Analysis of Water Quality Parameters of Owk Reservoir (Sri B V Subba Reddy Sagar), Owk, Kurnool District, Andhra Pradesh, India

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Abstract:

Various parameters in Owk Reservoir (Sri B V Subba Reddy Sagar), Owk were investigated from October 2012 to September 2014 to analyse the water quality. The different Physico-chemical parameters like Temperature, pH, TDS, conductivity, salinity, dissolved oxygen, turbidity, alkalinity, free carbon dioxide, chloride, total hardness, calcium, magnesium, phosphates, sulphates, silicates, nitrites, nitrates, BOD and COD were carried out by standard methods. Our results showed either positive or negative correlation between the parameters indicating that one parameter interrelated with each other. Water of the reservoir which is built for storing water to be used for irrigation, seems to be of good quality. As such fish are also cultured here.

Keywords: *Owk reservoir, water quality, Physico-chemical parameters.*

I. INTRODUCTION

India has a large spread of fresh water resources in the form of rivers, reservoirs, lakes, ponds. Indian reservoirs, being in the tropics, have high primary productivity and have the capacity to produce more fish than their present low Indian average of 29.7 kg/ha/yr in reservoirs. Reservoir fisheries are essential a stocking cum capture system. There are 975 reservoirs in the country with a total area of more than 3.15 million hectares (1). Andhra Pradesh has 98 small reservoirs, 32 medium reservoirs and 7 large reservoirs with total surface area of 4,58,507 hectares (2). The Kurnool district Gazetteer notes that there were over 600 tanks in the district in the beginning of the twentieth century. The survey identified a total of 4,725 water bodies in the entire district. Of this, 1,176 are big tanks with an average ayakut of 100 acres; 2164 are small tanks with an ayakut of 10 acres; and 328 are spring channels. Some of the reservoirs presently located in Kurnool district, Andhra Pradesh are Owk reservoir, Velugodu reservoir (Telugu Ganga Project), Sunkesula dam and Gajuladinne reservoir at Gonegandla.

Reservoirs, also called impoundments, are manmade lakes. Often, reseroirs can be thought of as a combination of lakes and rivers because they were created by building a dam and flooding a river valley. Reservoirs are built for many uses. Some are built strictly for recreation (such as fishing and boting) or to control floods. Other are built to store water that may be used for drinking water and irrigation. Finally, hydroelectric dams use the flow of water over turbines to generate electricity. The global fresh water reservoirs are under increasing pressure (3). In India much research has been carried out with regards to assessment of water quality of different tanks like fish pond in Tanjavur (4), Bolinj Ram Mandi Talao, Virar (5), Urban ponds in Thiruvanathapuram (6), Kadamba tank in Thoothukudi district (7), Fresh water fish ponds in Warangal area (8), Lalpur pond, Shahdol district (9), Ponds in Anand Panchayat (10), Almatti Reservoir of Bijapur district, Karnataka (11), Harsool-savangi dam, Aurangabad district (12), Ujjain reservoir, Solapur district (13), Ramsagar reservoir, Madhya Pradesh (14), Three manmade reservoirs i.e., Kolar, Kaliasote and Kerwa dam of Bhopal city (15). Andhra Pradesh has good number of Reservoirs, Ponds and Tanks. Qualitative and quantitative hydrological investigations had been carried out in few water bodies like Lower Manair reservoir of Karimnagar district (16). The knowledge of reservoir ecosystem is of considerable value in assessing the ecological nature of the reservoir (11). Hence this study was designed to monitor water quality parameters of Owk reservoir, so as analyse its status and suitable through the potability and agriculture, pisciculture and drinking water quality point of view (9).

