Int.J.Curr.Microbiol.App.Sci (2015) 4(2): 880-895

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 4 Number 2 (2015) pp. 880-895**
http://www.ijcmas.com

Original Research Article

Analysis of Water Quality using Limnological Studies of Wyra Reservoir, Khammam District, Telangana, India

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Keywords

Physico-chemical, Wyra reservoir, Pisciculture, Total Dissolved solids

A B S T R A C T

The present study was undertaken to assess the quality of water by using physico – chemical parameters of Wyra reservoir of Khammam district, Telangana, India. Monthly changes in physico-chemical parameters were analyzed for a period of one year from 2011 January to December. In the present study air, water temperatures, Dissolved oxygen, alkalinity, chlorides, Total dissolved solids and hardness turbidity etc, Results indicated that the quality of water from this reservoir is within the acceptable values. On the basis of the limnological analysis, it was found that, some physico- chemical parameters showed seasonal fluctuations. It has been found that the water can be used for drinking purpose in winter and summer seasons, and also water can be used for irrigation and pisciculture.

Introduction

Water is life. No life can exist without water. Water resources are of critical importance to both natural ecosystem and human development. It is absolutely essential for domestic purposes for cleaning, cooking, bathing, and carrying away wastes, and in agriculture for irrigation, power generation, industries, navigation, propagation of wild life, fisheries, recreation, aesthetics etc. Manifold increase in population has resulted in a rapid decrease in the ground water level due to its over exploitation. Water, the matrix of life is exposed to pollution, unhealthy environment, resulting in human affliction and diseases transmission due to rapid industrialization and population (Simpi et al., 2011). Acquiring potable water is a day to day struggle for most of the people in the Khammam district. The healthy aquatic ecosystem is dependend on the physic-chemical and biological characterstics

(Venkatesharaju, 2010). In last two decades, there has been a growing necessity for conservation our resources, especially water. At the same time, growing populations, progressive industrialization and intensification of agriculture have led to increased pollution of surface waters. This induces ecological imbalance, deleterious for sustained development of fisheries resources Nevertheless, an increasing number of specially created environmental agencies are being assigned the task of conserving water quality for all use within one river or lake basin. Water is scare and valuble resource and it is highly essential for the survival of mankind. Water also plays an equally important role in food control. Water quality monitoring is of immense importance in the conservation of water resources for fisheries, water supply and other activities; it involves the assessment of physico-chemical parameters of water bodies. Impacted changes in the quality of water are reflected in the biotic community structure, with the vulnerable dying, while the most sensitive species act as indicators of water quality. Discharge of pollutants from agriculture and industries and also sewage disposal are major causes of pollution of water of reservoirs (Singh et al., 2004, Vega et al., 1996, Sillanappa et al., 2004). Extensive evaporation of water from the reservoir due to high temperature and low rain enhances the amount of salts, heavy metals and other pollutants, which are conscientious factor for the poor quality of the reservoir ecosystem (Arain et al., 2008). Among environmental pollutants, metals are of particular concern, due to to their potential toxic effect and ability to bioaccumulation in aquatic ecosystems (Miller et al., 2002). The major ions are Ca+, Mg+, Na+, K+, Cl-, HCO_3 and CO^3 are essential constituents of water and responsible for ionic salinity as compared with other ions (Wetzel, 1983). Contamination of aquatic ecosystems with heavy metals is a serious problem, all over the world (Solak and Dogan, 1995). Wyra reservoir being an important ecological site, this study is aimed at providing useful inputs and necessary for the management of the environmental aspects of the many multi-purpose lakes and reservoirs. Despite such an exhaustive work, up to now, there was no systematic study carried out for the physico-chemical analysis and quality control assessment Wyra reservoir for a period of January -2011 to December -2011.

Materials and methods

Study area

To evaluate the water quality an effort was made to investigate the water in wyra reservoir, Khammam district, Telengana, India. It lies between North latitude 17° 11′ and East longitude 80° 22′ the total catchment area of 19.14 sq.km. The climatic conditions of the study area with hot summer, cool winter and rainy season. The region gets much rainfall from south west monsoon. The place gets most of its rain fall from June to September during the monsoon generally highest rainfall observed in the month of June during the study period. The average rainfall of this study area is 793.06 mm. The reservoir water is used for drinking, agriculture, boating (recreation) and supports fish culture.

Collection of sample

In order to determine the water quality, water samples collected from the Wyra reservoir during January –December 2011 in the first week of every month. Some of the results were recorded in the laboratory, according to APHA in 2005 and Kodrakar et al, 2008.

Analysis

The samples thus collected were analyzed for a number of physic-chemical parameters. Protocols were mostly based on the standard methods for the examination of water and waste water (APHA, 1998). The water samples were collected during the month of January to December 2011.The samples for analyses were collected in satirized bottles. Almost care was taken, so that no bubbling should observe during sampling, which avoids influence of the dissolved oxygen. The temperature was recorded at the sample site. The chemicals used were of A. R. grade and was used without further purification. The solutions were prepared in distilled water. The pH of water sample was measured with the help of pH meter (Elico LI-120) with a glass electrode. The pH meter was calibrated using buffer of pH 4.0 and 7.0.

Statistical analysis

All the Statistical analyses were carried out using SPSS for windows release 10.0. The season wise grouped data were used to calculate Student-Newmen-Keuls test (this is the one way ANOVA post hoc non parametric test, for making comparison among the means of three different seasons).

Result and Discussion

Water plays a vital role in the ecology of flora and fauna. Quantity and quality are two major issues involved in the use of water. The main purpose of analyzing physical and chemical characterstics of water is determine its ecological status. One of the major problems of fresh water bodies is eutrification due to allochthonous/nutrient input (perticulerly of phosphorous and nitrogen) from external sources. Social development and human activities greatly accelerate eutriphication. The physico-chemical characteristics of water quality may be affected by rainfall, temperature, availability of light. The monthly variation in physico-chemical parameters was presented in Table -1. The physico-chemical parameters such as temperature, pH, DO, organic and inorganic constituents play an important role in determining the nature and pattern of fluctuations of population densities of zooplankton in an aquatic environment. The physico-chemical analysis of water is the prime considerations to access the water quality for its best utilization like drinking, irrigation, industrial fisheries purpose and helpful in the understanding the complex process interaction between the climatic and biological process in the water. The physico-chemical parameters of water and dependence of all life process of these factors make it desirable to take water has environment. Therefore any change in any one of the factor directly or indirectly influence the other parameters.

