AJES
ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE ■ VOLUME 9 | ISSUE 2 | DECEMBER, 2014 | 68-74
➩ e ISSN-0976-8947
DOI: 10.15740/HAS/AJES/9.2/68-74 ■ Visit us : *www.researchjournal.co.in*

RESEARCH ARTICLE

Assessment of water quality status of Anjarakandy river in Kannur district of Kerala

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Article Chronicle :
Received **:**
17.10.2014;
Revised **:**
01.11.2014;
Accepted **:**
15.11.2014

SUMMARY : The rivers always form the lifeline of nation and society by providing precious resources for development and perpetuation of life. In India, the surface water, especially rivers form an inevitable part of culture and are used as drinking and irrigational water source. The present study focus on the assessment of seasonal changes in water quality of the Anjarakandy River in Kannur District, Kerala during the pre monsoon and monsoon seasons of the year 2013. The physical, chemical and bacteriological attributes of the river water were analyzed, and based on the selected parameters, the Water Quality Index (WQI) was calculated. The results show that there is chemical pollution of river water due to chloride, salinity, total hardness, sulphates, sodium, potassium etc. especially in down stretches of the river, where the severity of saltwater intrusion is common. The upstream portions of the river show high MPN values for total and fecal coliform bacteria, which indicate the organic pollution by excreta of warm blooded animals. From the water quality index values determined, it was found that the river water is 'Unfit For Drinking'. Based on the values of Sodium Adsorption Ratio and Percentage Sodium determined, it was found that the water of Anjarakandy River is suitable for irrigation.

HOW TO CITE THIS ARTICLE : Athira, N. and Jaya, D.S. (2014). Assessment of water quality status of Anjarakandy river in Kannur district of Kerala. *Asian J. Environ. Sci.,* **9**(2): 68-74.

Key Words :
Anjarakandy river, Water quality index, Irrigational quality, Sodium adsorption ratio, Percentage sodium, Coliforms

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Water is indispensable and one of the most abundant resources of nature and prime necessity for the survival of life. So the availability of water both in terms of quality and quantity is essential for the existence of living world. The rapid industrialization, urbanization and modern civilization (increased population) have lead to the increasing demand for water in domestic, agricultural and industrial sectors. Surface water comprises of flowing fresh water system (lotic), such as, river, streams, canals etc. and static fresh water system (lentic), like ponds, lakes, and reservoirs etc. Rivers attracted more attention by providing water for large scale activities and are defined as a relatively large volume of water moving within a visible channel, including sub surface water moving in the same direction and the associated flood plain and riparian vegetation. Both streams and rivers as ecological systems are highly variable over space and time, and exhibit high degrees of connectivity between systems longitudinally, laterally and vertically (Naiman and Bilby, 1998).

India though blessed with abundant water resources, is also facing water scarcity and the water pollution plays a significant role in the water shortage. Urban rivers, streams and wetlands are prone to pollution (Natumanya *et al.,* 2009) and deterioration of water quality reduces a river's amenity and aesthetic value. The problem of water quality deterioration in the nation is mainly due to human activities such as disposal of dead bodies, discharge of industrial and sewage wastes and agricultural runoff which are major cause of ecological damage and pose serious health hazards (Meitei *et al.,* 2004). Due to the peculiar geomorphologic and hydro-geological conditions prevailing in Kerala, the residence time of water in the stream channels is considerably low. Besides this, the unscientific ways of utilising the rivers and lakes, and the indiscriminate discharge of untreated industrial effluents, domestic and municipal wastes and sewage to water sources cause organic pollution and the degradation of the quality of water and the fresh water aquatic ecosystems themselves (Harikumar and Kokkal, 2009). The prominent source of surface water pollution is domestic sewage, industrial wastewater and agricultural run-off.