II. MATERIALS AND METHODS

Study area: Owk reservoir, (Sri B V Subba Reddy Sagar) is located near Owk, Kurnool district of Andhra Pradesh. It is the third largest reservoir in Kurnool district. It is located 2 km from Owk, 10 km from Belum caves and 90 km from Kurnool city. Geographical coordination of Owk reservoir is at 15°21’67’’N Lattitude and 78°11’67’’E Longitude. It has an average elevation of 194 meters (639 fts). The catchment area is 246.04 Sq km with existing ayakut 47638.74 acres. Storage capacity of this reservoir is

4.148 TMC. The source of water for this reservoir is Srisailam Right Bank Canal (SRBC) and rain.

A. Sample Collection and Analysis:

Water samples were collected during fisrst week at monthly interval for a period of two consecutive years from October 2012 to September 2014 for the analysis of Physico-chemical parameters. Water samples were collected in acid washed 10 liters polythene containers below the depth of 5-10 centimeters and collection was usually completed during morning hours between 08 AM and 10 AM. Colour and odour of water was noticed and recorded. For each sample Temperature, P^H was monitored at the sampling site using mercury Thermometer and digital P^H meter. Immediately after arrival into the laboratory the conductivity of the water was measured using the help of conductivity meter.

All the parameters were analysed by the following standard methods. The chemicals used in the present investigations were produced from the Merck India. All glass ware used was of corning grade manufactured by Borosil India Ltd. Spectrophotometer used for our research work was ELICO double beam, SL210, UV VIS Spectrophotometer. Systronic Water Analyser 371 used with a micro controller was used for measuring P^H, Dissolved oxygen (DO), Conductivity, Total Dissolved Solids (TDS), Salinity and Turbidity in water sample. Six replicates were taken for data analysis.

III. RESULTS AND DISCUSSION

A. *Temperature:*

The temperature of water assessed between 24.0±0.00°C (December, 2012) and 30.0±0.00°C (May, 2013) (Fig. 1). It showed significant positive correlation with P^H, TDS, Salinity, Turbidity, Chlorides, Total hardness, Calcium, Magnesium, Nitrates, BOD and negative correlation with Conductivity, DO, Carbon dioxide, Alkalinity, Silicates, Phosphates, Nitrites, Sulphates and COD (Table I, II). High temperatures observed during summer season (May) due to clear atmosphere, greater solar radiation and low water level (17). During winter season (December) it was low due to frequent clouds, high humidity, high current velocity and high water level (18).

P^H: The P^H of water observed in February was minimum (7.7±0.3) and maximum in the month of March (8.91±0.12) (Fig. 2). P^H showed positive significant correlated with salinity, alkalinity, calcium, silicates, phosphates, nitrates, nitrites, BOD and negatively significant correlated with conductivity, TDS, Turbidity, DO, carbon dioxide, chlorides, total hardness, magnesium, sulphates and COD (Table I, II). The higher values observed suggested that CO_2, carbonates, bicarbonates equilibrium is affected more due to change in physico-chemical condition in the month of March (19, 20). The lower value of P^H in the month of February is due to high turbidity, the high temperature enhances microbial activity causing excess production of CO_2 and reduces P^H (21, 22).

B. *Conductivity:*

In this regard monthly variability in conductivity of water has fluctuated between 502.6±1.3 µS (October 2012) and 6.73±0.19 ṁS (Fig. 3). It showed positive significant correlation with salinity, carbon dioxide, chlorides, total hardness, nitrites, sulphates, COD and showed negative significant correlation with TDS, turbidity, DO, alkalinity, calcium, magnesium, silicates, phosphates, nitrates and BOD (Table I, II). The variation in the conductivity values seasonally is mostly due to increase in the concentration of salts, because of evaporation (May), the dilution resulted from precipitation brings down its values in the month of October (23, 24).

C. *Total Dissolved Solids (TDS):*

TDS of water analysed between 279.3±3.2 mg/L (October 2012) and 3820.0±21.9 mg/L (April 2014) (Fig. 4). They showed positive significant correlation with chlorides, calcium, phosphates, nitrates, BOD and showed negative significant correlation with salinity, turbidity, DO, CO_2, alkalinity, total hardness, magnesium, silicates, nitrites, sulphates and COD (Table I, II). Seasonal variations showed maximum values in summer (April) due to high temperature, high turbidity and minimum in the month of October (25, 23).

D. *Salinity:*

The seasonal fluctuation in the salinity values ranged from 280.0±8.94 ppm (June 2014) was observed (Fig. 5). It showed positive significant correlation with turbidity, DO, alkalinity, total hardness, calcium, nitrates, nitrites, BOD, COD and showed negative significant correlation with carbon dioxide chlorides, magnesium, silicates, phosphates and sulphates (Table I, II). The maximum value for salinity was observed in the month of June and minimum in the month of October (4, 26). The differences in the salinity are attributed due to increase in the evaporation rate (27).

