INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN CHEMISTRY AND PHARMACEUTICAL SCIENCES

(p-ISSN: 2348-5213: e-ISSN: 2348-5221)
www.ijcrcps.com

Research Article

ANALYSIS OF WATER QUALITY SEASONAL VARIATIONS OF PALER RESERVOIR, KHAMMAM DISTRICT,TELANGANA, INDIA

JOHN MOHAMMAD. M*[1&2], P.V. KRISHNA[3], OSAMA A.LAMMA[4], SHABBAR KHAN[5]

*[1]Department of Environmental studies, Acharya Nagarjuna University, Nagarjunanagar, Guntur- 522 510, Andhra Pradesh, INDIA.
[2] Bomma Institute of Technology &Science, Khammam- 507 318, Telangana, India.
[3] Department of Zoology & Aquaculture, Acharya Nagarjuna University, Nagarjunanagar, Guntur- 522 510, Andhra Pradesh, INDIA.
[4] Department of Soil and Water Science, Baniwalid, Azzayatuna University, Libya
[5] Mohammadiya Institute of Technology & Science, Khammam- 507 163, Telangana, India

Corresponding Author: m.johnmohammad@gmail.com

Abstract

The present study dealt with assessment of the physico –chemical parameters and correlation coefficient of Paler reservoir, Khammam district, Telangana, India. The physico-chemical characteristics and correlation coefficient were studied and analyzed during janauary-december 2011. Seasonal fluctuations in water samples of Paler reservoir in different seasons were observed. The results revealed that there was significant seasonal variation in some physico- chemical parameters and most of the parameters were in normal range and indicated for better quality of reservoir water. Correlation co-efficient indicates showed high significant positive and negative relationship ($p<0.01$) and also show significant positive and negative relationship ($p<0.05$).

Keywords: Physico-chemical characteristics, Paler Reservoir, Correlation co-efficient.

Introduction

Water is one of the most essential natural resources for sustaining life and is likely to become critically scare in the coming decades, due to continuous increase in its demand, rapid increase in population and expanding economy of the country. Water is one of the abundantly available substances in nature. It is vital factor of life and it is considered as precious compound on the earth. The natural aquatic resources like rivers, ponds, streams and lakes are causing heavy and varied pollution in environment leading to changes in water quality and depletion of aquatic biota. Due to increased pollution, urbanization rapid growth of industrialization and disposal of sewage, domestic waste, industrial effluents and other human being activities. Pollution of water majorly shows effect on physico-chemical quality and then systematically destroys microbial and plankton communities thus it leads ecological imbalance of food chain in aquatic ecosystem. The surface water and ground water resources of the country play a major role in agriculture, hydropower generation, live stock production, industrial activities, forestry, fisheries, navigation, recreations activities. Etc., In an aquatic ecosystem, all the life processes are dependent directly or indirectly upon the various physical and chemical factors. Due to unplanned management, tremendous development of industry and agriculture and disposal of untreated public sewage water, agricultural run off and other human and animal wastes to rivers, lakes, reservoirs and water bodies are continuosly deteriorating their water quality and biotic resources (Venkateshan, 2007) The rise and fall of these factors very frequently affect the biota, varying qualitatively and quantitively. In other words, the growth, reproduction and development of biota are influenced by the physico-chemical factors.

Human anthropogenic activities are the main constituent agents in the increase of nutrients like phosphates, chlorides, and calcium and ultimately leads to eutriphication (Sekhar, 2008). Water quality provides current information about the concentration of various solutes as a given place and time. Water quality parameter provides the basis for judging the sustainability of water for its designated uses and to improve existing condition.

The study of different water parameters is very important for understanding of the metabolic events in aquatic ecosystems. The parameters influence each other and also the sediment parameters, as well as they govern the abundance and distributation of the flora and the fauna. Therefore, it has become obligatory to analyze at least the important water parameters when ecological studies on aquatic ecosystems carried out. Such studies, when done from time to time can indicate the favorable or unfavorable changes occurring in the ecosystems. Unequal distribution of water on the surface of the earth and fast declining, availability of usable fresh water are the major concerns in terms of water quantity and quality (Boyd et al., 1998).

In the present study, being the made an attempt, the morphometric data was obtained from the Irrigation department, Government of Telangana and the limnological data was obtained from the observations made during the field surveys of Paler reservoir during January-December 2011.

Materials and Methods

Study area

To evaluate the water quality an effort was made to investigate the water in Paler lake. Krishna River located in Khammam and Nalgonda districts in Telangana. It is situated about 30kms south western side of Khammam town. The paler reservoir has been constructed in the year 1928. it is located 17^{o} – 12' North latitude and 79-54' East longitude and is a balancing water body of Nagarjunasagar left canal. The total lake catchment area is 651.24 Kms, reservoir water spread area is 7600 hectares with 2.55tmc. The reservoir hosts good diversity of Itcthyofauna along with other fauna viz., Macro crustaceans, Malcofauna. etc., due its fish potentiality it has become lively hood to large number of fisherman families. The lake exclusively used for irrigation, domestic, fish culture and recreation and also useful for electricity (hydropower) generation.

Collection of sample

In order to determine the water quality, samples of water collected from the paler reservoir during January – December 2011 in the first week of every month. The samples were collected in acid washed five liter plasic container from a depth of 5-10 cm below the surface of water. The physic-like water temrature, turbidity, pH, Cnductivity, total dissolved solids, chloride, phosphate, and nitrate were determined in different seasons according to standard methods (APHA, 2005, Trivedy and Goel, 1986).

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 comparision among the means of three different seasons).

Results and Discussion

The monthly variation in physico-chemical parameters was presented in Table -1. There are some variations in different physico-chemical parameters have been observed during the study period. The physical and chemical properties of fresh water bodies are characterized by the climatic, geochemical, geomorphological and pollution conditions. The quality of aquatic life depends on the water quality. In order to utilize fresh bodies successfully for fish production, it is very important to study the physico-chemical factors which influence the biological productivity of the water bodies.

Atmospheric temperature

The Atmospheric temperature was recorded between 24.3^{o}c to 35. 2^{o}c. The reason for the exceptional lower temperature (air) of 26 can be attributed to the unseasonal rain during the period at the spot. The Atmospheric temperature is also one of the important factors in aquatic environment. It regulates physicochemical as well as biological activities (Kumar et al., 1996).

Water temperature

Water temperature is very important parameter, because it influence the biota in a water body by affecting activities such as behavior, respiration and metabolism.The temperature of surface water is also influenced by latitude, altitude, season, air circulation, cloud cover, flow and depth of water body. In present study, the water temperature was ranged from 21.1^{o}c to 34.2^{o}c. Water temperature fluctuations shows impact on aquatic animals. Highest water temperature was measured in June (33.8^{o}c) due to the summer; in summer maxima and in winter minima of water

temperature was reported by Patil and Pitamber (1996). The variation in the water temperature in present investigation may be due to the different timings of collections and the influence of seasons.