Kannur, the northern district (area: 2,996 km^2) in Kerala state, South India, is with more than 50% of its residents living in urban areas. Seven rivers (Valapattanam, Kuppam, Mahe, Anjarakandy, Thalassery, Ramapuram and Perumba) drain to Kannur, of which the Anjarakkandy River is the medium sized river. The River forms the municipal water supply in the Kannur Municipality and most of the urban populations in the district depend on the water supply. Comparatively due to less industrialization the water bodies in the northern districts of Kerala, were less polluted due to the industrial effluents, but sand quarrying in rivers and watersheds are killing the rivers. Such activities lead to bank erosion, lowering of water table and create several environmental problems. The dumping of domestic sewage, unscientific agricultural practices and aquaculture practices in rivulets etc. also contribute to pollution of rivers in Kannur area. The major objective of the present study is to assess the seasonal changes in the water quality status of Anjarakandy River based on the Water Quality Index.

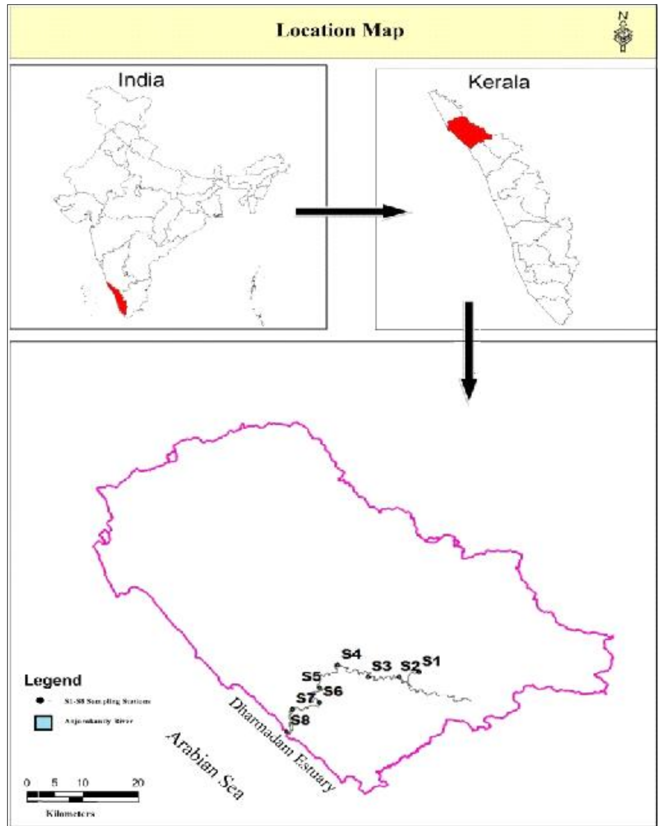

Fig. A : Location map of the Study area showing sampling stations

EXPERIMENTAL METHODOLOGY

Study area :

Anjarakandy river in Kannur District of Kerala state, South India is located at $11^0$52' 44.7"N- $11^0$46' 40.2"N and $075^0$39'13.1"E- $075^0$27'22.6"E. It is a medium sized river having 48 km length, and the navigable length of the river is about 27.2 km. The Anjarakkandy River originates from Kannoth forests in Thalassery Taluk and joins the Lakshadweep Sea. It has a catchment area of 113 sq km. The main tributaries are Idumbathodu and Kapputhodu. The average annual stream flow in the river is 433 Mega meters. The location map of the study area is given in Fig. A.

Sampling scheme and study stations :

A detailed field survey was conducted in the study area to select the sampling stations. Eight sampling stations were selected from the upstream to downstream of Anjarakkandy River, at an interval of 4 to 10 km, and almost all the sampling stations selected were located in the settlement area. The upstream portions of the river banks (Idumba, Mudapathur and Meruvembayi) are characterized by the presence of wild varieties of vegetation. The mid and down stretches of the river banks (Kizhallur, Odakdu, Mambaram, Mammakunnu and Dharmadam) contain agricultural lands, coconut plantations and mangrove vegetations. The washing and swimming are the major human activities in the upstream portions of the river. The sand mining, fishing and irrigation etc. are the major activities in the mid and down stretches of the river. During the pre-monsoon season, the salt water intrusion to the river (*i.e.* flow of water from lower stretch to the middle stretch) from the Dharmadam estuary which joins Arabian Sea was quite common. For the present study, the water samples were collected during pre-monsoon (April) and monsoon seasons (August) of the year 2013.

