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Hydrochemistry And Environmental Status Of Vaigai River Water In Tamil Nadu, India.

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Abstract

For more than a century, rivers have been of interest to hydrologists, geochemists and civil engineers. Recently, rivers are of great concern to environmentalists as well. Rivers are subjected to various physico-chemical and biological processes which may ultimately result in their environmental deterioration. Acceleration of these processes by human activities, mainly in the form of waste disposal, agricultural run off, industrial pollution, etc. is a matter of great concern. Increased pollution level in river water contributes to health hazards and leads to deterioration of the ecosystem. Hence, a qualitative and quantitative assessment of these pollutants in the riverine system must be seriously looked into.

A systematic investigation was done to elucidate the level of environmental status of a river Vaigai was carried out. Representative of three samples were analyzed for various water quality parameters such as TDS,TSS,EC,DO & Mg were analyzed using filteration method, gravimetric method, Electrometric method, Winkler's iodometric method and titrimetric method respectively following the guidelines of APHA, WHO and BIS. From this study, it is inferred that the over all water quality was found to be satisfactory proper treatment is necessory for drinking purposes.

Key Words: Hydrochemistry, Environmental status, Vaigai River, TDS, TSS, EC,DO,Mg.

Introduction:

Water plays an essential role in human life. Although statistics vary, the world Health Organization (WHO) reports that approximately 36% of Urban and 65% of rural Indian's were without access to safe drinking water (WHO, 2009). Water scarcity and the fast decline of aquatic biodiversity are indicators of ineffective implementation of water protection policies (Rapport et al., 1995). Fresh water is the most essential requirement for life and yet comprises only <1% of the Earth's surface water (Johnson et al., 2001). Sustainable and optimal use of natural resources is imperative in any country due to its concomitant economic implications such as industrial and population growth infrastructure and development demands (Department of Environmental Affairs and Tourism (DEAT, 2005)).It is essential that people be informed about goods and services provided by freshwater ecosystems (Palmer et al., 2005). Humans utilize the services provided by aquatic ecosystems for food crops in agriculture, skin, medicinal products, ornamental products (such as aquarium fish), implementation of biological control of insects and weeds of aquatic ecosystems in order to better manage them, and increasingly for recreational purposes. According to the Food and Agricultural Organization (FAO, 2003), Inland fisheries contributes approximately 12% of all fish used for human consumption. The agricultural industry accounts for 70% of fresh water withdrawn from the ecosystem for its practices such as irrigation (Lanza,1997). Urbanization becomes main reason of pollution for the rivers and other water bodies (DOE, 2001). Water plays an essential role in human life. Physical and chemical properties of water immensely influenced by its uses, the distribution and richness of the biota (Courtney and Clement, 1998; Unanam and Akpan, 2006). The Physicochemical characteristics of water bodies affect the species composition, Abundance, productivity and physiological conditions of aquatic organisms (Bagenal, 1978). The impact of these anthropogenic activities has been so extensive that the water bodies have lost their self purification capacity to a large extent (Sood et al., 2008).

Hence the present study is intended to evaluate the available river water resources using its physical and chemical parameters and classify according to usage.It is essential to study the long term river water table fluctuations for a proper planning of river water development and management of the study areas.

Study area

The Vaigai is a river in Madurai, Tamil Nadu State of Southern India. It originates in the Periyar Plateau of the Western Ghats range, and flows northeast through the Kambam Valley, which lies between the Palni Hills to the north and

Varushanad Hills to the South. The Vattaparai Falls are located on this river. As it rounds the eastern corner of the Varushanad Hills, the river turns Southeast, running through the region of Pandya Nadu. Madurai, the target city in the Pandya Nadu region and its ancient Capital, lies on the Vaigai. The river empties into the Palk Strait in Ramanathapuram District. The Vaigai is 258 kilometers (160mi) long, with a drainage basin 7,031 square kilometers (2,715 sq mi) large. It falls within the co-ordinates of Latitude 7o21'00'' N and Longitude 79o00'00''E. Vaigai Dam is built across the Vaigai River near Andipatty, in the Theni district of Tamil Nadu, Southern India. The Vaigai river rarely flood; its chief tributaries are the Suruliar, Theniar, Varaha Nadi and Mangalar (Britannica, 2009).