Table- 1 Paler reservoir water analysis Jan-Deceember2011

	PH	AT	WT	DO	ALK	HARD	EC	TDS	FLOU	NO2	CA	CL	TUR
11-Jan	7.15	24.6	21.4	4.3	120	200	618	399	0.4	0.01	110	120	1.0
11-Feb	7.25	26.3	21.1	4.1	100	220	639	412	0.4	0.03	110	140	0.8
11-Mar	7.48	27.9	26.2	4.4	80	220	618	399	0.6	0.01	90	120	1.5
11-Apr	7.48	31.2	29.2	5.1	80	180	508	328	0.6	0.02	50	120	1.0
11-May	7.7	35.2	34.2	5.3	100	180	503	324	0.4	0.02	40	100	1.0
11-Jun	7.64	34.3	33.8	5.9	60	240	606	391	0.4	0.02	60	180	2.1
11-Jul	7.5	29.4	28.2	6.2	120	200	540	348	0.4	0.03	90	160	1.2
11-Aug	7.47	29.4	28.2	6.4	100	220	575	245	0.4	0.04	100	160	0.8
11-Sep	7.19	31.3	29.4	6.5	80	180	476	357	0.6	0.06	110	120	0.8
11-Oct	7.5	29.2	27.4	5.9	60	220	530	342	0.4	0.02	100	140	0.6
11-Nov	7.25	26.2	24.2	5.8	100	200	580	374	0.6	0.02	90	120	1.0
11-Dec	7.56	24.3	22.3	4.8	120	180	589	380	0.6	0.01	80	140	1.2
SUM	89.17	349.3	325.6	64.7	1120	2440	6782	4299	5.8	0.29	1030	1620	13
AVE	7.43083333	29.10833	27.13333	5.391667	93.33333	203.3333	565.1667	358.25	0.483333	0.024167	85.83333	135	1.083333
MIN	7.15	24.3	21.1	4.1	60	180	476	245	0.4	0.01	40	100	0.6
MAX	7.7	35.2	34.2	6.5	120	240	639	412	0.6	0.06	110	180	2.1
STDEV	0.17865448	3.49895	4.351036	0.845801	21.46173	20.59715	52.69092	46.0121	0.102986	0.014434	23.91589	22.76361	0.39734

P^H

The pH is defined as the intensity of the acidic or basic character of solution at agiven temperature. P^H is a most important chemical factor of water. It is considered as important ecological factor of aquatic ecosystem. During the present study, P^H is ranged from 7.15 to 7.7 with mean value of 7.430. Alkaline waters harbor more plants than acidic waters. pH between 8.5 to 9.5 is unfavorable for the growth of aquatic organisms, but in the Paler reservoir the pH values around below these limits, supporting its growth. It is used in alkalinity and carbon dioxide measurement and many other acid - base equilibrium (Ahamed, 1992). According to Umavathi et al., (2007) pH is ranged 5 to 8.5 is best for plankton growth. Higher hydrogen ion concentration that was observed during summer seasons could be attributed to enhanced rate of evaporation coupled with human interference. The high pH with photosynthetic activity and more conductive for net production. High pH might be due to the enhanced chemical interaction that led to buffering and release of alkaline ions (bicarbonate and carbonate ions) or salts in the water, in their study on physicochemical characterstic of water of the wetland in Kaziranga National park, Assam. Pawar and Pulle (2005) observed that pH in range of 7.0 to 7.85 and stated that the pH of water is important for the biotic communities because most of the plant and animal species can survive in narrow range of pH from slightly acidic to slightly alkaline condition.

DO (Dissolved Oxygen)

Dissolved oxygen (DO) plays a major important role in water quality determination by the entering of either organic and inorganic materials causes depletion of DO levels of water bodies. This poses a threat to fish and other higher forms of aquatic life. The concentration of DO regulates the distribution of flora and fauna. It is also essential for all forms of aquatic life especially for those organisms responsible for self purification process in natural water. Dissolved oxygen concentration was 5 mg/l throught the year the reservoir is productive for fish culture. During the present study, DO level are in between4.1 mg/l to 6.5 mg/l with mean value 5.39 mg/l. Kataria (2006), also

reported that depletion of DO in water is due to high temperature and increased microbial activity.

Alkalinity

Alkalinity of water is significant for biological activity. Alkalinity in natural water bodies in generally due to the presence of CO_2 in water or HCO_3 produced by the action of ground water on lime stone or chalk. Alkalinity is a vital parameter for aquatic life in fresh water because it equilibrated pH changes, that occur naturally as a result of photosynthetic activities of the chlorophyll bearing vegetation (Pailwan, 2005). In the present investgation, alkalinity 60 mg/l to 120 mg/l. According to USPHS 120 mg/l is the standard for total alkalinity in drinking water (Prasad, 2003). The higher alkalinity in rainy season might be due the availability of high amount of CO_2 and organic matter which is reported by (Paliwal & Sati, 2007). However , the mean alkalinity in all three seasons during present investigation was more than the permissible limits (93.33 mg/L) of WHO.

Hardness

Hardness of water is imparted pre-dominanatly by alkaline with metal cations mainly calcium and magnesium in it with minor contribution of strontium, barium, zink and iron. Hardness of water is due to the presence of major cations like calcium and magnesium that are imparting hardness along with anions like Sulphate, Chloride, Bicarbonates and Carbonates. The hardness of water varies considerably from place to place and reflects the nature of geological formations with which have been in contact (Khan et al.1986). The increase in hardness can be attributed to the decrease in water volume and increase in the rate of evaporation at high temperature. In the present study, Hardness range in between 180 mg/l to 240 mg/l. These studies revealed that total hardness values were found during summer and lowest values were formed during winter months in the entire study of the year. Hujare (2008) reported total hardness was high during summer than rainy season and winter season.In the present investigation, the maximum hardness recorded in monsoon and minimum in summer season. Maximum total hardness value recorded during the mansoon may be due to leaching of rocks in catchments area. Hardness is mainly due to calcium and magnesium, its main source being leaching of rocks in the catchments. Its concentration restricts water use, while it is an important component in the exoskeleton of arthropodas and shells in mollusca. Similarly results have been reported by Pawar and Pully (2005) studied on Pathwadaj Dam, Nanded, Maharashtra, the maximum values were recorded during monsoon while minimum during winter, Salve and Hiwaro (2006) reported that the hardness was higher in winter, moderate in monsoon and lower in summer.

Electro conductivity

Electric conductivity is a numerical expression ability of an aqueous solution to carry electric current. Conductivity reflects the nutrient status of the water and the distribution of macrophytes. It is a good method to estimate the total dissolved solids present in water. Several reporters have been reported that seasonal variation of conductivity showed maximum (494ms/cm) in summer in Tawa reservoir, Madhyapradesh. In the present study, electro conductivity ranged from 476 to 639 mm/cm. Rajasekhar (2007) reported that EC values were maximum recorded during mansoon and minimum in post monsoon months in Nadargul reservoir of Rangareddy district (AP). Das, (2000) studied the limnological chemistry of some important reservoirs have lower values of specific conductivity as compared to Andhra Pradesh reservoirs. Similarly, results have been reported by Narayana et al.,(2008) reported that high electric conductivity in monsoon.

Total Dissolved Solids

Solids refer to suspended and dissolved matter in water. They are very useful parameter describing the chemical constituents of the water and can be considered as general of edaphically relation that contributes to productivity within the water body. In nature water dissolved solids are composed mainly of carbonates, bicarbonates of calcium, magnesium, sodium, potassium etc. Total dissolved solids are determined as the residue left after evaporation. In the present study Total Dissolved solids ranged from 245 mg/l to 412 mg/l with mean value 358.25 TDS analysis has great implications in the control of biological and physical waste water treatment process. Narayana et al., (2008) reported that seasonal fluctuation in total dissolved solids from Anjanapura reservoir near Shikaripur, Shimoga district, Karnataka, where the maximum concentration of total dissolved solids was recorded during summer which decreased during rainy season due to dilution of pond water. Similarly, results have been reported by Jawale and Patil (2009).