Methodology :

The water samples were analysed for water quality parameters following the standard procedures in APHA (2012) and by Senior (1996). The integrated status of various water quality parameters that are relevant and significant to particular use is reflected in water quality index (WQI) and it is a single value indicator to the water quality (Sisodia and Moundiotiya, 2006 and Kankal *et al.*, 2012).

Water quality index :

The Water Quality Index (WQI) was calculated by weighed arithmetic index method (Brown *et al.*, 1972; Behera *et al.*, 2004; Thakor *et al.*, 2011 and Manju *et al.*, 2014). The parameters selected for the calculations of WQI include pH, Electrical conductivity, Total dissolved solids, Alkalinity, Hardness, Calcium, Magnesium, Nitrate, Sulphate, Chloride, dissolved oxygen, Total coliforms etc :

$$\mathbf{WQI} = \frac{\sum_{n=1}^{n} QnWn}{\sum_{n=1}^{n} Wn}$$

where, Qn = quality rating of nth water quality parameter

Wn = unit weight for nth parameter

Quality rating/sub index (Qn) is a number reflecting the relative value of a parameter in the polluted water with respect to its standard permissible value :

$$Qn = 100\ [(Vn - Vio) \div (Sn - Vio)]$$

where, Vn = estimated value of the nth parameter

Vio = ideal value of the nth parameter

Sn = standard permissible value of the nth parameter

In most cases, Vio= 0, except for parameters pH and DO.

For pH, Vio = 7 and Sn = 8.5; DO, Vio = 14.6 and Sn = 5mg/L

Unit weight (Wn) is inversely proportional to the recommended standards for the corresponding parameters $Wn = K/Sn$, where K is a constant for proportionality;

$$K=1/\ [S^{1}/Sn]$$

After the calculations, the quality of water in sampling stations were classified based on WQI into different categories (Chatterjee and Raziuddeen, 2002). The permissible standard limits for the water quality parameters were compared with CPCB (1993-1994), BIS (1991) and WHO (1992) standards.

Sodium adsorption ratio (SAR) :

The SAR is only one factor for determining the suitability of water for irrigation purpose. In general, the higher the SAR, the water is less suitable for the irrigation. The Sodium Adsorption Ratio was calculated by using the formula by Todd (1995).

$$SAR = Na^{+}/\ [\sqrt{(Ca^{2+} + Mg^{2+})/2}]$$

where, the concentrations of all the constituents were expressed in Milli Equivalents per liter. Based on SAR values, the irrigational quality of water was determined as described by Raghunath (1987).

Percentage sodium :

Percentage sodium (%Na) was calculated using the formula by Todd (1995).

$$\%\ Na^{+} = (Na^{+} + K^{+}) \times 100\ /\ (Ca^{2+} + Mg^{2+} + Na^{+} + K^{+})$$

where the concentrations of all constituents were expressed in milli Equivalents per liter. Percentage sodium was determined and the river water was classified on the basis of its irrigational quality as given by Raghunath (1987).

EXPERIMENTAL FINDINGS AND DISCUSSION

The results of the physico-chemical parameters of the river water were tabulated in Table 1and 2. The results were compared with the surface water quality standards provided by the CPCB (2008; 2009), and with drinking water quality standards prescribed by ISI (BIS, 1991) and WHO (1996).

Table 1 : Physico-chemical quality of Anjarakandy river water during Pre monsoon season