Materials and methods

To get a brief insight about the quality of Vaigai river water and to determine the spatial and temporal variation of water quality parameters a total of 3 samples were collected from Kunnur (Theni), AnnnaiPatty and Vaigai Dam for the period of one year (Nov 2009 – Oct 2010) with an interval of 30 days. In each station a sampling spot were fixed for the collection of water sample. Every month samples were collected at the surface of the rivers at 11.30 am to 12.30 pm in order to maintain uniformity. Samples were collected in clean white polythene containers. Collected samples were brought to the laboratory and kept in the refrigerator for further analysis. TDS, TSS, EC, DO and Mg parameters were analyzed by using standard procedures (APHA, 2005). TDS and TSS were analyzed by using Whatmann No.1 filter paper, EC was determined by Electrometric method, Dissolved Oxygen was analyzed by Winkler's method and Mg was quantified by titrimetric method.

Results and Discussion

Total Dissolved Solids

The determination of total dissolved solids is a measure of all salts in solution or elements dissolved in water. This can include inorganic anions (negative charged ions) like Carbonates, Chlorides, Sulfates and Nitrates. The inorganic cations (Positively charged ions) include Sodium, Potassium, Calcium and Magnesium. Water with high TDS produces scales on cooking vessels and boilers. Water containing more than 500 mg/L of TDS is not considered suitable for drinking water supplies.The TDS concentration in Kunnur sample unit is varying from 310 mg/L to 440 mg/L with an average of 373.3 mg/L. In Annaipatty it ranges from 600 mg/L to 800 mg/L with n average of 783 mg/L. Concentration of TDS in Vaigai Dam sample unit varying from 140 mg/L to 370 mg/L with an average of 230 mg/L. The values of both Kunnur and Annaipatty sample units are not within acceptable limits of WHO and ISI standards. Where as the TDS value of Vaigai Dam sample unit lies in the permissible limit of BIS and WHO standards. Also TDS value is higher in summer than the rainy and winter seasons in all the three sample units.

Total Suspended Solids

The TSS concentration in Kunnur sample unit is varying from 6 mg/L to 26 mg/L with an average of 13.5 mg/L. In Annaipatty it ranges from 1mg/L to 10 mg/L with an average of 4 mg/L. Concentration of TSS in Vaigai Dam sample unit varying from 12 mg/L to 30 mg/L with an average of 19.5mg/L. The values of all the three sample units are well Within the permissible limits of WHO and ISI standards. The maximum value was observed at Vaigai dam sample unit during monsoon period and minimum was observed in post monsoon period. In monsoon period the TSS value was high due to floating materials like fine silts and detritus carried by rain water from the catchment. This is in acceptance with the findings of Muduli Bipra Prasanna et al. (2010).

Electrical Conductivity

These may be attributed to leaching processes along the flow direction, high rates of evaporation and anthropogenic activities prevailing in the area (Adil Elkrail et al., 2012). Electrical conductivity shows that total soluble salt content in water. Conductivity is an important criterion in determining the suitability of water for irrigation.The value of EC in Kunnur sample unit is varying from 400 micro mhos/cm to 710 micro mhos/cm with an average of 545 micro mhos/cm. In Annaipatty it ranges from 650 micro mhos/cm to 1060 micro mhos/cm with an average of 842.5 micro mhos/cm. The value of EC in Vaigai Dam sample unit is varying from 300 micro mhos/cm to 420 micro mhos/cm with an average of 351.6 micro mhos/cm. The Value of EC is high during Summer and less during Monsoon and post Monsoon period in all the sampling units. EC OF Vaigai dam sample unit lies within the permissible limit where as Annaipatti and kunnur samples lie in the range of medium salinity.