E. *Turbidity:*

The monthly fluctuation of Turbidity of water in this study was noticed between 0.1±0.0 NTU (April 2012) and 10.5±0.83 NTU (October 2013) (Fig.6). It showed positive significant correlation with DO, carbon dioxide, magnesium, silicates, sulphates, BOD and showed negative significant correlation with alkalinity, chlorides, total hardness, calcium, phosphates, nitrates, nitrites and COD (Table I, II). High values of turbidity in monsoon (October) may be due to influx of rain water from catchment area, cloudiness, less penetration of light, washes, silts, sand, high organic matter and low values of the turbidity in summer (April) may be due to clear atmosphere, evaporation of water and high light penetration (12, 28).

F. *Dissolved Oxygen (DO):*

Analysis of monthly variation of DO of water in the study was as low as 1.56±0.15 mg/L in July 2013 and as high as 10.86±0.93 mg/L in January 2013 (Fig. 7). It showed positive significant correlation with carbon dioxide, alkalinity, total hardness, nitrates, COD and showed negative significant correlation with chlorides, calcium, magnesium, silicates, phosphates, nitrites, sulphates and BOD (Table I, II). The maximum DO in winter might be due to low atmospheric temperature and intensive photosynthetic activity (3). It decreases as turbidity and TDS increases because of influx of rain water retorted photosynthetic activity of biota (29).

G. *Free Carbon dioxide (CO_2):*

Results of the concentration of free carbon dioxide of water in this study was between 0.22±0.0 mg/L (June 2013) and 0.44±0.0 mg/L (February 2013) (Fig. 8). It showed positive significant correlation with alkalinity, total harness, calcium, silicates, phosphates, BOD and showed negative significant correlation with chlorides, magnesium, nitrates, nitrites, sulphates and COD (Table I, II). High carbon dioxide is due to increase in the decomposition of organic matter, low temperature and photosynthetic activity of phytoplankton. Absence of it is due to its utilization by algae during photosynthesis or carbonates present (17).

H. *Alkalinity:*

Measurement of the alkalinity of water was fluctuated between 13.5±0.5 mg/L (October 2012) and 52.00±0.63 mg/L (April 2014) (Fig.9). It showed positive significant correlation with total hardness, calcium, magnesium, phosphates, nitrites, BOD, COD and showed negative correlation with chlorides, silicates, nitrates and sulphates (Table I, II). High alkalinity reported during the summer season (April). The increased alkalinity during summer was due to concentration of nutrients in water, water level in many number of water bodies decreases resulting the death and decay of plants and living organisms and followed by steep fall in the monsoon periods (12, 30).

I. *Chlorides:*

The seasonal variation in the chloride content of the water was a low level of 45.3±1.0 mg/L in November 2012 and high level of 99.9±0.0 in March 2013 (Fig. 10). They showed positive significant correlation with total hardness, calcium, BOD, COD and showed negative significant correlation with magnesium, silicates, phosphates, nitrates, nitrites and sulphates (Table I, II). Concentration of higher chloride in the summer period could be due to sewage mixing and increased temperature and evaporation of water (21).

J. *Total Hardness (TH):*

Our analysis showed the Total hardness of water was minimum in October 2013 (130.0±1.6 mg/L) and maximum in June 2014 (190.0±2.8 mg/L) (Fig. 11). It showed positive significant correlation with Calcium, Magnesium, Nitrates, Sulphates, BOD, COD and showed negative significant correlation with Silicates, Phosphates and Nitrites (Table I, II). Total hardness of water bodies may be high during the summer season may be became higher temperature causes evaporation of water. Decrease in volume of water increase the concentration of salts and also due regular addition of large quantities of sewage and detergents into water bodies from the nearby residential localities (16, 31).