Parameters	Min	Max	Avg	SD
Depth (m)	0.60	4.01	2.37	1.68
Temperature (^{0}C)	26.00	30.00	28.00	1.51
Turbidity (NTU)	17.15	124.20	62.32	41.87
pH	6.90	9.00	7.75	0.67
Conductivity (µS)	90.00	48400.00	19840.00	21686.10
Dissolved Oxygen (mg/L)	3.23	7.25	4.53	1.65
Alkalinity(mg/L as $CaCO_3$)	30.00	185.00	96.25	49.62
Hardness (mg/L as $CaCO_3$)	24.00	6250.00	2478.75	2777.87
Calcium (mg/L as $CaCO_3$)	4.01	420.84	160.02	152.68
Magnesium(mg/L as$CaCO_3$)	3.41	1266.67	506.69	575.28
Chloride (mg/L)	63.82	18614.93	8101.94	8841.60
Salinity (g/L)	117.11	34158.39	14867.03	16224.36
Sodium (mg/L)	5.10	3082.00	1075.98	1115.68
Potassium (mg/L)	0.60	204.00	93.43	99.84
Sulphate (mg/L)	0.03	366.32	139.99	164.49
Phosphate (mg/L)	1.68	8.11	2.76	2.18
Nitrate (mg/L)	0.12	0.77	0.31	0.08
Silicate (mg/L)	2.42	22.89	13.03	8.38
Fluoride (mg/L)	0.11	1.37	0.52	0.39
Total Solids (g/L)	0.14	48.74	18.80	19.48
TDS(g/L)	0.13	39.22	5.06	13.80
TSS(g/L)	0.01	43.74	13.74	17.61

Physico-chemical quality of water :

The physical condition of water strongly influences the chemical and biological process that take place in the water body (Stanley, 2009). The depth of the sampling stations can influence the other parameters of the water. The mean depth (upstream to downstream) of Anjarakandy River was recorded as 2.37 m during the pre monsoon, and 3.23 m during the monsoon season. The temperature, also have effect on hydrochemistry and biological reactions in the organisms in both surface and ground waters. Temperature of the water body varied from 26^{0}C to 30^{0}C during the pre monsoon, and

Table 2 : Physico-chemical quality of Anjarakandy river water during monsoon season

Parameters	Min.	Max.	Avg.	SD
Depth (m)	1.20	5.10	3.23	1.79
Temperature (^{0}C)	26.00	29.00	27.50	0.93
Turbidity (NTU)	14.68	107.80	46.23	35.26
pH	6.75	7.51	6.97	0.29
Conductivity (µS)	40.00	44200.00	5610.00	15594.41
Dissolved Oxygen (mg/L)	6.40	10.67	9.00	1.29
Alkalinity(mg/L as $CaCO_3$)	30.00	100.00	47.50	22.36
Hardness (mg/L as $CaCO_3$)	14.00	1300.00	179.75	452.68
Calcium (mg/L as $CaCO_3$)	3.21	17.64	5.92	4.81
Magnesium (mg/L as $CaCO_3$)	1.46	3.91	2.38	0.84
Chloride (mg/L)	42.55	18969.49	2454.51	6673.17
Salinity (g/L)	78.08	34809.02	4504.03	12245.28
Sodium (mg/L)	2.40	2086.00	270.86	733.51
Potassium (mg/L)	0.10	201.70	26.31	70.88
Sulphate (mg/L)	0.03	316.22	41.46	111.12
Phosphate (mg/L)	0.83	2.13	1.67	0.54
Nitrate (mg/L)	0.05	0.32	0.14	0.09
Silicate (mg/L)	3.02	18.26	14.64	4.91
Fluoride (mg/L)	0.20	0.76	0.51	0.22
Total Solids (g/L)	0.08	42.17	6.93	14.82
TDS(g/L)	0.02	39.21	4.99	13.83
TSS(g/L)	0.02	11.87	1.94	4.13

26^{0}C to 29^{0}C during the monsoon seasons of the study period.

The pH of the surface waters mainly contributes the atmospheric precipitation and the presence of several compounds. pH is considered as an ecological factor and is the result of interaction of various substances in solution, in water and also influences numerous biological phenomenon. The pH values (7.75 and 6.97 in pre monsoon and monsoon, respectively) of the river water in different stations are within the permissible limits of Indian surface water quality standards (BIS, 1991).

The electrical conductivity (E : C) is an index to represent total concentration of salts. High level of electrical conductivity indicates the pollution status as well as tropic level of aquatic body. The down stretches of river water recorded high E : C values during the pre monsoon (48400 µS) and monsoon seasons (44200 µS) compared to the permissible limits (300 µS) of Indian water quality standards (BIS, 1991) and WHO (1996) water quality standards. The recorded higher values of conductivity in the water body are due to the salt water intrusion from the Dharmadam estuary. The turbidity of the river water ranges from 17.15 NTU to 124.2 NTU in pre monsoon season and during monsoon season the values ranges from14.68 NTU to 107.8 NTU. The increased value of the turbidity may be due to the sand mining and the salt water intrusion in the downstream portions.