Atmospheric temperature

Temperature is a primary environmental factor that affects and governs the biological activities and solubility of gases in water. Owing to the gases in air, humidity, dust and other colloidal particles, the air temperature is always higher than water temperature. The Atmospheric temperature of Wyra ranged from 22.8°C to 33.7°C in different seasons. Variation in the air and surface water temperatures are due to changing seasons. A high temperature was recorded during summer and lower tempratue during post monsoon, which is a normal feature in fresh water bodies. The temperature directly influences some of chemical reactions in aquatic eco systems and it is important physical parameter (Jakhar and Rawat, 2003). Any increase in water temperature

decreases the dissolved oxygen concentration (Huet and Timmermans, 1986).

Water temperature

Temperature is basically important parameters and affects on the chemical and biological in the organisms of water (Trivedi and Goel, 1986). The temperature of reservoir water ranged from 21.6°C to 30.9°C in different seasons. The water temperature is always lower than air temperature. The reason for higher temperature values can be attributed to low water level, low velocity, clear atmosphere and greater solar radiation while its lower values can be explained due to frequent clouds, high percentage of humidity, high current velocity and high water levels.

High seasonal variations were observed at different sites of reservoir. The water temperature was high due to the low water levels and high air temperatures. Sharma et.al, (2000) observed that water temperature fluctuate between 21°C to 29°C during limnological studies of Udaipur lakes. Water temperature plays an important role which influences chemical, biological characteristics of water body. It is noticed that water temperature is always lower than that of air temperature due to various reasons like gases in the air, humidity, dust and other colloidal particles.

P^H

During the present study water p^H values were found to be 7.2 to 7.74. It is indicating that it possesses alkalinity nature throughout the study period. The high values may be due to the sewage discharged from agricultural fields and higher temperatures. P^H values were important for plankton growth (Chisty, 2002). Earlier studies reported by Umavathi et.al, (2007) recorded taht pH is ranged from 5 to 8.5 which is best for plankton growth. The pH of water effects many chemical and biological process in water. The largest variety of aquatic animals prefer a range of 6.5- 8.0.

Dissolved Oxygen (DO)

Dissolved oxygen is a most important aquatic parameter; it is vital to aquatic fauna. It plays an important role in the respiration process. Adequate DO is necessary for good water quality. In the present study, the DO values ranged from 4.1 to 6.5 mg/l (figure). Previous studies reported by Benerjee (1967), and Torzwell (1957), stated that the DO concentration of about 5mg/l throughout the year was found to be productive for Fish culture. As DO levels in water drop below 5.0 mg/L, many life forms are put under pressure (Bowman et al., 2008).

Alkalinity

Alkalinity of natural water is due to the salts of carbonate, bicarbonates, silicates phosphates along with hydroxyl ions. In the present study alkalinity values were ranged from 40-140mg/l. The direct relation of alkalinity to productivity has been reported by Goldman and Wetzel man (1963) and Shreenivasan (1964). An increase in the free CO2 may result in the increase in alkalinity (Singhal et al., 1986).

Hardness

In the present study, total hardness ranged from 180-240 mg/l in different seasons. Hardness often employed as indicator of water quality depends on the concentration of carbonates and bicarbonate salts of calcium and magnesium or sulphate chloride or other anions of mineral acids. The above

higher values may be due to increased concentration of these ions. Hardness is inversely proportional to water volume and directly proportional to rate of evaporation. When the concentration of calcium and magnesium ions is less than 40 ppm, it is considered as soft water and if the concentration is greater than 40ppm it is hard water. Hujare (2008) reported total hardness was high during summer than rainy season and winter season. The total hardness was below the desirable limits of 300 mg/ L (BIS, 1991).

Electro conductivity

The electrical conductivity of water depends upon ions present in water. It reflects the Nutrient status of water and distribution of Macrophytes. In the present study, the EC values ranged from 536 to 613 mmho. The overall mean record was 575.58 mmho. The seasonal variation of the conductivity in the present study may be due to the insufficient inflows of freshwater, discharge of silt and salts from the surrounding agricultural fields as well as the discharge of domestic effluents. Das (2000) studied the limno-chemistry of some important reservoirs of Andhra Pradesh and observed that specific conductivity was in the range of 316 to 610 ms/cm.

Total Dissolved Solids

Dissolved solids are important in drinking water and other water quality standards. Water probability depends on the total dissolved solids. Total dissolved solids value ranged from 346 to 406 mg/l in different seasons. The desirable level of TDS is 500 mg/L where as the permissible limits is 2000 mg/L. Similar values of TDS are reported by Rao et al (2003), Kirubavathi et al (2005). The TDS analysis plays an important role in the control of Biological and physical waste water treatment processes. During present study the total dissolved solids were high in summer followed by winter and rainy. Devi (1997) also reported the maximum total dissolved solids during pre monsoon season and lowest during monsoon in Shathamraj and Ibrahimbag reservoirs of Hyderabad. Presence of excess of TDS may cause gastrointestinal irritation and if used for cooking will form scales on the cooking vessels (Anadaparameswari et al., 2007).

Fluorides

In the present study fluoride values ranged from 0.4 to 0.6 mg/l with the mean value 0.5.High concentration of fluoride may reflects on aquatic ecosystem.

Nitrates

Nitrates are essential nutrients for plant growth. During the study nitrate fluctuated between 0.01 to 0.04 mg/l. these values are much lower than the Chisty (2002) and Rani et al (2004). High concentration of nitrate in drinking water is toxic (Umavathi et al 2007).

Calcium

Calcium is found in all the natural waters and its main source is weathering of rocks from which it leaches out .In the present study Calcium ranged from 40 to 130 mg/l with mean value 89.16 mg/l concentration of Calcium ions indicates the hardness of water the hardness of water with 15 ppm more satisfactory for growth of fishes (Rajashekar et al., 2005).