Fluorides

In the present study, fluoride values ranged from 0.4 mg/l to 0.6 mg/l with the mean value 0.5 mg/l. Flourides concentrations fluctuate due to seasonal variations. High fluoride concentration in water causes flourosis. Its concentration varied in different seasons

is mainly due discharge of sewage waste and industrial effluent into the water.

Nitrates

Nitrates is the most highly oxidized form of nitrogen compounds commonly present in natural waters, because it is a product of aerobic decomposition of organic nitrogenous matter. Significant source of nitrates are fertilizers, decayed vegetable and animal matter domestic and industrial effluents and atmospheric washouts. Nitrates plays major role in controlling and occurrence of phytoplankton in water bodies. The results revealed that Nitrates ranged from 0.01 mg/l to 0.06 mg/l with mean value 0.0241 mg/l. High concentration of nitrate in drinking water is toxic (Umavathi et al.,2007). Nitrates levels in surface water often show marked seasonal fluctuations with higher concentrations being found during monsoon months compared to summer and winter months.

Calcium

Calcium is very important element which influences the aquatic flora and fauna of aquatic ecosystem and it also plays potential role in metabolism and growth of living organisms. Calcium is found in all the natural waters and its main source is weathering of rocks from which it leaches out. The element is an important component of the carbonic system and also cycles through biotic and a biotic component of the ecosystem. In the present study, Calcium ranged from 40 mg/l to110 mg/l. In general, the higher values of calcium may be due to the decomposition of organic materials that releases the carbon-di-oxide which brings calcium into the system. Higher concentration increases total hardness of water reported by Ravi kumar et al., (2005).

Chlorides

Chloride anion is generally present in natural waters. The chloride concentration is higher in organic wastes and its higher level in natural water is definite indication of pollution from domestic sewage. The increase in chloride concentrations in lakes, rivers and dams is due to the discharge of municipal and industrial wastes reported by Kant and Raina (1990). Presence of high amount of chloride influences the amount of dissolved oxygen and this may affect adversely the number of aquatic organisms. In the present study, chlorides are ranged from 100 mg/l to 180mg/l, our results were in permissible limit of 200 mg 1^{-1} (WHO, 1993). Higher chloride content during summer may be due to the heavy temperature and consequent evaporation and this could be explained by the fact that the presence of chlorides salts may interfere with other nutrients, which are being utilized in the process of photosynthesis. Lower quantity of chlorides in winter season may be due to dilution effect of water.

.

Turbidity

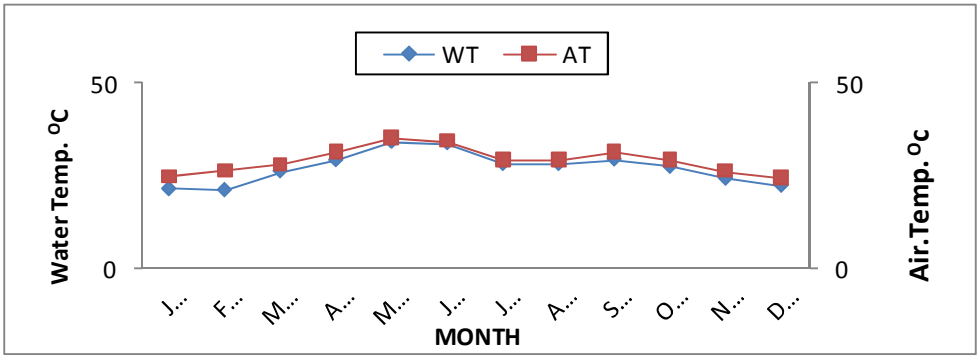
Turbidity is an expression of light scattering and light absorbing property of water and is caused by the presence of suspended particle such as clay, silt, colloidal organic particles. In the present study, turbidity ranged fom 0.6 NTU to 2.1 NTU. The reason for this occasional phenona may be due to the suspended organic matter of autochthonous and allochthonous nature and biosystems like phytoplankton. Higher turbidity is known to affect the primary productivity by restricting the light penetration and photosynthesis.

Correlation (r) between different parameters of water samples of Paler reservoir

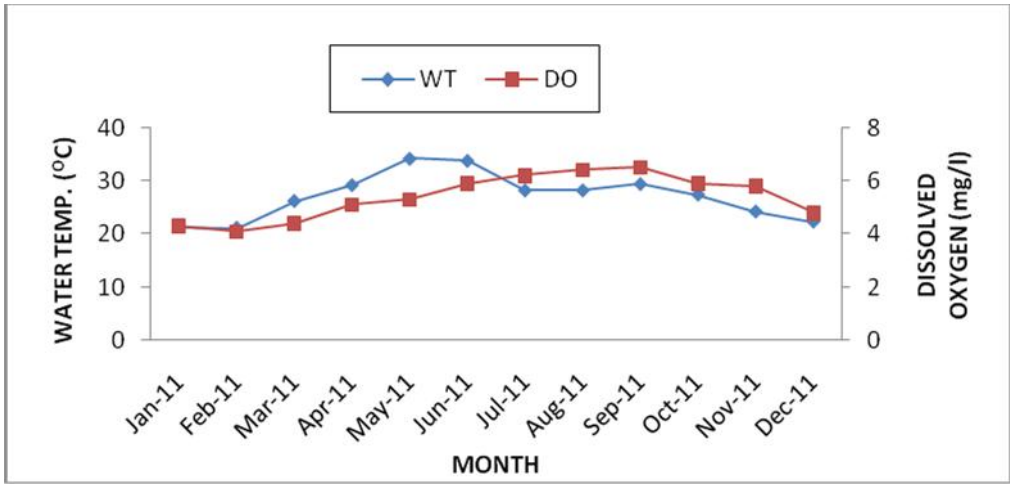
In the present study the correlation coefficient (r) between every parameter pair in computed by taking the average values as shown in table-2. Correlation coefficient (r) between any two parameters, x & y is calculated for parameter such as PH, atmospheric temperature, water temperature, dissolved oxygen, alkalinity, hardness, elecroconductivity, total dissolved solids, fluorides, nitrates, calcium of the Paler reservoir. The degree of line association a between any of the water quality parameters measured by the simple correlation coefficient (r) is presented in table-2 as correlation matrix. In this correlation analysis P^H has been found to show positive correlation with atmospheric temperature (r=0.575),water temperature (r=0.648), hardness (r=0.093), turbidity (r=0.439) and chloride (r=0.264). Atmospheric temperature also showed positive correlation with water temperature (r=0.975), nitrates (r=0.312), chloriides (r=0.0713), dissolved oxygen (r=0.487)and turbidity(r=0.276). Data is the mean value of monthly collectead samples. The values (r) ranged from 0.576 to 0.975 and to above are more significant at ($p<0.05$ and $p<0.01$ respectively