In the present study, the alkalinity values show gradual changes (30 to 125 mg/L as $CaCO_3$) from upstream to downstream portions of the Anjarakandy River and are within the permissible limits of surface water quality standards. The total solids (TS), total dissolved solids (TDS) and total suspended solids (TSS) were found as high in down stretches of the river. The maximum values recorded in pre monsoon season were 48.74 g/L, 39.22 g/L and 43.74 g/L for TS, TDS and TSS, respectively. During the monsoon season it was found as 42.17 g/L, 39.21g/L and 11.87 g/L for TS, TDS and TSS, respectively. The major reason for the high values for TS, TDS and TSS in the down stretches of the Anjarakandy River was sand mining. Sand mining disturbs the equilibrium of a river channel by effecting the habitat destruction of both aquatic and riparian vegetation. It affects the water quality by adding high content of suspended and particulates to surface water. Under favourable conditions the suspended solid may be carried downstream by river water and will settle out blanketing the river bed. During the sand mining these river beds were disturbed mechanically and the solids spreads in water. These suspended sediments may impair the respiration and photosynthesis of instream fauna. Sand mining also causes deleterious effects on the riparian vegetation seen along the banks of the rivers.

The oxygen dissolved in water can influence the biological process of the aquatic ecosystem. The major sources of oxygen in water include diffusion from the air and photosynthetic activity within water. The minimum dissolved oxygen (3.23 mg/L) was found during the pre monsoon in the down stretches of the river, and the middle stretches of the river was found rich in dissolved oxygen (7.25 mg/L). The low dissolved oxygen content detected in the downstream stations of Anjarakandy River is due to the salinity by the salt water intrusion. The salinity of water causes the unfavorable conditions to photosynthetic algae which produce oxygen in water. The salinity of water can also reduce the diffusion of oxygen from atmosphere to the water (Saxena, 1998).

The salinity, as a measure of the mass of dissolved salts in a mass of water mainly due to the presence of chloride. Chloride is one of the anions which determine the total salinity of water and make a quantitative accumulation of this anion over a period of time is an indicative of anthropogenic pollution. In the study the chloride content in river water ranges from 63.82 mg/L to18615 mg/L and salinity ranged from 117.11 g/L to 34158 g/L during the pre monsoon season. During the monsoon season, the concentration of chloride varied from

42.55 mg/L to 18969 mg/L, and salinity ranged from 78.08 g/L to 34809.02 g/L. The high values for chloride and salinity in the down stretches of Anjarakandy River is due to the salt water intrusion. The sand mining activities in the river basin causes the widening of river mouth and depth of the river surface, which induce the salt water intrusion. High chloride content in water bodies harms metallic pipes and structures as well as agricultural crops. In the pollution assessment, the salinity and chlorides can be used as indicators of intrusion of saline waters into fresh water resources through tidal actions in the estuary (Mahapatro, 2004).

In the present study, the calcium, magnesium and total hardness values showed an increasing tendency from upstream to downstream due to gradual increase in salt water incursion in the down stretches. During pre monsoon season the concentration of total hardness, calcium and magnesium were found as 6250 mg/$CaCO_3$, 420.84 mg/$CaCO_3$ and 1267 mg/$CaCO_3$, respectively. And in monsoon season total hardness, calcium and magnesium values were recorded as 1300 mg/$CaCO_3$, 17.64 mg/$CaCO_3$ and 3.91 mg/$CaCO_3$, respectively. In pre-monsoon season, the fresh water gets evaporated rapidly devoid of the dissolved cations and anions in the water, and contributes hardness and more salinity in the river.