Chlorides

Chlorides plays a very important role to determine the water quality in a water body, indicate the presence of high organic matter. Chlorides occure in most fresh water, as the salts of sodium or calcium. Chloride ions are

essential for plants and animals. Chlorides found high during the study ranged in between 80 to 240 mg/l. In the present study the higher chloride values were recorded in summer and lower in rainy. Many results are also reported in different studies by Swarnalatha and Narsing rao (1998) and Umavathi et al., (2007) showed that higher concentration of chloride indicates the increased levels pollution in water bodies.

Turbidity

Water turbidity is mainly due to suspended in organic substances like clay, silt, phyto-zooplankton and sand grains Reservoirs with clay bottom are likely to have high turbidity. During the present study turbidity values ranged from 0.5 to 2.2 NTU. The maximum values (2.2 NTU) Was recorded in the month of May it might be human activities, decrease in water levels and presence of suspended particulate matter, and minimum value (0.5 NTU) in the month of march.

Correlation (r) between different parameters

In the present study the correlation coefficient (r) between every parameter pair in computed by taking the average values as shown in table-3. Correlation coefficient (r) between any two parameters, x & y is calculated for parameter such as PH, atmospheric temperature, water temperature, dissolved oxygen, alkalinity, hardness, elecroconductivity, total dissolved solids, fluorides, nitrates, calcium of the wyra reservoir. The degree of line association between any of the water quality parameters measured by the simple correlation coefficient (r) is presented in table-3 as correlation matrix. The PH has been found to show positive correlation with air temperature (r=0.034), conductivity (r=0.086), fluorides (r=0.324), negative correlation with water temperature (r=-0.036), dissolved oxygen(r=-0.305), alkalinity (r=-0.5), hardness, calcium, chlorides and also Water temperature has been found to show strong correlation with dissolved oxygen (r=0.712), alkalinity(r=0.081), conductivity (r=0.77), chlorides (r=0.512), turbidity. Data is the mean value of monthly collected samples. The value (r) ranged from 0.300 to 0.558 and 0.851 to above are significant at $p<0.05$ and $p<0.01$ respectively.

The present investigation is an attempt to assess the physico-chemical parameters in Wyra reservoir of Khammam district Telangana, India. Due to man made activities, anthropogenic stress have a considerable effect on the physico-chemical characteristic of water samples of wyra reservoir. The results reveal that the all water quality parameters are within the permissible limits. Reservoir is not polluted. The water is useful for drinking, irrigation, fishing and hydro electric generation activities.

The primary aim of this study is to understand the elements affecting reservoir water quality. Another goal is to show the benefits of keeping a long term record of water quality data. Such a record documents changes and helps to distinguish between a reservoir natural variability and the impacts of human activity. Based on the results of the present study it can be stated that, the fish productivity of the Wyra reservoir can be improved, if the physicochemical parameters of the water body are maintained at required levels. This will help in uplifting of the economic condition of the natives. However, further detailed pilot studies are required for the improvement of the water quality and fish productivity.

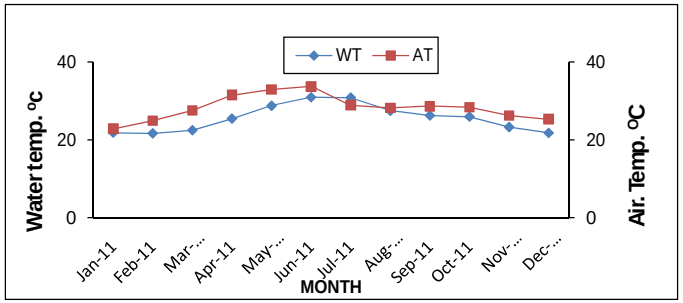
Table.1 Wyra Reservoier Water Analysis Jan -Dec 2011

	pH	AT	WT	DO	ALK	HARD	EC	TDS	FLOU	NO2	CA	CL	TUR
11-Jan	7.48	22.8	21.8	4.1	80	180	557	359	0.4	0.02	130	100	1.6
11-Feb	7.58	24.9	21.6	4.2	80	180	540	348	0.4	0.02	90	80	0.8
11-Mar	7.6	27.5	22.4	4.4	40	180	536	346	0.6	0.03	70	120	0.5
11-Apr	7.74	31.5	25.4	4.8	60	180	570	348	0.6	0.02	40	120	1.2
11-May	7.44	32.9	28.7	5.2	80	220	586	378	0.4	0.01	60	140	2.2
11-Jun	7.46	33.7	30.9	5.8	120	240	602	388	0.6	0.04	70	120	0.8
11-Jul	7.74	28.9	30.8	6.1	40	220	613	382	0.4	0.03	90	220	1.3
11-Aug	7.26	28.2	27.4	6.3	60	220	572	402	0.4	0.04	100	240	1.1
11-Sep	7.54	28.6	26.2	6.5	120	240	595	406	0.4	0.04	100	240	1.2
11-Oct	7.2	28.3	25.9	6.1	140	190	572	368	0.4	0.01	90	190	1.1
11-Nov	7.62	26.2	23.2	5.4	100	200	588	379	0.6	0.02	110	160	0.8
11-Dec	7.42	25.3	21.7	4.8	80	200	576	372	0.6	0.03	120	120	1.2
SUM	90.08	338.8	306	63.7	1000	2450	6907	4476	5.8	0.31	1070	1850	13.8
AVERAGE	7.506667	28.23333	25.5	5.308333	83.33333	204.1667	575.5833	373	0.483333	0.025833	89.16667	154.1667	1.15
MIN	7.2	22.8	21.6	4.1	40	180	536	346	0.4	0.01	40	80	0.5
MAX	7.74	33.7	30.9	6.5	140	240	613	406	0.6	0.04	130	240	2.2
STDEV	0.166969	3.258927	3.437758	0.850089	31.71846	23.14316	23.3022	20.2215	0.102986	0.010836	25.74643	55.34328	0.440041