K. *Calcium:*

Determination of the variability in the Calcium content of water was lowest in October 2012 (16.0±0.0 mg/L) and highest in February 2013 (56.11±0.0 mg/L) (Fig. 12). It showed positive significant correlation with Silicates, Phosphates, Nitrates, Nitrites, BOD, COD and negative significant correlation with Magnesium and Sulphates (Table I, II). The calcium content was higher in summer and lower in monsoon months due to rapid oxidation/decomposition of organic matter and the decrease of their level in water may be due to absorption by the phytoplankton and macrophytes (32, 33). The high value of calcium may be due to the seepage of effluent and domestic wastes or due to cationic exchange with sodium (34).

L. *Magnesium:*

The range of Magnesium of water was between 16.4±0.4 mg/L (September 2013) and 32.6±0.0 mg/L (February 2013) (Fig. 13). It showed positive significant correlation with Silicates, Phosphates, Nitrites, Sulphates and showed negative significant correlation with Nitrates, BOD and COD (Table I, II). The permissible limit of Mg content for drinking water is 50 mg/L, maximum limit is 150 mg/l (11, 35). The highest concentration of magnesium observed in the month of June and a lower concentration observed in the month of March in Ground water quality in and around Thiruvallur district (34).

M. *Silicates:*

Fluctuation in the Silicate concentration of water was between 0.001±2.4 mg/L (October 2013) and 0.006±0.08 mg/L (May 2014) (Fig. 14). They showed positive significant correlation with Phosphates and showed negative significant correlation with Nitrates, Nitrites, Sulphates, BOD and COD (Table I, II). The concentration of silica was in the range of 40.61 to 99.41 mg/L. The higher concentration of silica observed in the month of June and lower concentration observed in the month of February in Ground water quality in and around Thiruvallur district (34).

N. *Phosphates:*

Phosphate value obtained in this study ranged between 0.020±0.0 mg/L (February 2013) and 1.50±0.27 mg/L (July 2014) (Fig. 15). They showed positive significant correlation with Nitrates, Nitrites, Sulphates, COD and showed negative significant correlation with BOD (Table I, II). The high values of phosphate are mainly due to rain, surface water runoff, agriculture runoff, washer man activity, leaching of phosphate fertilizer (36, 37).

Nitrates: Fluctuation of the Nitrate concentration in this study was as low as 0.015±0.01 mg/L in July 2014 and as high as 1.45±0.10 mg/L in April 2014 (Fig. 16). They showed positive significant correlation with Nitrites, BOD and negative significant correlation with Sulphates and COD (Table I, II). During summer season (April) lesser nitrates are due to algal assimilation and other biochemical mechanisms and nitrate higher values are due to surface runoff and domestic sewage and especially anthropogenic activities in the month of July (12, 37).

O. *Nitrites:*

Monthly variation of Nitrites content of water in the present study ranged between 0.031±0.0 mg/L (January 2013) and 0.88±0.09 mg/L (February 2014) (Fig. 17). They showed positive significant correlation with COD and negative significant correlation with Sulphates and BOD (Table I, II). The concentration of nitrite was maximum during the pre-monsoon period and minimum during post monsoon period observed in Kadamba tank, Thoothukudi district of Tamil Nadu (7, 38).

P. *Sulphates:*

Water samples collected from Owk reservoir were analysed Sulphate content of water was minimum in September 2013 (0.01±0.0 mg/L) and maximum in April 2014 (0.04±0.00 mg/L) (Fig. 18). They showed positive significant correlation with COD and showed negative significant correlation with BOD (Table I, II). High concentration of sulphates may be due to biodegradation of organic matter by the microorganisms. Whereas, dilution and utilization of sulphate by the aquatic plants and phytoplankton gradually brings down the sulphate concentration (11).

Q. *Biological Oxygen Demand (BOD):*

Monthly variation of Biological Oxygen Demand (BOD) of water was recorded low in October 2012 (3.0±0.0 mg/L) and high in August 2014 (16.0±0.0 mg/L) (Fig. 19). It showed negative significant correlation with COD (Table I, II). Minimum BOD values are noticed in the month of October. Whereas, maximum was observed in the month of August because of input organic wastes and enhanced bacterial activity (25, 39).

R. *Chemical Oxygen Demand (COD):*

Analysis of COD value of water was ranged between 96.63±6.2 mg/L (February 2014) and 418.1±5.9 mg/L (March 2013) (Fig. 20). Maximum COD was recorded during the summer (March) and minimum during winter season (February). The higher values are also due to higher decomposition activities and low level of water. However minimum COD are due to low temperature, low decomposition activities and dilution effect (31, 40).