The concentration of sodium ranged from 5.1 mg/L to 3082 mg/L during the pre monsoon season, and in monsoon season it varied from 2.4 mg/L to 2086 mg/L. The sodium occurs generally in lower concentrations than calcium and magnesium in fresh waters and makes its way in water through rock weathering. In saline and brackish waters, its concentration is remarkably high and limits the biological diversity due to osmotic stress (Saxena, 1998). In Anjarakandy River water analysed, the potassium concentration ranged from 0.6 mg/L to 204 mg/L during pre monsoon season and 0.1 mg/L to 201.7 mg/L during monsoon season. It was also found that the values increased in the downstream of the river compared to that in the upstream portions.

The sulphate content in the river varied from 0.03 mg/L to 366.32 mg/L during the premonsoon and in monsoon season, it is ranges from 0.03 mg/L to 316.22 mg/L. Domestic sewage and industrial effluents, besides biological oxidation of reduced sulphur species, may add to sulphate content of water. The phosphate concentration in the river water varied from 0.83 to 8.11 mg/L in pre monsoon season, and in monsoon season it varied from 0.83 to 2.13 mg/L. The dumping of domestic waste, agricultural runoff and salt water intrusion contribute high phosphate concentration in the downstream of the river. The presence of phosphates in large quantities in fresh water indicates the pollution through sewage and industrial waste (Bandela *et al.*, 1999).

The concentration of silicates during pre monsoon season showed an average value of 13.03 mg/L, and during monsoon season, it showed as an average value of 18.26 mg/L in Anjarakandy River water, which are within the permissible limits of water quality standards. The major source of dissolved silica in river is the weathering of rocks and mineral in the catchments area. Silicate is an essential nutrient for growth of diatoms that are important food to fishes (Nath and De, 1998; Nath and Srivastava, 2001). The nitrate concentration in the river water samples recorded values between 0.12 mg/L and 0.77mg/L, with an average of 0.31 mg/L in the pre-monsoon season, and in monsoon season it varied from 0.05 mg/L to 0.32 mg/L, with an average of 0.14 mg/L. The nitrites and nitrates are the oxidized form of nitrogen and in water. Its most important source is biological oxidation of nitrogenous organic matter of both autochthonous and allochthonous origin (Saxena, 1998).

The fluoride concentration in the Anjarakandy River water varied from 0.11 mg/L to 1.37 mg/L in premonsoon, and in monsoon, it varied from 0.2 mg/L to 76 mg/L. The estimated values are within the standard maximum permissible limits (CPCB, 2008). The fluoride has been considered as an acute pollutant to natural environment because of the ability of plants and aquatic organisms to accumulate it and have detrimental effect on the aquatic biota (Mahapatro, 2004).

Bacteriological quality of water :

In the present study the changes in bacteriological parameters in water during the pre monsoon season and monsoon seasons are shown in Table 3. During the pre monsoon season the total coliforms ranged from 23 MPN in 100 ml to 2200 MPN in100 ml and fecal coliforms ranged from 20 MPN in 100 ml to 920 MPN in 100 ml. During the monsoon season the total coliforms ranged from 210 MPN in 100 ml1100 MPN in 100 ml and fecal coliforms ranged from 120 MPN in 100 ml to 480 MPN in 100 ml. In the monsoon season, more number of bacteria was recorded in down stretches of the river compared to that in the pre-monsoon season due to the dilution of salt content and increased flow rate. The coliform bacteria are discharged from the human intestine and their presence indicates the possibility of the presence of pathogenic organisms (Behera *et al.,* 2004). The coliform bacteria include the genera *Escherichia*, *Citrobacter, Enterobacter* and *Klebsilla* etc. According to WHO standards for drinking water quality (1996), the drinking water should be devoid of coliforms, and if present, will be below 10 MPN/100 ml. According to the CPCB (2008, 2009) classification for 'class D' water bodies, the permissible limit for coliforms in surface water was 5000 MPN/100 ml. It was found that the number of total and fecal coliforms showed a gradual decrease from upstream to downstream of Anjarakandi River according to the increase in the salt content of the water. In the Anjarakandy River, the upper stretches of the river showed highest bacterial contamination and the major sources are the septic tank leakage and agricultural runoff from the pig farms and poultry farms of nearby areas. The present study also showed an average value of total coliforms in Anjarakandy River during pre monsoon as 775.13 and 568.75 during monsoon seasons. This results reveals that the Anjarakandy River water is bacteriologically contaminated and is not suitable for bathing and other recreation activities (CPCB, 2009).