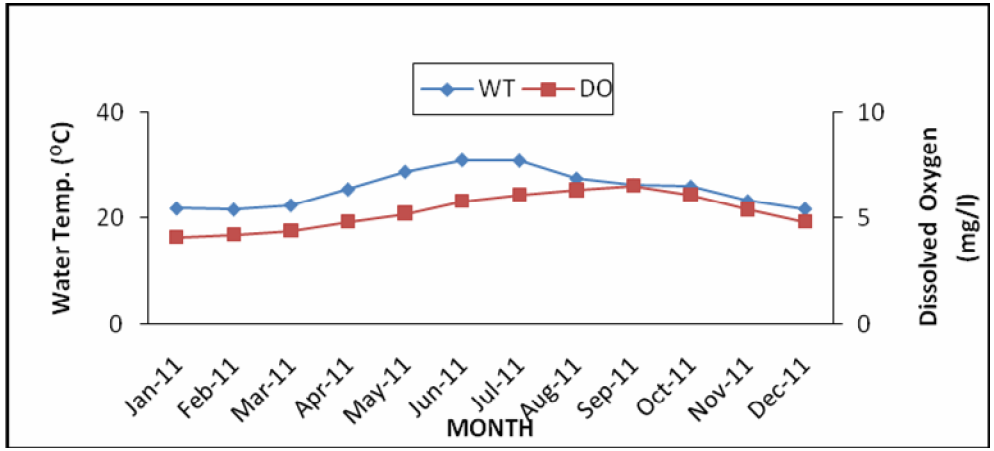
Table.2 Wyra Reservoier Water Analysis Correlations Jan -Dec 2011

	PH	AT	WT	DO	ALK	HARD	EC	TDS	FLOU	NO2	CA	CL	TUR
PH	1												
AT	0.034639	1											
WT	-0.03611	0.803976	1										
DO	-0.3053	0.450764	0.712988	1									
ALK	-0.50581	0.118435	0.081705	0.376491	1								
HARD	-0.1537	0.558475	0.758713	0.774374	0.301352	1							
EC	0.086296	0.513403	0.772032	0.733561	0.262806	0.799176	1						
TDS	-0.33656	0.290245	0.583771	0.851443	0.337333	0.903284	0.727727	1					
FLOU	0.324257	0.164326	-0.20029	-0.27864	-0.09277	-0.15893	-0.04483	-0.27938	1				
NO2	0.046895	0.099538	0.263558	0.398864	-0.11461	0.583018	0.273318	0.560078	0.1765	1			
CA	-0.29888	-0.80249	-0.43036	-0.01211	0.181825	-0.02416	-0.01427	0.260174	-0.24571	0.149346	1		
CL	-0.22562	0.184144	0.512226	0.901586	0.105303	0.595618	0.556248	0.780643	-0.41736	0.380232	0.13664	1	
TUR	-0.14848	0.19208	0.271029	0.037669	-0.01303	0.191924	0.300107	0.187983	-0.50151	-0.4099	-0.01204	0.087724	**1**

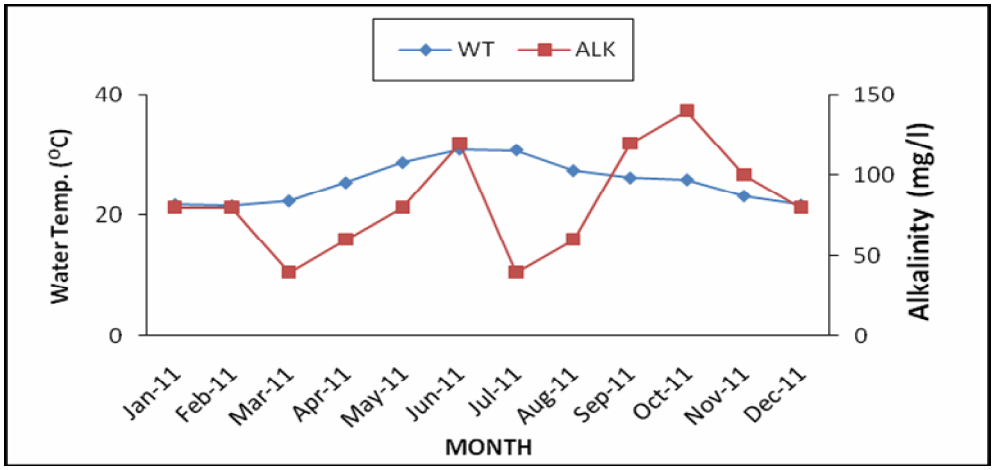
Correlation betweenWater Temperature (O C) and Air. Temp. (OC) in Wyra 2011



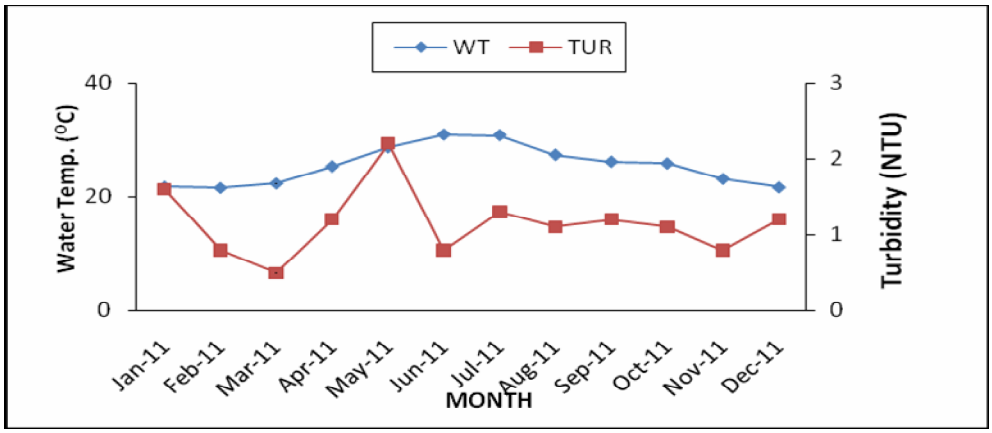
Correlation between Water Temperature (oc) and Dissolved Oxygen (mg/l) in Wyra 2011