Table-2. Paler reservoir water analysis correlations Jan-Deceember 2011

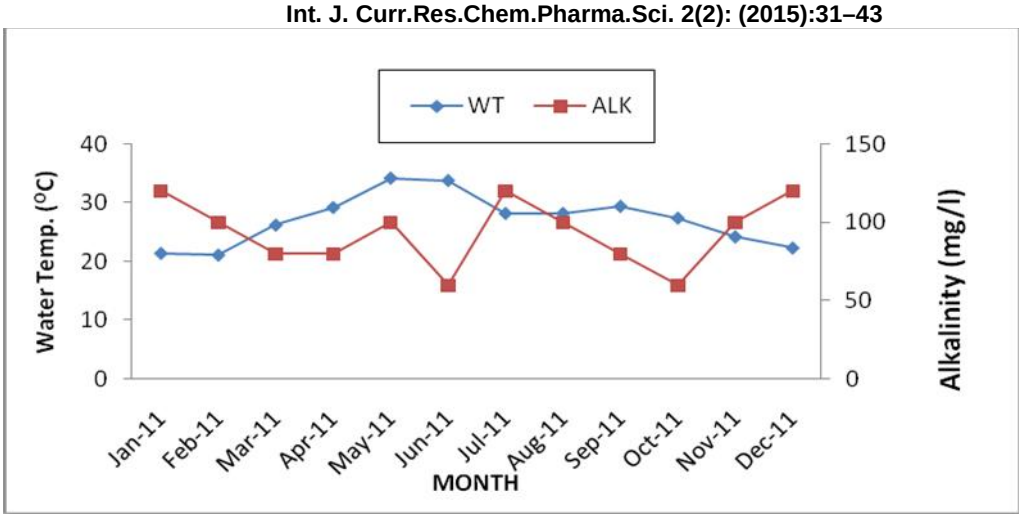
	PH	AT	WT	DO	ALK	HARD	EC	TDS	FLOU	NO2	CA	CL	TUR
PH	1												
AT	0.575602	1											
WT	0.6488	0.975052	1										
DO	0.163692	0.487837	0.57714	1									
ALK	-0.23552	-0.54881	-0.52116	-0.27378	1								
HARD	0.093056	0.029854	0.022993	0.012176	-0.43873	1							
EC	-0.17877	-0.57028	-0.58269	-0.60683	0.214912	0.615955	1						
TDS	-0.32096	-0.38196	-0.44156	-0.61734	0.018412	0.142927	0.526818	1					
FLOU	-0.19188	-0.23421	-0.17718	-0.0748	-0.05484	-0.48571	-0.18373	0.179378	1				
NO2	-0.31523	0.312463	0.2567	0.643513	-0.13695	-0.11212	-0.49945	-0.39868	-0.01019	1			
CA	-0.76508	-0.64595	-0.66775	-0.01536	0.188923	0.252218	0.319466	0.18939	-0.06767	0.344556	1		
CL	0.264893	0.071336	0.121157	0.365932	-0.14886	0.659232	0.328185	-0.09591	-0.42656	0.124509	0.125239	1	
TUR	0.439477	0.276706	0.344249	-0.07078	-0.2061	0.38508	0.374442	0.384622	0.037027	-0.36722	-0.4289	0.432188	1



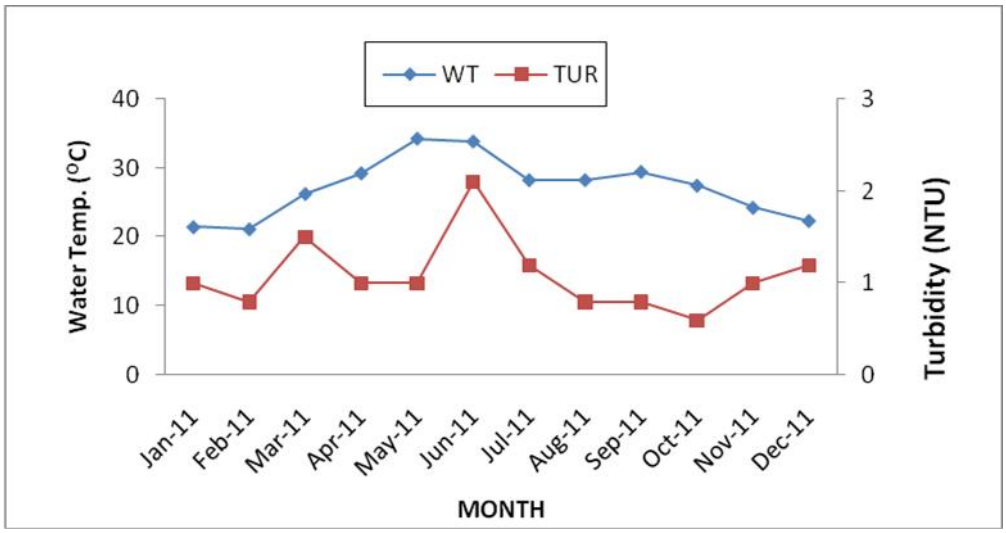
Correlation between **Water Temperature (^{O}C)** and **Air. Temp. (^{O}C)** in Paler 2011.



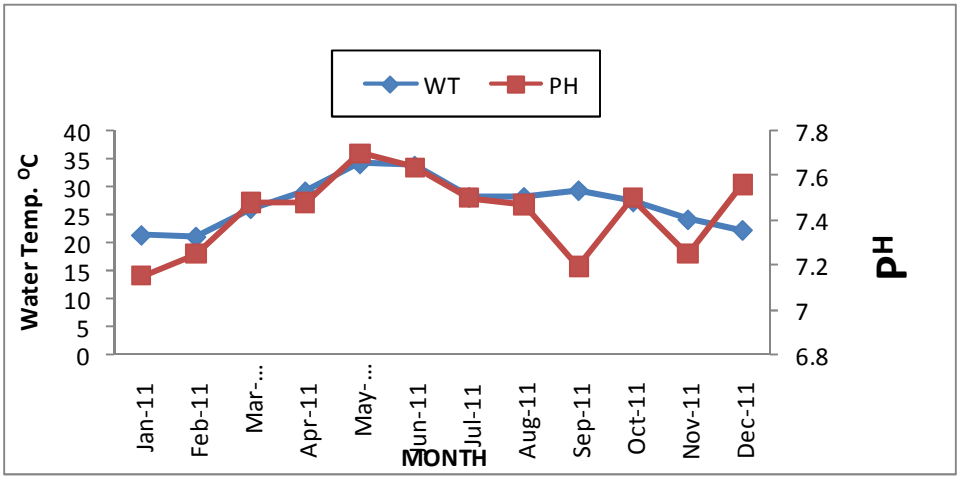
Correlation between **Water Temperature (^{o}C) and Dissolved Oxygen (mg/l)**in Paler2011.



