.94	1.09	2.63
12	KOORITHARA	2.95	6.4	2.42	1.31	1.87	2.78
13	VEEYAPURAM	9.25	7.1	3.12	1.72	2.07	3.47

Table 8a. Correlation between various physico chemical parameters during Monsoon

Monsoon	WT	DO	PH	EC	Turbidity	TDS	BOD	Salinity	Nitrite	Nitrate	Phosphate	Silicate
WT	1											
DO	.168	1										
PH	-.497	.456	1									
EC	.016	-.491	-.181	1								
Turbidity	.189	-.363	-.375	-.038	1							
TDS	.015	-.632*	-.139	.741**	.051	1						
BOD	-.039	-.714**	-.191	.577*	.053	.749**	1					
Salinity	.128	-.378	-.462	.747**	-.071	.370	.291	1				
Nitrite	-.459	-.696**	-.025	.356	-.031	.454	.463	.049	1			
Nitrate	-.388	-.868**	-.210	.416	.219	.700**	.708**	.198	.721**	1		
Phosphate	.120	-.500	-.458	.470	-.115	.705**	.561*	.434	.261	.631*	1	
Silicate	-.418	-.425	.026	.565*	-.094	.618*	.461	.207	.565*	.667*	.405	1

Table 8b. Correlation between various physico chemical parameters during post monsoon

Post monsoon	WT	DO	PH	EC	Turbidity	TDS	BOD	Salinity	Nitrite	Nitrate	Phosphate	Silicate
WT	1											
DO	-.745	1										
PH	-.498	.583	1									
EC	.292	-.413	.035	1								
Turbidity	.636	-.701	-.508	.803	1							
TDS	.484	-.157	-.097	.085	.240	1						
BOD	.457	-.449	-.225	.803	.878	.269	1					
Salinity	.315	-.129	.265	.792	.553	.529	.707	1				
Nitrite	.572	-.821	-.517	.638	.805	.140	.629	.393	1			
Nitrate	.714	-.904	-.600	.445	.770	.304	.615	.258	.899	1		
Phosphate	.500	-.359	-.173	.788	.825	.338	.958	.791	.594	.537	1	
Silicate	.440	-.748	-.635	.400	.715	.114	.669	.163	.781	.859	.564	1

Table 8c. Correlation between various physico chemical parameters during pre monsoon

Pre monsoon	WT	DO	PH	EC	Turbidity	TDS	BOD	Nitrite	Salinity	Nitrate	Phosphate	Silicate
WT	1											
DO	-.296											
PH	.079	.404	1									
EC	.241	-.456	-.261	1								
Turbidity	-.028	-.564	-.560*	.894**	1							
TDS	.321	-.293	.022	.808**	.632*	1						
BOD	.325	-.430	-.401	.926**	.842**	.806**	1					
Nitrite	-.006	-.722	-.526	.733**	.854**	.405	.672*	1				
Salinity	.441	-.303	.169	.732**	.511	.891**	.683*	.421	1			
Nitrate	.022	-.760	-.639*	.648*	.823**	.294	.669*	.946**	.267	1		
Phosphate	.221	-.518	-.315	.735**	.733**	.767**	.843**	.669*	.741**	.664*	1	
Silicate	.330	-.477	-.476	.660*	.694**	.506	.810**	.675*	.432	.783**	.756**	1