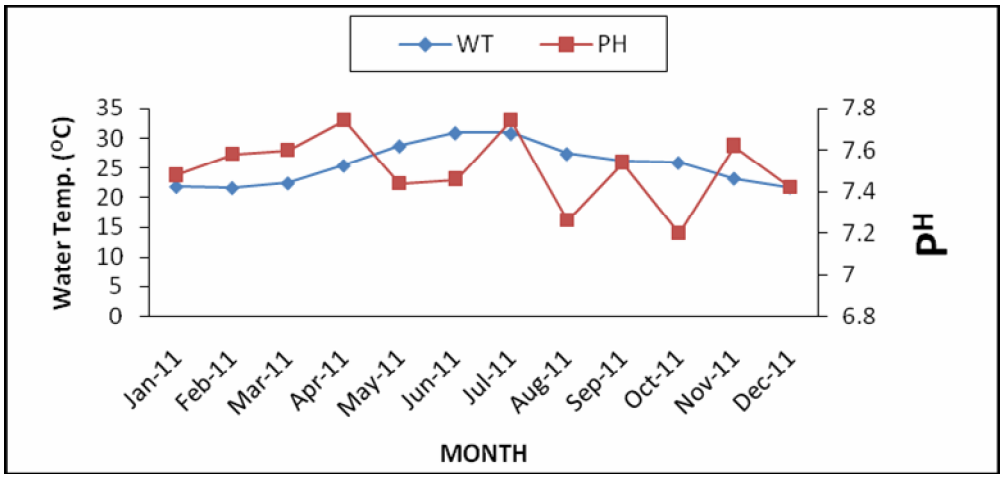
Correlation between **Water Temperature (^{o}C)** and **Alkalinity (mg/l)** in Wyra 2011.



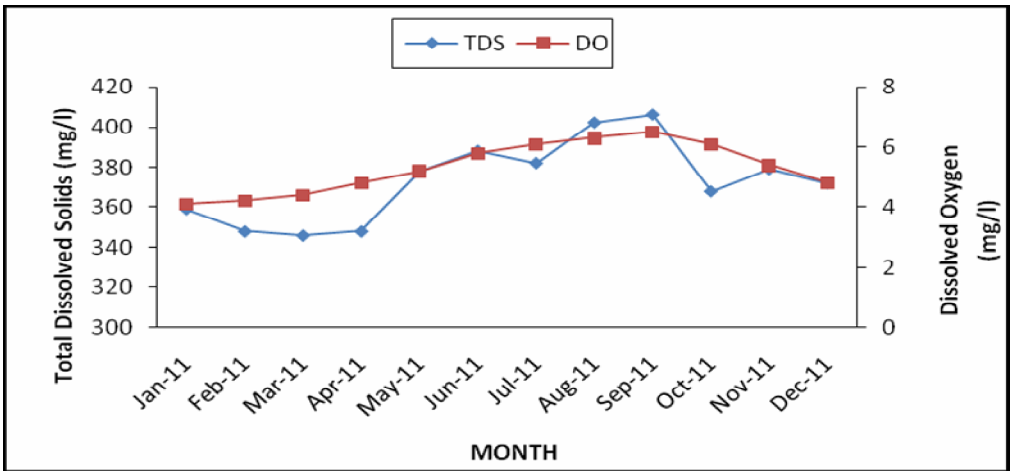
Correlation between **Water Temperature (^{O}C)** and**Turbidity (NTU)** in Wyra 2011



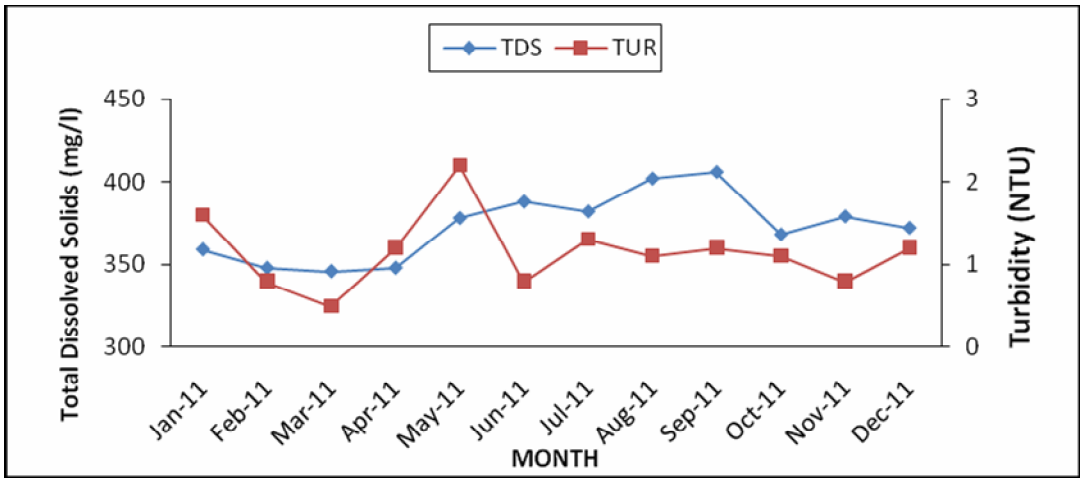
Correlation between **Water Temperature (^{O}C)** and **P ^{H}** in Wyra 2011



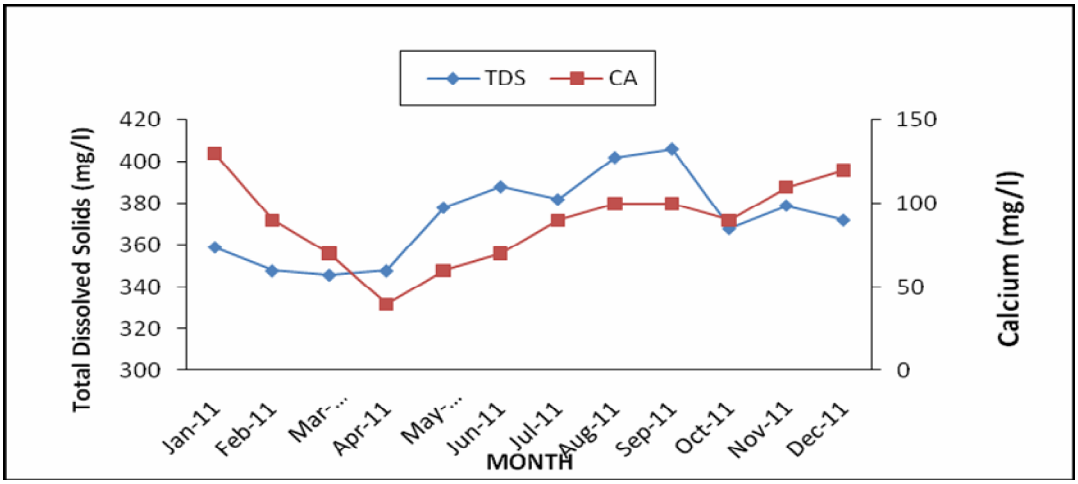
Correlation between **Total Dissolved Solids (mg/l)** and **Dissolved Oxygen (mg/l)** in Wyra 2011.