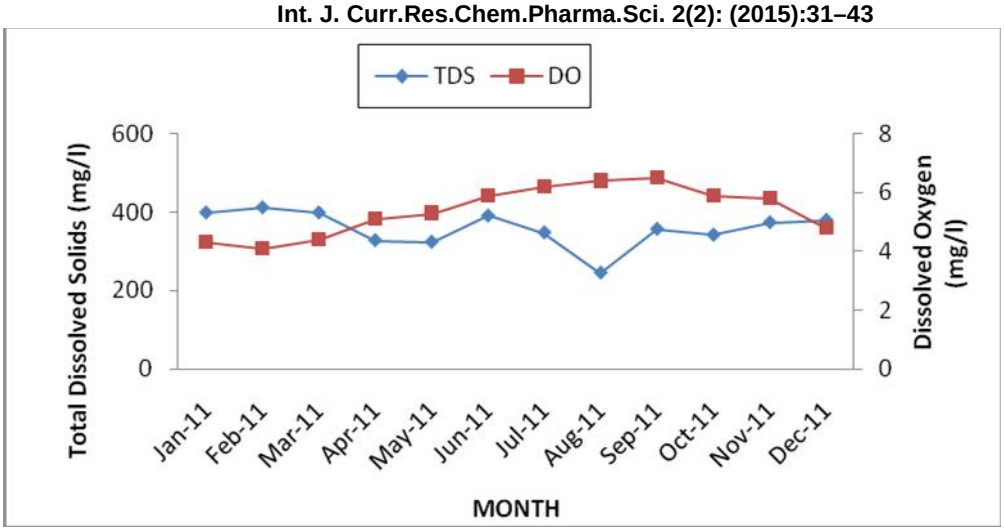
Correlation between **Water Temperature (°C) and Alkalinity (mg/l)** in Paler 2011.



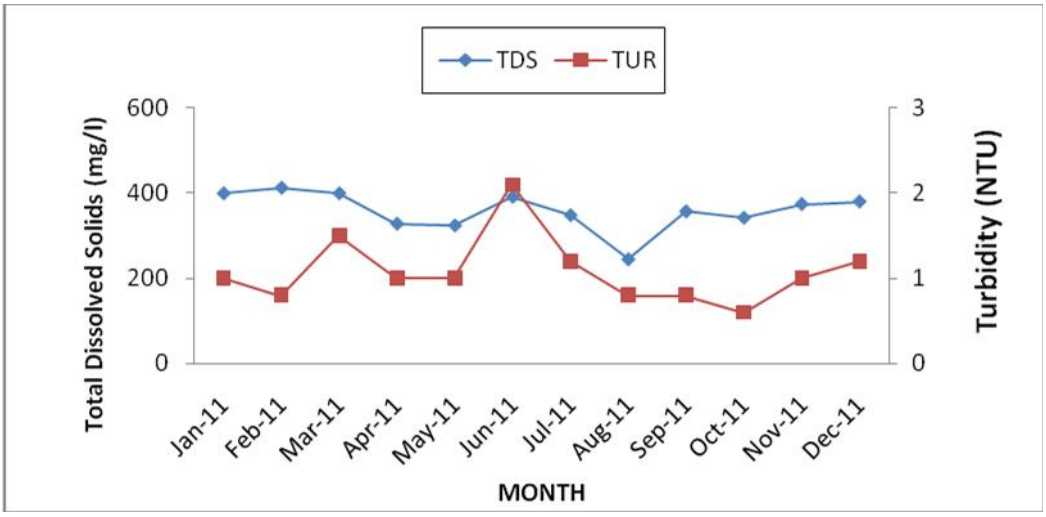
Correlation between **Water Temperature (°C)** and **Turbidity (NTU)** in Paler 2011.



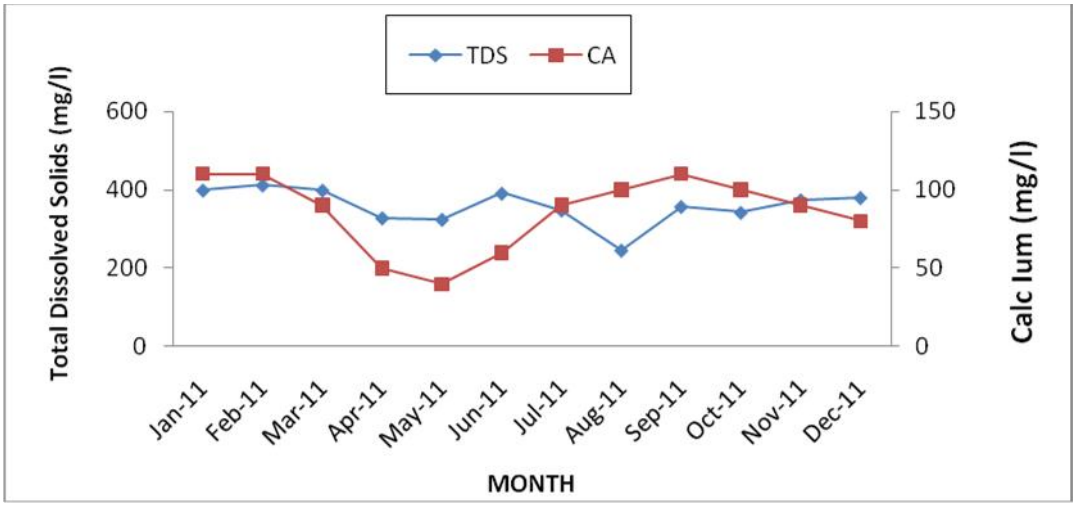
Correlation between **Water Temperature (°C)** and **P H** in Paler 2011



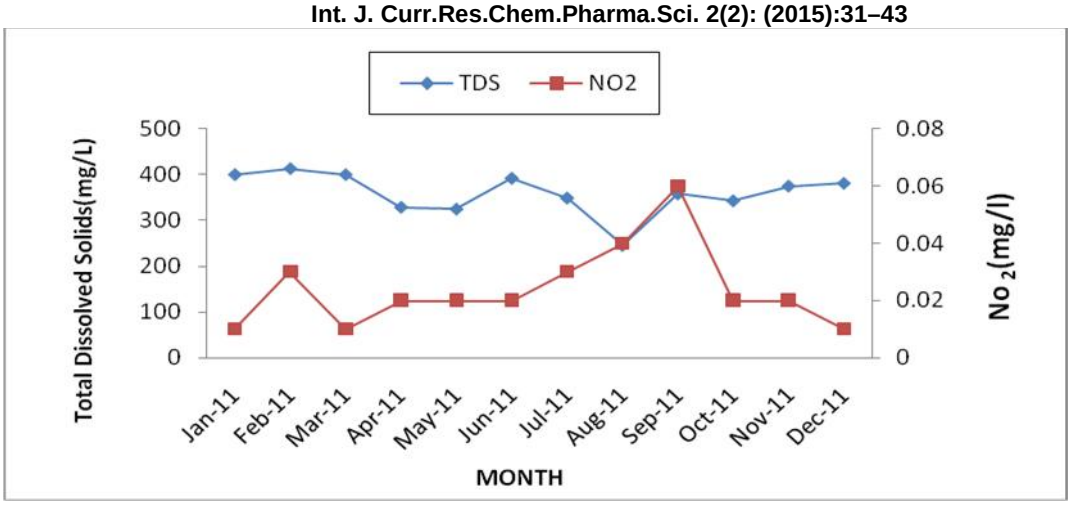
Correlation between**Total Dissolved Solids (mg/l) and Dissolved Oxygen (mg/l)** in Paler 2011