CONCLUSION

From all the above mentioned research findings, it is finally concluded that Sri B V Subba Reddy Sagar (Owk reservoir) water physico-chemical parameters were within permissible limits. Hence, it can be said that water is good for Drinking. It can be used for Fish culture and for the purpose of Agriculture.

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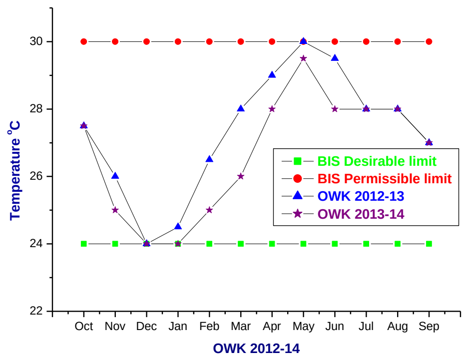

Fig. 1. Variations in Temperature

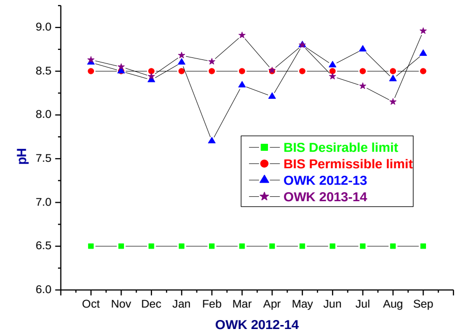

Fig. 2 Variations in pH

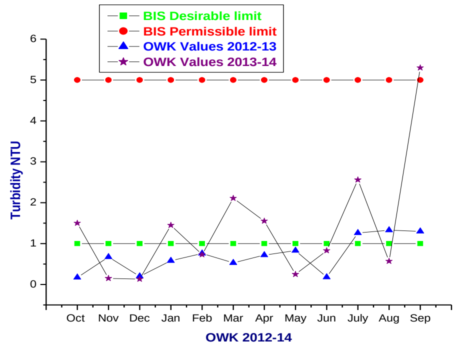

Fig. 6. Variations in Turbidity

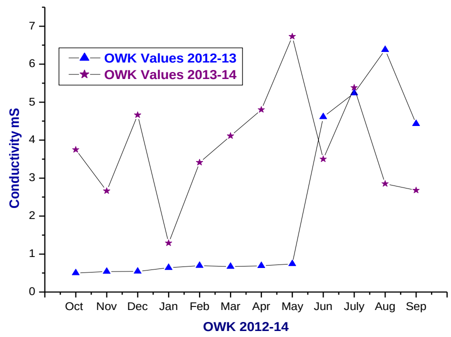

Fig. 3. Variations in Conductivity