Table 3 : Bacteriological quality of Anjarakandy river water

Season	Parameter	Min. (MPN in 100 ml)	Max. (MPN in 100 ml)	Avg. (MPN in 100 ml)	SD
Pre monsoon	Total coliforms	23	2200	775.13	866.69
	Fecal coliforms	20	920	362.38	375.54
Monsoon	Total coliforms	210	1100	568.75	334.94
	Fecal coliforms	120	480	221.25	115.57

Water quality index :

Based on the water quality index (WQI), the overall water quality of the water body can be expressed as a single number. The unit weights for parameters were given in Table 4 and calculated WQI values were shown in Table 5. The WQI values obtained were high in pre-monsoon season compared to that of monsoon season of the study period. The upper and mid stretches of the river are with good quality water considering the physico-chemical characteristics but are with high bacterial contamination. The study showed that based on the water quality index values, the Anjarakandy river water comes under the category 'Unfit For Drinking' (UFD).

Table 4 : Unit weight for parameters

Parameters	Sn	1/Sn	Wn=k/Sn
pH	8	0.125	0.284
EC	300	0.003	0.008
TDS	500	0.002	0.005
Alkalinity	120	0.008	0.019
Hardness	300	0.003	0.008
Calcium	75	0.013	0.030
Magnesium	30	0.033	0.076
Nitrate	45	0.022	0.051
Sulphate	200	0.005	0.011
Chloride	250	0.004	0.009
DO	5	0.200	0.455
Total Coliforms	50	0.020	0.045
	Σ1/Sn	0.440	
	k=1/(Σ1/Sn)=	2.273	
		ΣWn=	1.001

Irrigational quality of water :

The calculated Sodium Adsorption Ratio (SAR) and Percentage Sodium (% Na) values of river water are shown in Table 5. The SAR values varied from 0.359 to 16.945 during the pre monsoon season with an average of 6.879. In monsoon, the values ranged from 0.246 to 125.796 with an average 16.657. The sodium adsorption ratio (SAR) evaluates the sodium hazard in relation to calcium and magnesium concentrations (Richards, 1954). The results of percentage sodium in the water body show that there was no sodium hazard in the river water. Therefore the water of Anjarakandy River is of good irrigational quality and can be used for agricultural purposes.

Conclusion :

The present study on the water quality assessment of Anjarakandy River revealed that the physico-chemical quality of the water was good in the upstream stretches but the bacteriological contamination was significantly high. The down stretches of the river recorded high values for chemical parameters and it may be due to the salt water intrusion through wide river mouth formed by the uncontrolled sand mining in the lower stretches of the river. The water quality index determined show that the water of Anjarakandy River is 'Unfit' for drinking. Based on sodium adsorption ratio and percentage sodium values, the river water is suitable for irrigation. The study concludes that the Anjarakandy River is bacteriologically contaminated and is not suitable for bathing and other recreation activities. Also the river water can be used for domestic purposes only after proper disinfection.

Acknowledgement :

The authors sincerely thank the Head, School of Chemical Sciences, Kannur University, Kerala for help rendered to do the analytical work. Also thank the Head, Dept. of

Table 5 : Status of the Anjarakandy river based on water quality index, sodium adsorption ratio and percentage sodium

Parameters	Pre-monsoon				Monsoon			
	Min.	Max.	Avg.	Status	Min.	Max.	Avg.	Status
Water quality index (WQI)	103.817	704.856	370.017	UFD	57.431	304.261	107.764	UFD
Sodium adsorption ratio (SAR)	0.359	16.945	6.879	Excellent	0.246	125.796	16.657	Good
Percentage sodium (%Na)	23.759	53.695	41.54	Permissible	22.856	98.926	53.403	Permissible

UFD- Unfit for drinking

Environmental Sciences, University of Kerala for the support and facilities provided for this study.

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