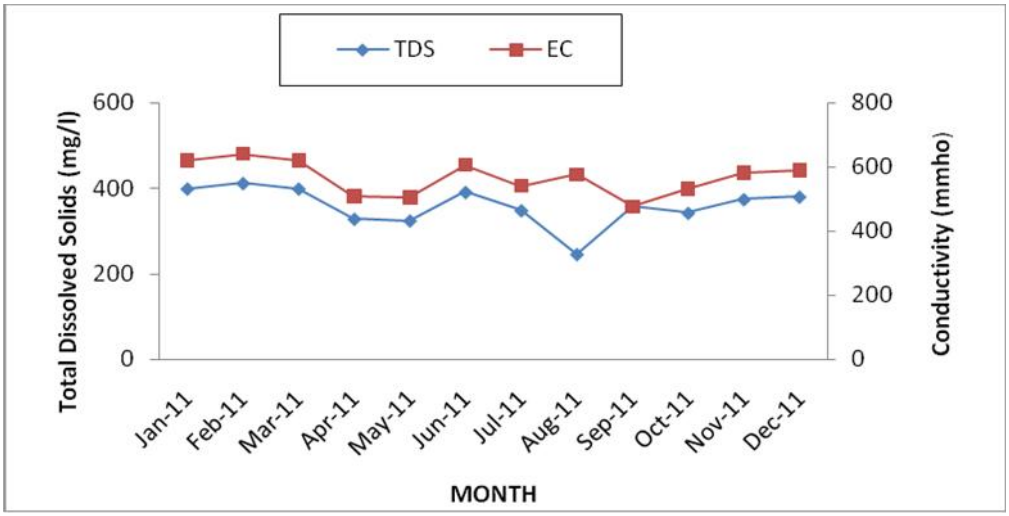
Correlation between**Total Dissolved Solids (mg/l) and Turbidity (NTU)** in Paler 2011



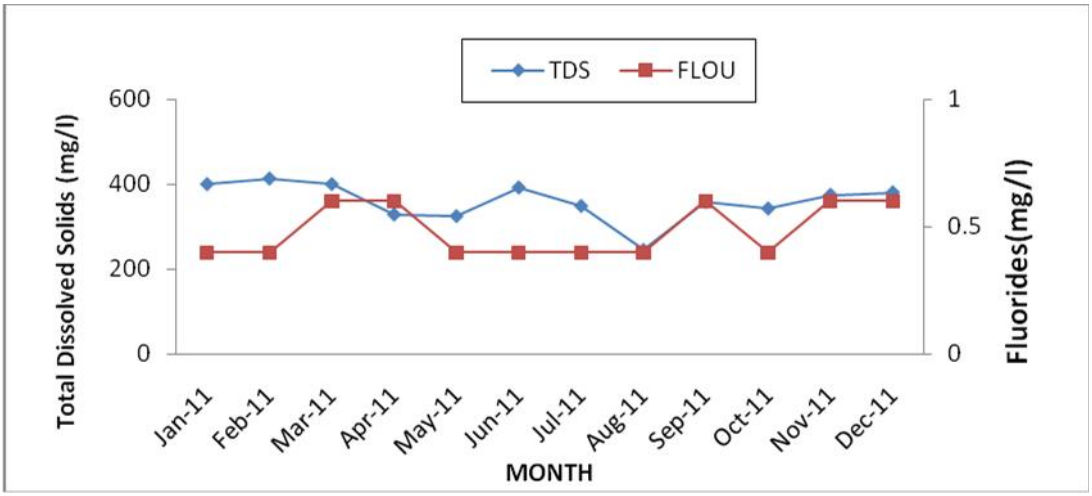
Correlation between**Total Dissolved Solids (mg/l) and Calcium (mg/l)** in Paler 2011.



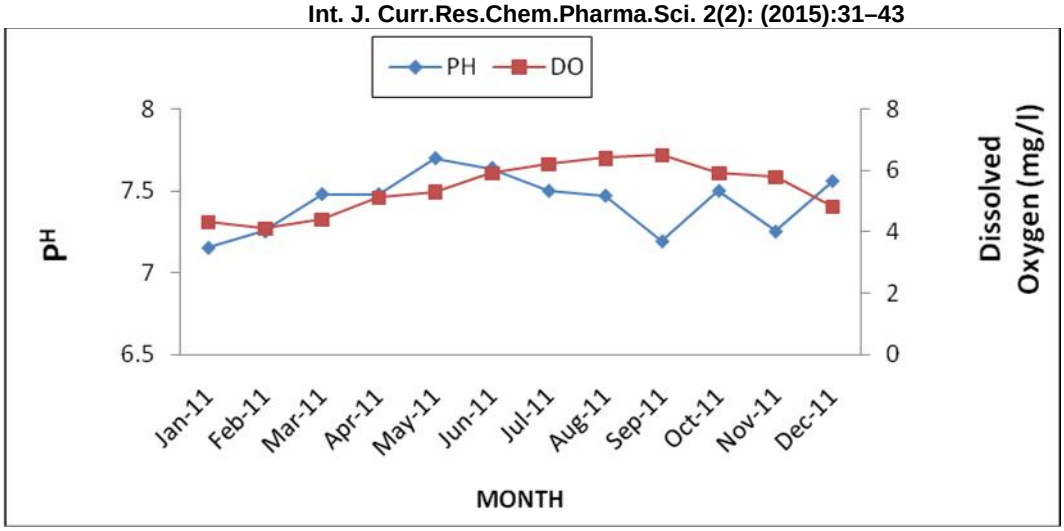
Correlation between**Total Dissolved Solids (mg/l)** and **No $_2$(mg/l)** in Paler 2011.



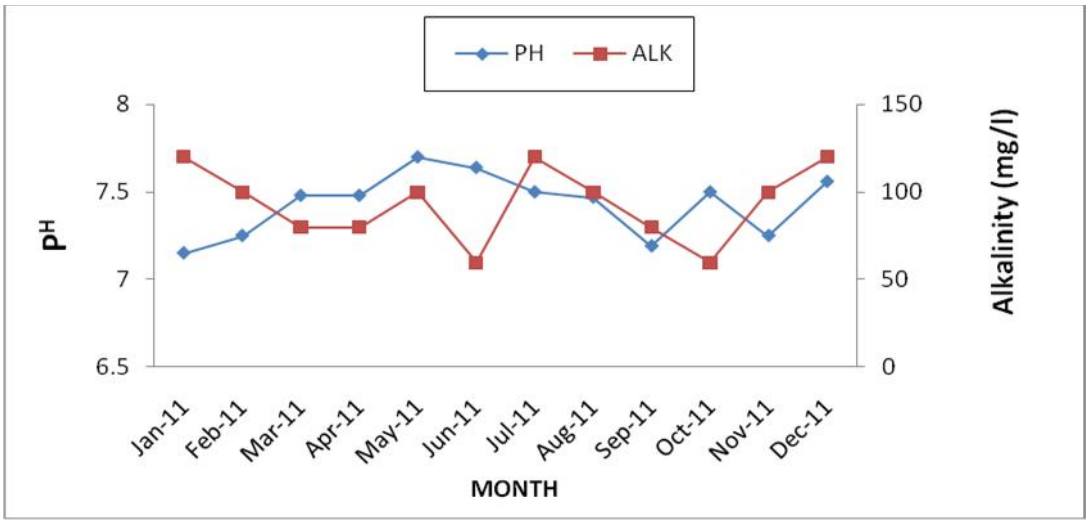
Correlation between**Total Dissolved Solids (mg/l)** and**Conductivity (mmho)** in Paler 2011.