Dissolved Oxygen

The concentration of dissolved oxygen regulates the distribution of flora and fauna. Seasonally the concentration of dissolved oxygen was more during monsoon and least during summer. In the present investigation the concentration of dissolved oxygen in Kunnur sample unit is varying from 1mg/L to 2.4 mg/L with an average of 1.5 mg/L. In Annaipatty it ranges from 2.4 mg/L to 4.6 mg/L with an average of 1.5mg/L. Concentration of DO in Vaigai Dam sample unit varying from 4 mg/L to 6 mg/L with an average of 4.1mg/L. Low DO value is seen in both Kunnur and Annaipatty sample

unit. This may be due to poor productivity. This is in acceptance with the findings of Schuster,(1952).

Magnesium

The source of magnesium in natural water are various types of rocks, industrial waste and sewage. The total hardness of water is due to Ca, Mg. There is evidence that hard water plays a role in heart diseases (Sastry and Rati,1998). Higher concentration of Mg makes the water unpalatable and act as laxative to humanbeings.The Mg Concentration in Kunnur sample unit is varying from 14mg/L to 28 mg/L with an average of 19.75 mg/L. In Annaipatty it ranges from 38mg/L to 70 mg/L with an average of 45.8 mg/L. Concentration of Mg in Vaigai Dam sample unit varying from 8.6 mg/L to 16.5 mg/L with an average of 12.2mg/L. The results reveal that Mg concentration lies within permissible limit at Kunnur and Vaigai dam Sample units. Whereas at Annaipatty Mg concentration do not lie within the BIS and WHO permissible limit. Hence treatment of the water is necessary for drinking and irrigation purposes.

Table1: Chemical composition of Vaigai River water at Kunnur sampling unit .

Months	TDS (mg/ L)	TSS (mg/ L)	EC (Micro mhos/cm)	DO (mg/ L)	Mg (mg/ L)
Nov	380	12	490	1.4	18.3
Dec	390	13	440	1.4	19.4
Jan	400	13	410	1.5	21.5
Feb	400	20	630	2.0	22.8
Mar	450	24	600	2.2	25.6
Apr	440	26	710	2.4	28.0
May	410	14	700	1.7	27.9
June	300	8	610	1.0	15.5
July	320	6	54	1.1	14.0
Aug	310	8	500	1.2	14.2
Sep	330	8	510	1.3	14.8
Oct	350	10	400	1.3	15.0

Table 2: Chemical composition of Vaigai River water at Annaipatty sampling unit .

Months	TDS (mg/ L)	TSS (mg/ L)	EC (Micro mhos/cm)	DO (mg/ L)	Mg (mg/ L)
Nov	720	03	760	3.2	44.3
Dec	750	04	700	3.4	46.2
Jan	770	04	660	3.4	48.8
Feb	790	06	830	3.6	50.2
Mar	780	08	940	3.6	52.8
Apr	800	10	1060	4.6	70.2
May	716	04	1050	3.8	57.8
June	610	03	980	2.2	38.5
July	620	02	900	2.4	38.0
Aug	600	01	880	2.6	40.0
Sep	650	02	700	2.8	40.4
Oct	700	03	650	3.0	42.3

Table3: Chemical composition of Vaigai River water at Vagai Dam sampling unit .

Months	TDS (mg/ L)	TSS (mg/ L)	EC (Micro mhos/cm)	DO (mg/ L)	Mg (mg/ L)
Nov	210	12	490	4.8	11.8
Dec	220	13	440	5.0	12.0
Jan	240	13	410	5.1	12.5
Feb	300	20	630	5.3	13.9
Mar	350	24	600	5.8	14.5
Apr	370	26	710	6.0	16.5
May	214	14	700	5.4	15.9
June	150	08	610	4.0	8.6
July	170	06	540	4.2	9.8
Aug	140	08	500	4.6	10.0
Sep	190	08	510	4.6	10.2
Oct	200	10	400	4.8	11.4

Fig 1:

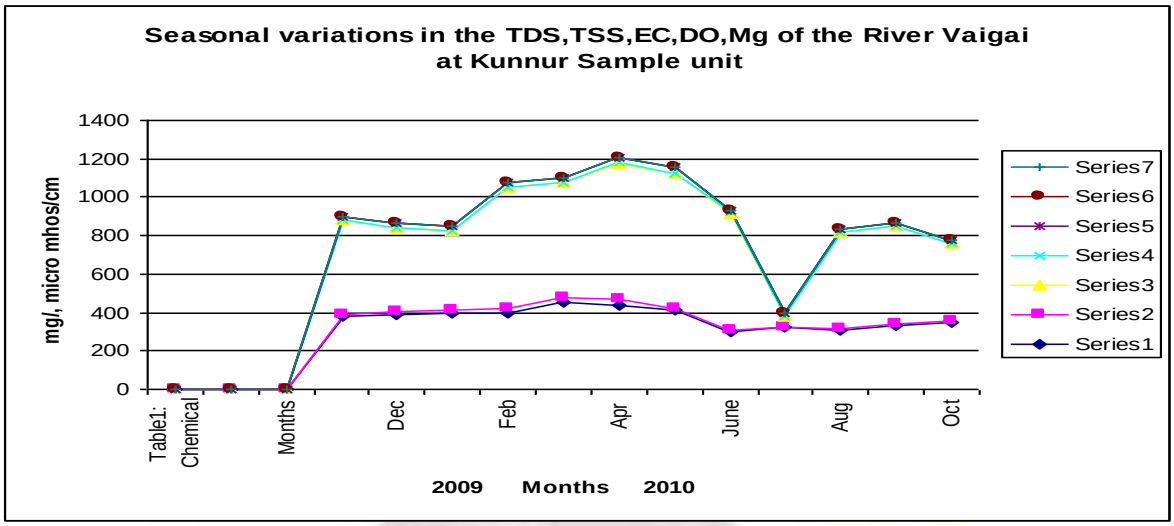

Seasonal variations in the TDS,TSS,EC,DO,Mg of the River Vaigai at Kunnur Sample unit
mg/, micro mhos/cm
1400
1200
1000
800
600
400
200
0
Table1: Chemical
Months
Dec
Feb
Apr
June
Aug
Oct
2009 Months 2010
Series7
Series6
Series5
Series4
Series3
Series2
Series1

Fig2:

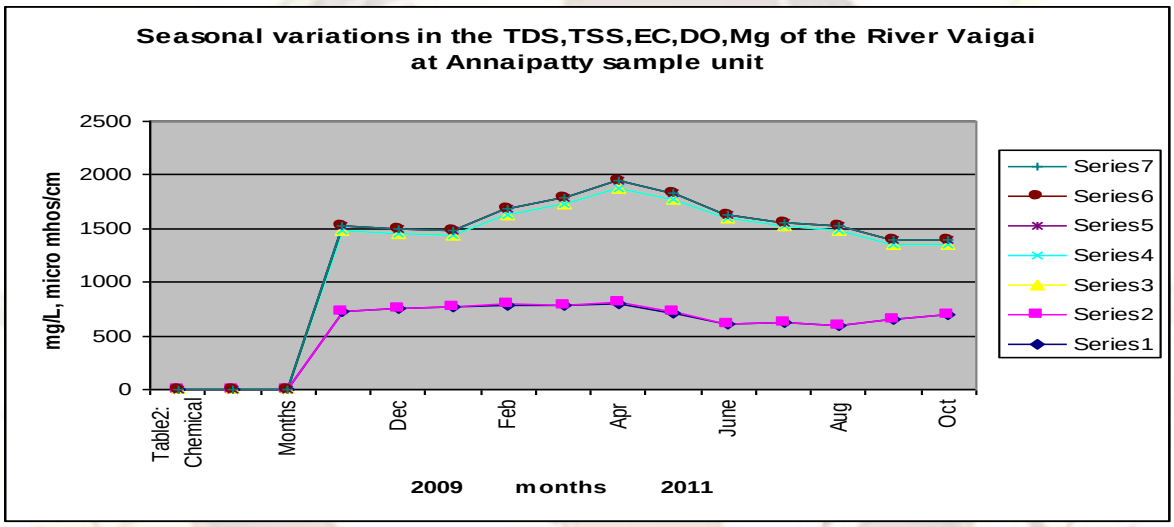
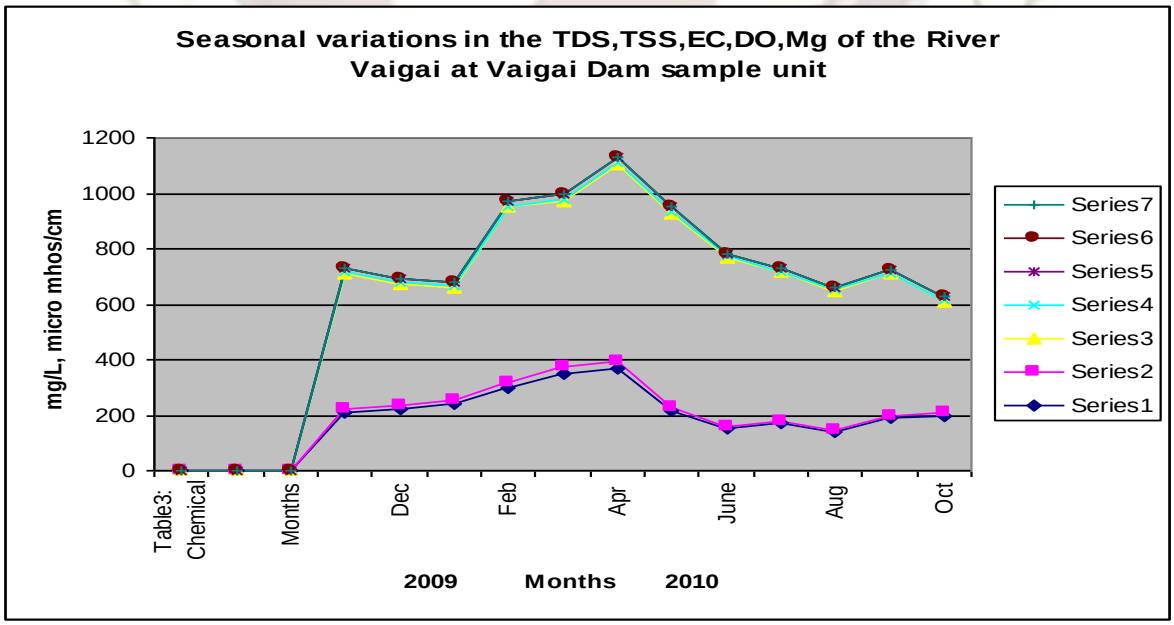

Seasonal variations in the TDS,TSS,EC,DO,Mg of the River Vaigai at Annaipatty sample unit
mg/L, micro mhos/cm
2500
2000
1500
1000
500
0
Table2: Chemical
Months
Dec
Feb
Apr
June
Aug
Oct
2009 months 2011
Series7
Series6
Series5
Series4
Series3
Series2
Series1

Fig 3:


Seasonal variations in the TDS,TSS,EC,DO,Mg of the River Vaigai at Vaigai Dam sample unit
mg/L, micro mhos/cm
1200
1000
800
600
400
200
0
Table3: Chemical
Months
Dec
Feb
Apr
June
Aug
Oct
2009 Months 2010
Series7
Series6
Series5
Series4
Series3
Series2
Series1

Conclusion

The hydrochemical investigation indicates that the concentration of TDS, TSS, EC, DO and Mg lie within the permissible limits of WHO and BIS standards at Vaigai Dam sampling unit.Whereas these chemical compositions are not within permissible limits at Annaipatty and Kunnur Sampling units. Deleterious levels of almost all the physico-chemical parameters were observed, which stands as a potential health hazards to the inhabitants of the area, that uses these water resources directly for domestic purpose without treatment. The overall observation of the data indicate a deterioration of water quality in the water resources. It is therefore needful that steps to be taken to ensure effective water resources management.

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