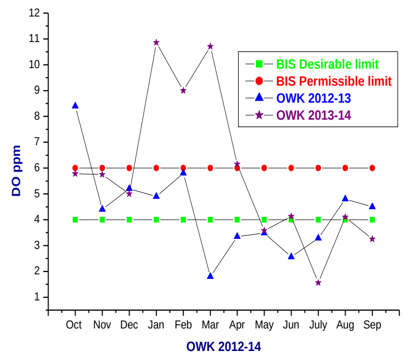

Fig. 7. Variations in DO

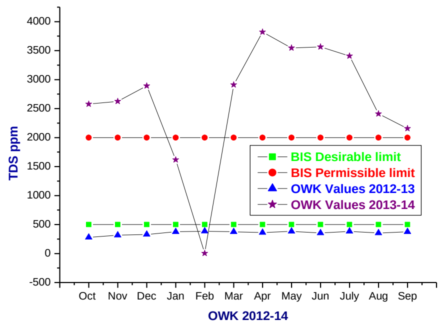

Fig. 4. Variations in TDS

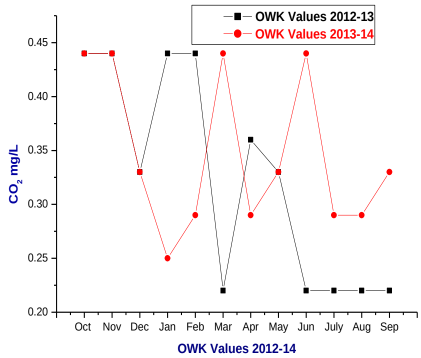

Fig. 8. Variations in Free Carbon dioxide

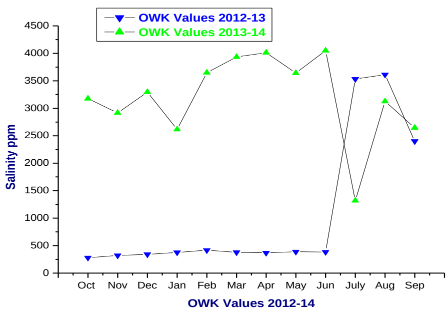

Fig. 5. Variations in Salinity

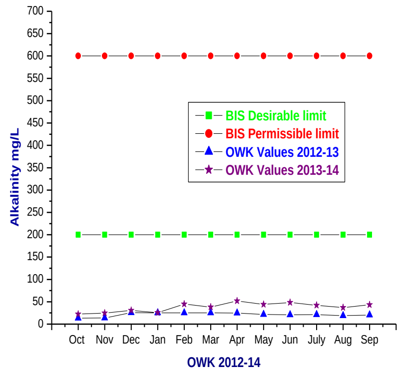

Fig. 9. Variations in Alkalinity

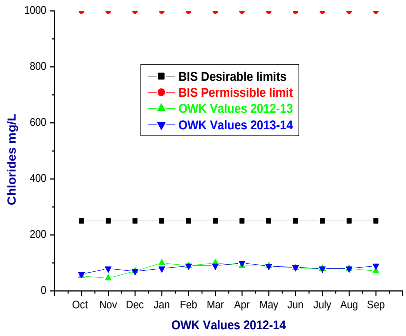

Fig. 10. Variations in Chlorides

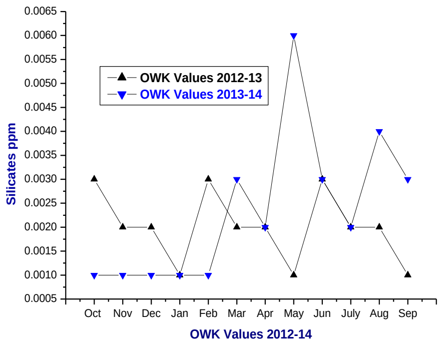

Fig. 14. Variations in Silicates

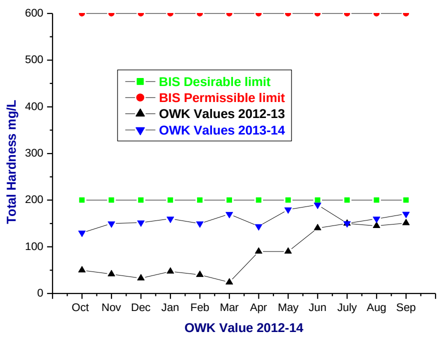

Fig. 11. Variations in Total Hardness

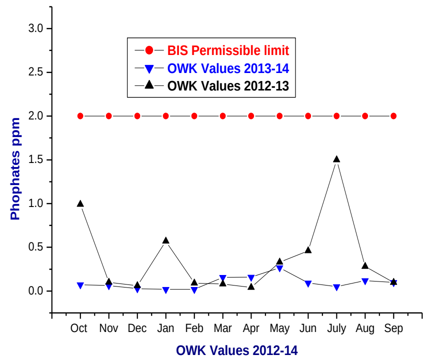