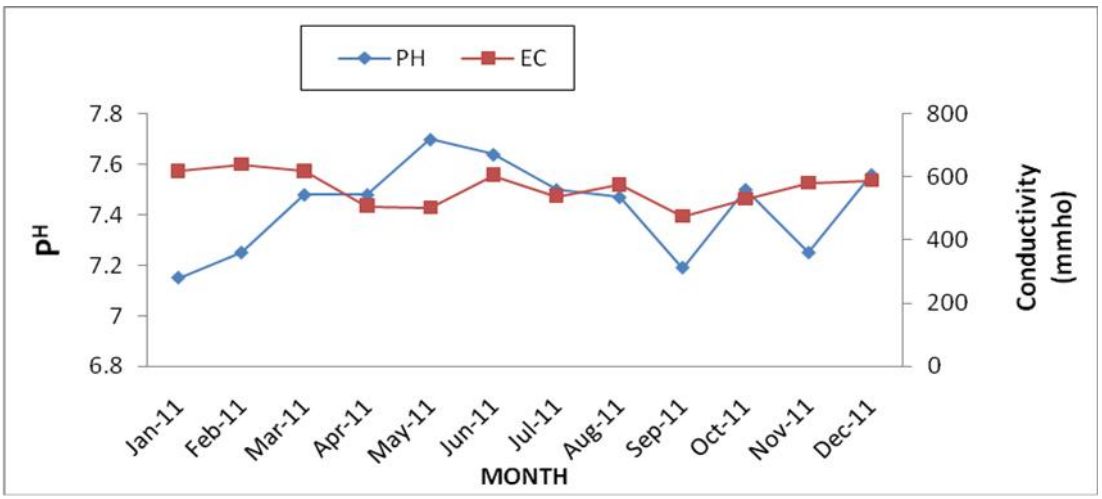
Correlation between**Total Dissolved Solids (mg/l)** and **Fluorides (mg/l)** in Paler 2011.



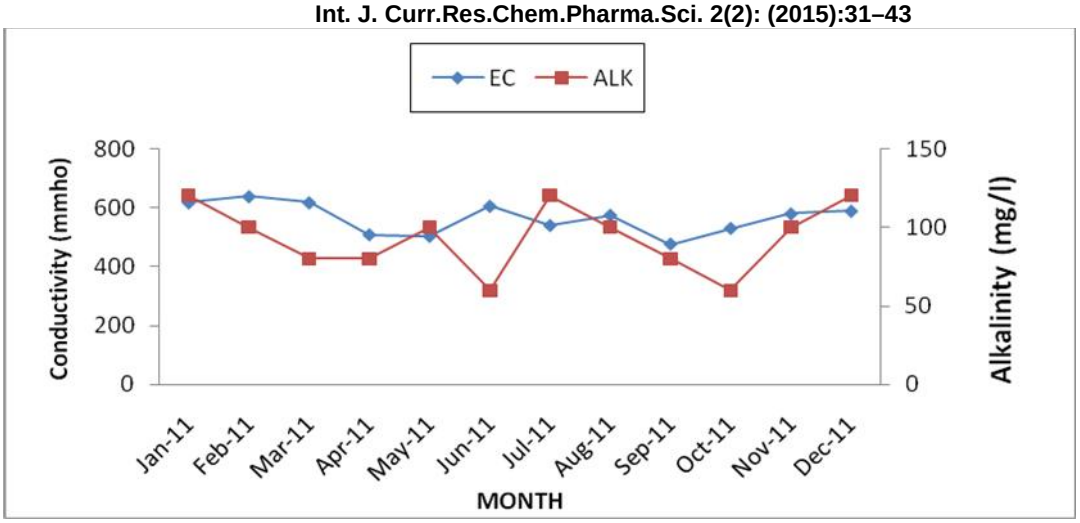
Correlation between **P^H** and**Dissolved Oxygen (mg/l)** in Paler 2011



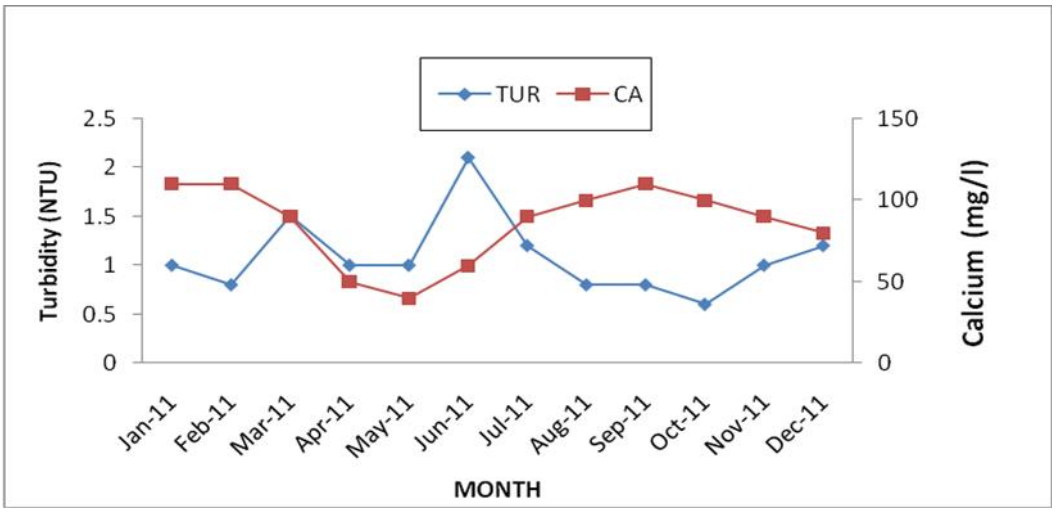
Correlation between **P^H and Alkalinity (mg/l)** in Paler 2011



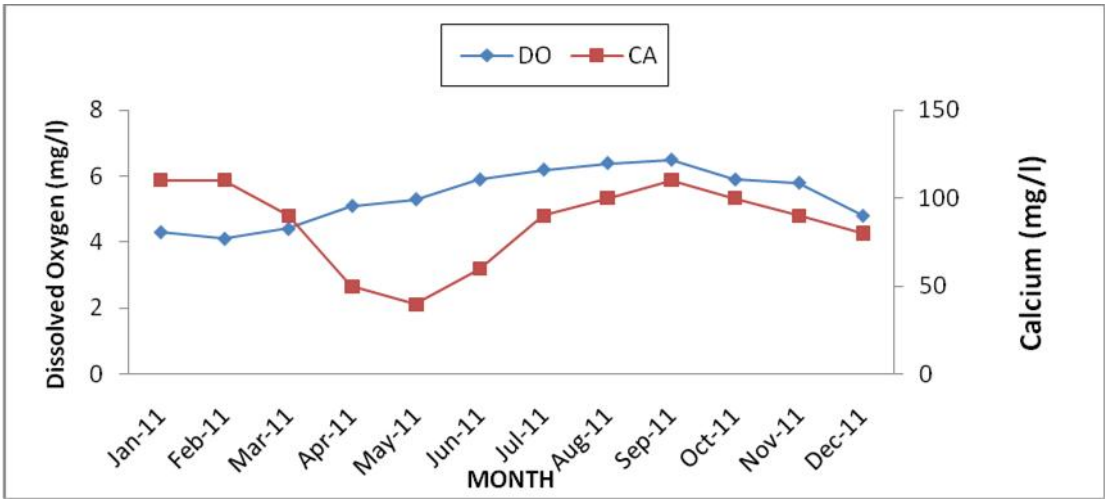
Correlation between **P^H and Conductivity (mmho)** in Paler 2011.