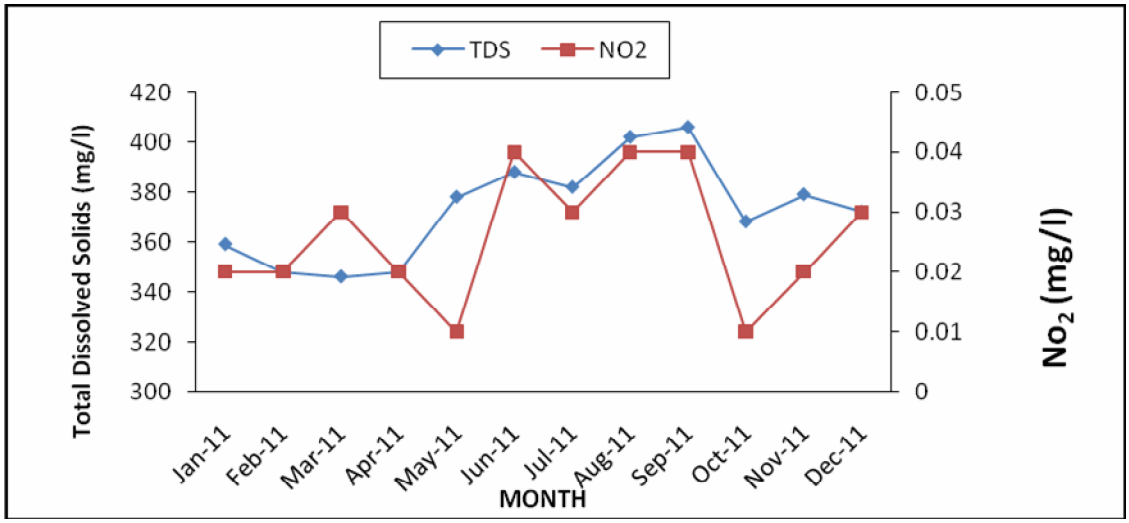
Correlation between **Total Dissolved Solids (mg/l)** and**Turbidity (NTU)**in Wyra 2011



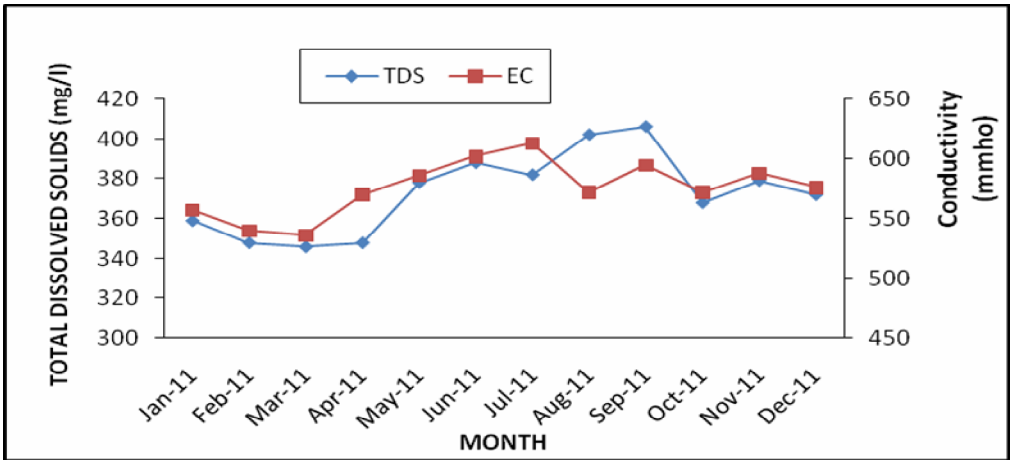
Correlation between **Total Dissolved Solids (mg//l)** and **Calcium (mg/l)**in Wyra 2011.



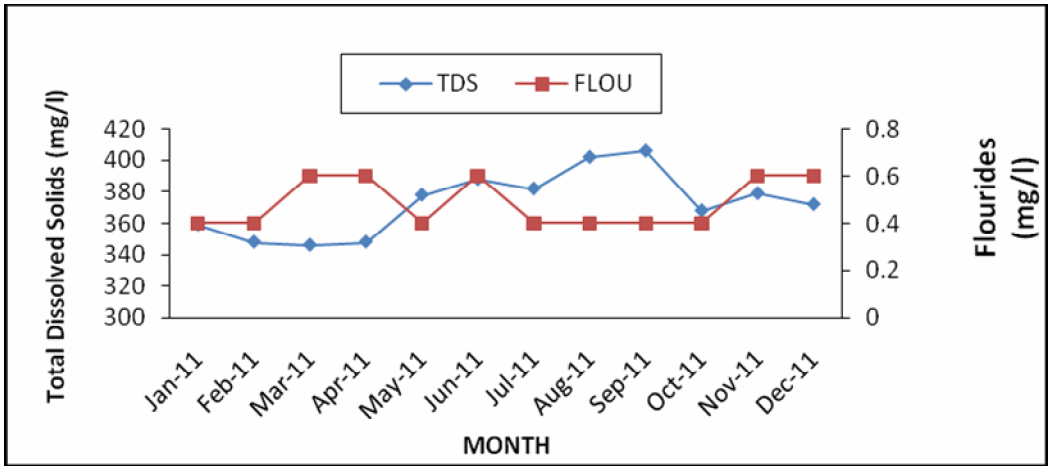
Correlation between **Total Dissolved Solids (mg/l)** and**No $_2$ (mg/l)**in Wyra 2011