Fig. 15. Variations in Phosphates

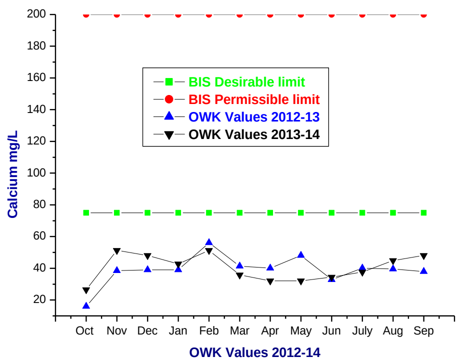

Fig. 12. Variations in Calcium

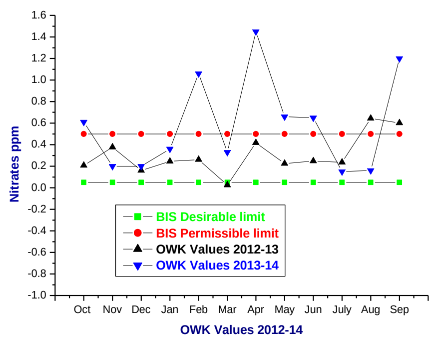

Fig. 16. Variations in Nitrates

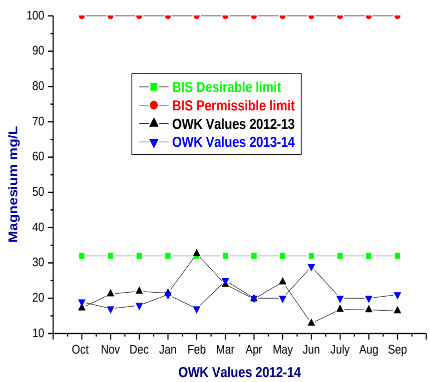

Fig. 13. Variations in Magnesium

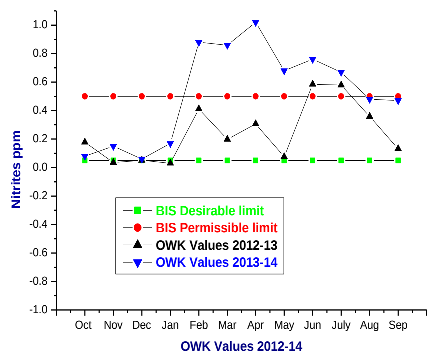

Fig. 17. Variations in Nitrites

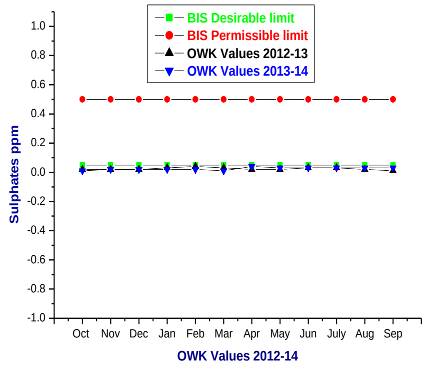

Fig. 18. Variations in Sulphates

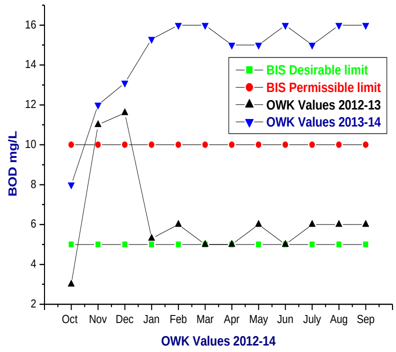

Fig. 19. Variations in BOD

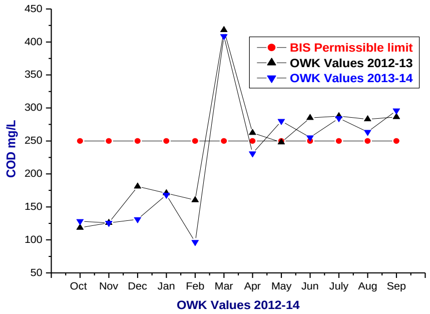

Fig. 20. Variations in COD

Table: I. Correlation coefficient values of water samples collected from Owk reservoir during 2012-13