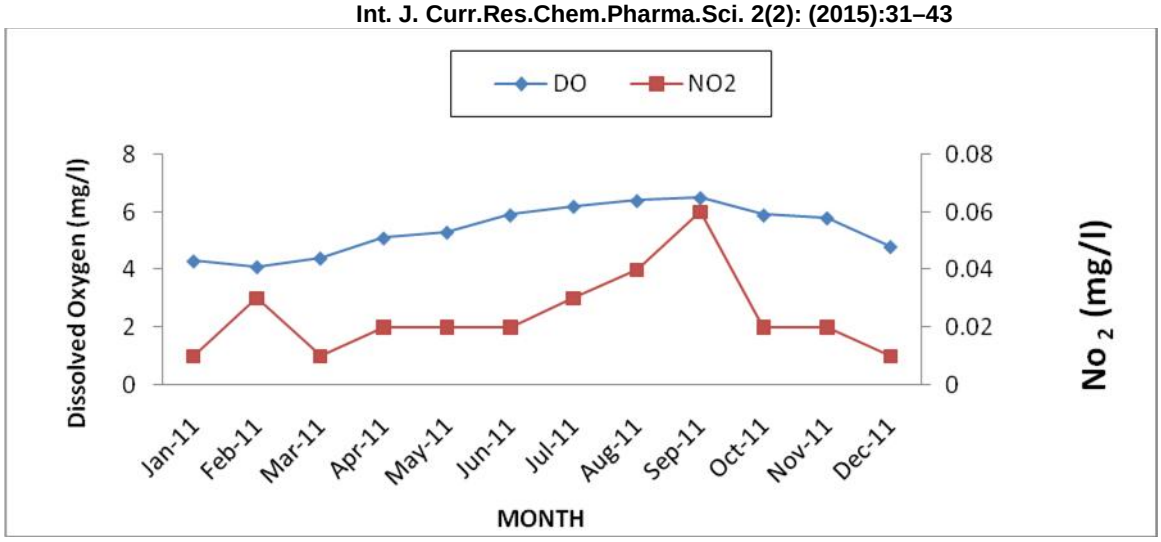
Correlation between **Conductivity (mmho)** and **Alkalinity (mg/l)** in Paler 2011



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



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



Correlation between **Dissolved Oxygen (mg/l)** and **NO_2 (mg/l)** in Paler 2011.

Conclusion

The present study shows detailed physic-chemical characteristics and quality of water in Paler reservoir. The summer, monsoon and winter seasons shows seasonal fluctuations in various physico-chemical parameters. The water of present reservoir is useful for irrigation as well as fish culture. The water parameters indicate that the reservoir is rich in nutrients. To improve quality of water there should be continuous monitoring of pollution level and maintain the favorable conditions essential for the fish culture, growth and reproduction. It has been found that Paler reservoir can be categorized as meso-eutrophic with rich amount of nutrients which may be due to agricultural practices being done by farmers in surrounding catchment area of this reservoir. Thus, the reservoir may serve as a good habitat for planktonic organisms and can also be very well used for further stocking of Indian major carps for their cultivation

References

1. Ahmed, M. and Alireza Shayestehfar (1992). Diurnal fluctuations in population density of Zooplankton from Nathsagar, paithan (Maharashtra). *Proc. Acad. Environ Biol.*1 (2), PP: 173-178.
2. APHA (2005), Standard methods for the examination of water and waste water. 21st Edn., Washington, D. C.
3. Boyd, C.E., and Tucker, C.E., (1998). Pond aquaculture and water quality management Kluwer Academic Pub., London, pp: 44-48.
4. Das A. K. (2000). Limno – chemistry of some AndhraPradesh Reservoirs, *J. Inland Fish. Soc.Ind.,* 32 (2), 37– 44.
5. Hujure, M.S., (2008). Seasonal variation of physic-chemical parameters in the perennial tank of Talasande, Maharastra*, J. Ecotoxicology & Environmental Monitoring.* 18(3): 233-242.
6. Jawale, A.K., and Patil, S.A., (2009). Physico-chemical characterstics and phytoplanktons abundance of Mangrul dam, Dist-Jalgaon, Maharastra, J.Aqua. BIOL., 24(1):7-12.
7. Kataria.H.C., Arun Singh and Pandey, S.C (2006). Studies on water quality of Dahod Dam,India.poll Res.25(2): 403-407.
8. Kant, S., and Raina, A.K.,(1990). Limnological studies of two ponds in Jammu ii Physiological parameters. J. Envi. Biol., 11(2)., 137.
9. Kumar A, HP Gupta and DK Singh, (1996). Impact of sewage pollution on chemistry and primary productivity of two wate rbodies in santal paragana (BIHAR) India. *J. Ecol.* 23(2):82-86.
10. Khan, A., Musharraf Alik, Nooral Hauge (1986). Population Ecology of Zooplankton in a polluted pond at Aligarh. Environment Biology Costal ecosystem.
14. Narayana, J., Puttaiah,E.T. and Basvaraj, D., (2008). Water quality charecterstics of Anjanapura reservoir near Shikarpura, District Shimoga, Karnataka. J.Aqua.Biol. 23(1): 59-63.
15. Prasad, N.V. (2003). Diversity and Richness of Zooplankton in Coringa mangrove Ecosystem Decadal changes. *J. Aqua Biol.,* Vol. 18(2), pp: 41-46

16.Ravi Kumar, M.S., Manjappa B.R., Kiran and Puttaiah, E.T (2005). Hydrochemistry of Ayyenkere tank in Harpanahalli town, Davanagere District, Karnataka*. J. Aqua, Biol.* 20(2): 495-498.

Salve, B.S., and Hiwaro, C.J.,(2006). Studies on water quality of Wanparkalpa reservoier, Nagpur, near parli vaijanth dist, Beed, Marathwada region. J.Aqua.Biol., 21(2):113-117.

Shekar, T.R.S., Kiran, B.R., Puttaiah, Y., et al., (2008). Phytoplankton as index of water quality with reference to industrial pollution. J. Environ. Biol, 29: 233-236.

20. Trivedy RK and Goel, (1986). Chemical and biochemical methods for water pollution studies, Environmental publication, Karad, Maharashtra.

21. Pailwan, I.F.(2005). Limnology and fisheries potential of perennial tanks of Kolhapur district, Kolhapur. Ph.D Thesis, Shivaji University, Kolhapur.

22. Patil , S.G and P. Peetamber (1996). Hydro biological studies on some water bodies along Bombay highway and Warangal Road (Hyderabad, Andhra Pradesh)Rec.Zool.SURV.india,95(3-4),pp:243-259.

23. Pawar, S.K., and Pulle, J.S., (2005). Studies on physic-chemical parameters in pethwadj dam Nanded District in Maharashtra, India. J. Aqua. Biol., 20(2): 123-128.

Venkatesan, J., (2007). Protecting wetlands. Curr.Sci, 93: 288-290.

24. Umavathi, S., Lorragakumar, K and Subhashini. (2007). Studies on the nutrient content of sulfur in pond of Coimbator, Tamil Nadu, *J.Ecology & Environmental Conservation,* 13(5), pp 501-504.

25. World Health Organization (1993). Guidelines for drinking water quality 2nd ED.WHO. Geneva.