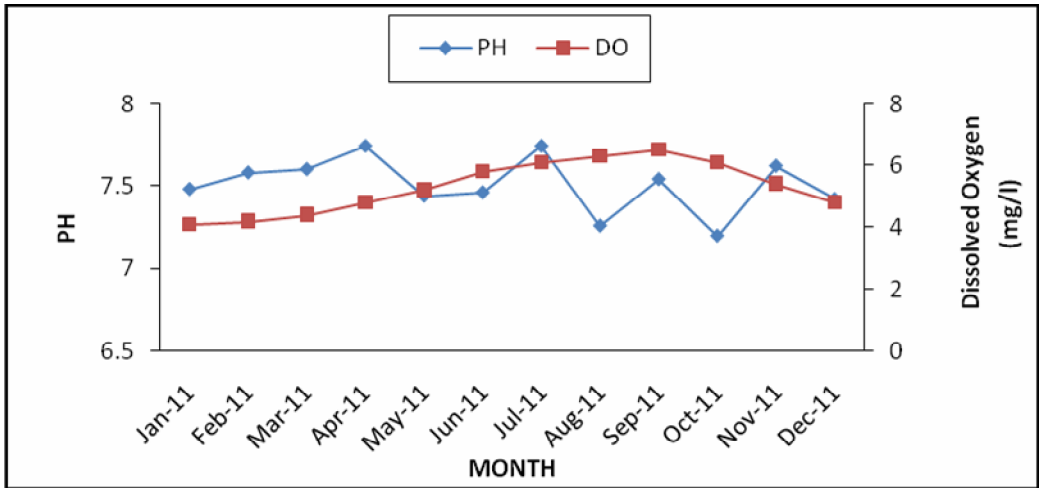
Correlation between **Total Dissolved Solids (mg/l)** and**Conductivity (mmho)**in Wyra 2011.



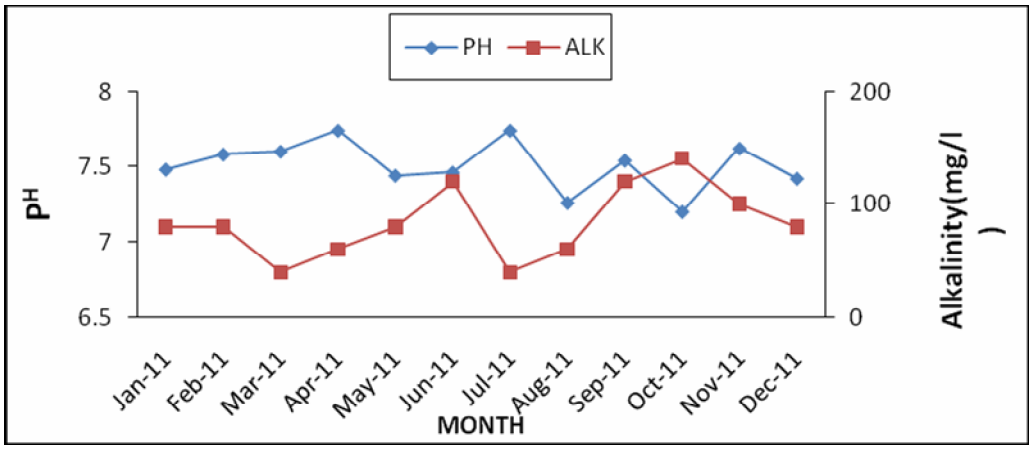
Correlation between**Total Dissolved Solids (mg/l)** and**Fluorides (mg/l)** in Wyra 2011.



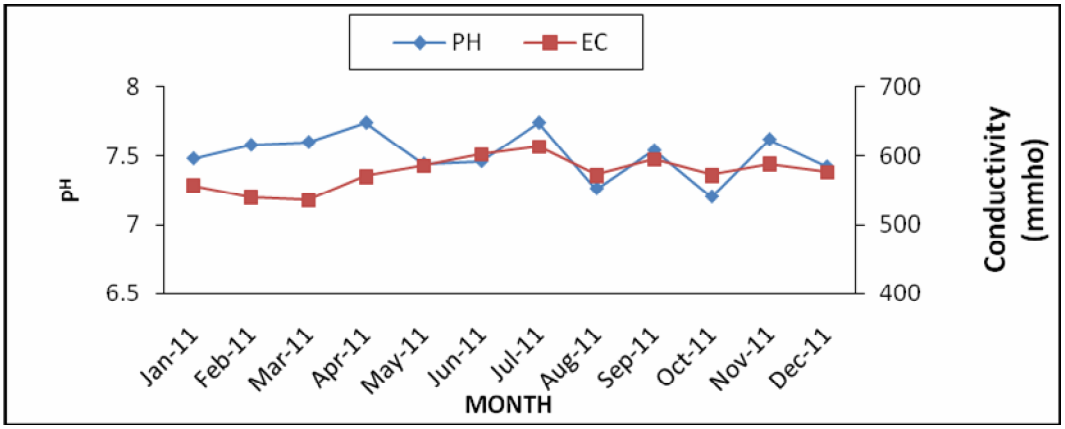
Correlation between **p^{H}**and**Dissolved Oxygen (mg/l)** in Wyra 2011.



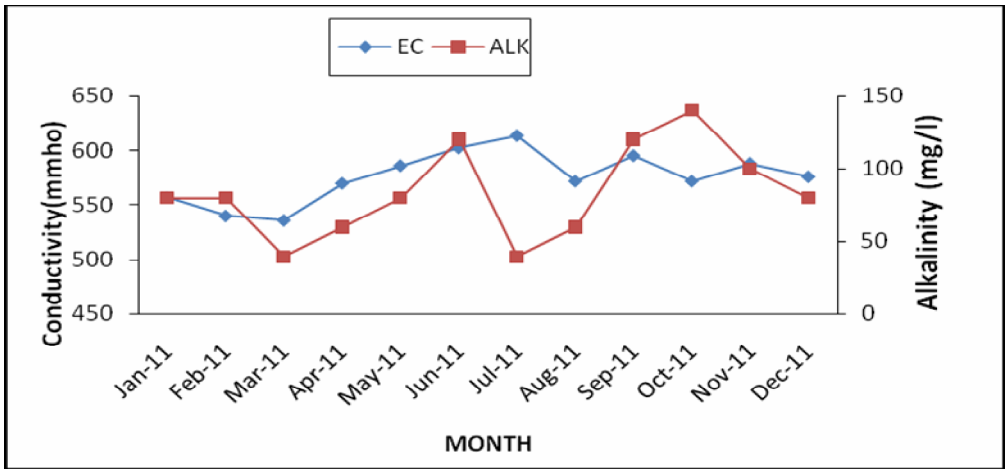
Correlation between **p^{H}** and**Alkalinity (mg/l)** in Wyra 2011



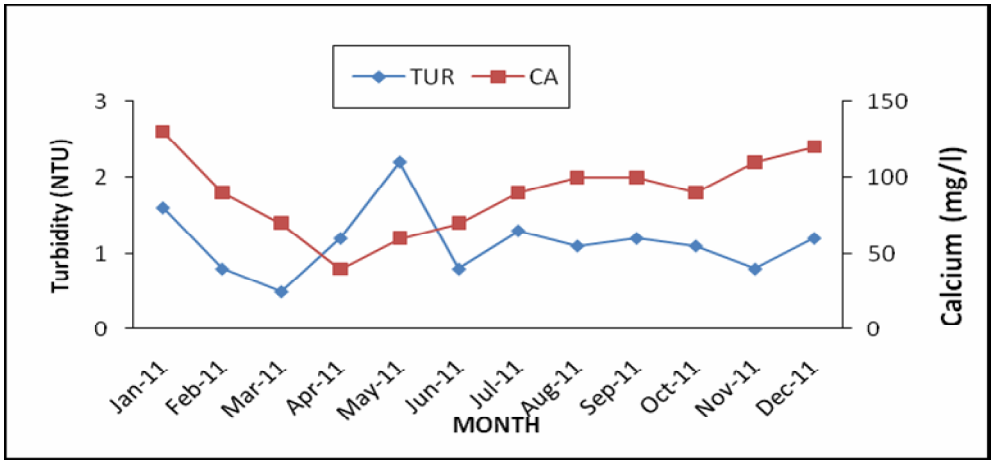
Correlation between **p^{H}** and**Conductivity (mmho)** inWyra 2011.



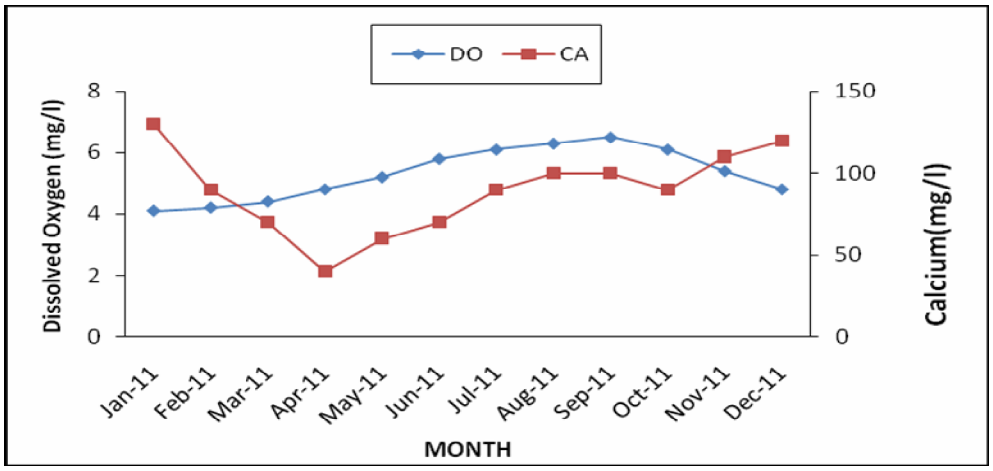
Correlation between **Conductivity (mmho)** and **Alkalinity (mg/l)** in Wyra 2011.



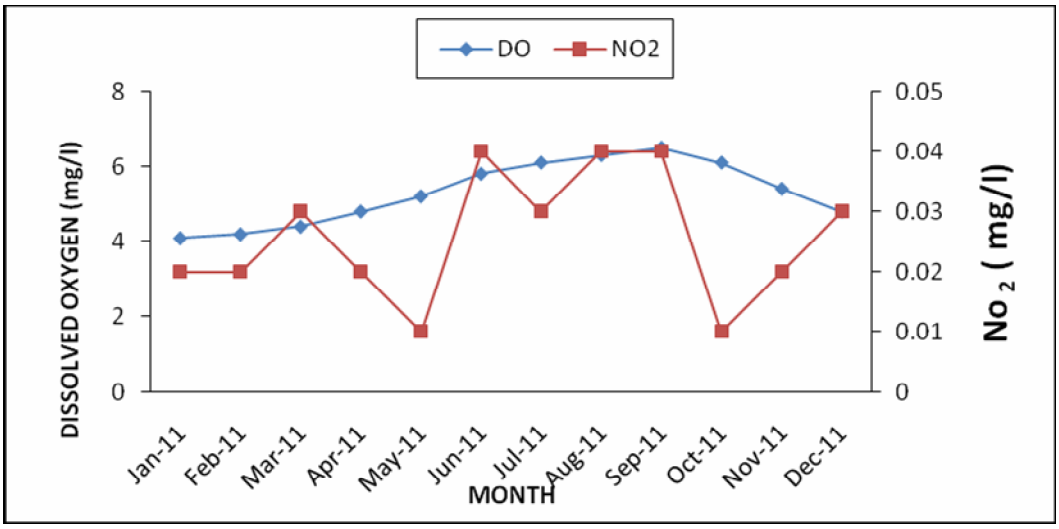
Correlation between **Turbidity (NTU)** and **Calcium (mg/l)** in Wyra 2011



Correlation between **Dissolved Oxygen (mg/l) and Calcium (mg/l)** in Wyra 2011.



Correlation between **Dissolved Oxygen (mg/l)** and **No_2 (mg/l)** in Wyra 2011.



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