	Temp	*pH*	*Cond*	*TDS*	*Sal*	*Turb*	*DO*	*CO2*	*Alk*	*Chl*	*TH*	*Ca*	*Mg*	*Si*	*PO4*	*NO2*	*NO3*	*SO4*	*BOD*	*COD*
Temp	1																			
pH	0.05	1																		
Cond	-0	-0.1	1																	
TDS	0.2	-0.5	-0	1																
Sal	0.26	0.04	0.14	-0	1															
Turb	0.09	-0.2	-0.2	-0	0.02	1														
DO	-0.3	-0.1	-0.1	-0.3	0.15	0.16	1													
CO2	-0	-0.1	0.07	-0	-0.1	0.16	0.15	1												
Alk	-0	0.02	-0.1	-0.1	0.13	-0	0.11	0.16	1											
Chl	0.02	-0.1	0.06	0.34	-0.1	-0.2	-0	-0.2	-0.1	1										
TH	0.3	-0.1	0.01	-0	0.08	-0	0.07	0.01	0.05	0.15	1									
Ca	0.03	0.03	-0.1	0.21	0.12	-0.2	-0.1	0.12	0.05	0.01	0.14	1								
Mg	0.02	-0.1	-0.1	-0.1	-0.1	0.17	-0	-0	0.04	-0.1	0.18	-0.1	1							
Si	-0	0.05	-0.2	-0	-0.2	0.02	-0	0.12	-0.1	-0.2	-0.2	0.1	0.02	1						
PO4	-0.2	0.02	-0.1	0	-0.2	-0.1	-0.2	0.05	0.02	-0.2	-0.1	0.03	0.11	0.15	1					
NO3	0.32	0.12	-0.1	0.2	0.02	-0.1	0.24	-0.1	-0.1	-0.1	0.12	0.12	-0	-0	-0.1	1				
NO2	-0.1	0.06	0.08	-0.3	0.11	-0	-0.1	-0.1	0.01	-0.1	-0	0.16	0.13	-0.1	-0	0.02	1			
SO4	-0	-0.2	0.18	-0.1	-0.1	0.05	-0.2	-0.1	-0.2	-0.1	0.01	-0.1	0.17	-0.1	-0	-0.1	-0.2	1		
BOD	0.29	0.01	-0.2	0.1	0.15	0.03	-0	0.14	0.06	0.01	0.36	0.34	-0.1	-0.1	-0	0.02	-0	-0.1	1	
COD	-0.1	-0	0.07	-0	0.08	-0.1	0.19	-0.1	0.09	0.12	0.04	0.01	-0.2	-0.3	-0.2	-0.1	0.07	0.04	-0.2	1

Table: II. Correlation coefficient values of water samples collected from Owk reservoir during 2013-14

	Temp	*pH*	*Cond*	*TDS*	*Sal*	*Turb*	*DO*	*CO2*	*Alk*	*Chl*	*TH*	*Ca*	*Mg*	*Si*	*PO4*	*NO2*	*NO3*	*SO4*	*BOD*	*COD*
Temp	1																			
pH	0.03	1																		
Cond	0.01	0.08	1																	
TDS	0.11	0.08	0.37	1																
Sal	-0.03	-0.07	0.38	0.40	1															
Turb	0.18	0.19	0.27	-0.11	0.05	1														
DO	-0.11	0.01	0.02	-0.47	-0.25	0.2	1													
CO2	-0.13	0.05	-0.17	0.14	-0.23	-0.33	-0.06	1												
Alk	0.20	-0.18	0.02	0.27	-0.13	-0.1	-0.16	0.29	1											
Chl	0.07	0.01	0.10	-0.04	-0.05	0.08	-0.1	-0.29	0.09	1										
TH	0.4	0.18	0.01	0.05	0.11	0.20	-0.2	-0.07	-0.1	0.01	1									
Ca	0.20	0.03	0.01	0.08	0.18	-0.14	-0.05	-0.11	-0.05	0.04	0.13	1								
Mg	0.19	0.28	0.12	0.03	0.09	0.26	0.07	0.09	-0.05	-0.13	0.28	-0.19	1							
Si	0.09	0.34	-0.05	0.05	-0.24	0.04	0.13	-0.06	0.12	0.13	-0.03	-0.03	0.11	1						
PO4	0.16	-0.11	0.10	0.05	0.06	-0.01	0.19	-0.05	-0.01	0.07	0.18	0.01	0.03	0.05	1					
NO3	-0.14	0.29	0.07	0.12	0.12	0.26	-0.08	-0.09	-0.01	-0.14	0.07	-0.02	0.15	0.20	0.13	1				
NO2	0.22	0.049	0.037	-0.22	0.043	0.32	0.12	-0.17	-0.06	-0.11	0.18	-0.16	0.07	-0.07	0.12	0.16	1			
SO4	-0.08	-0.07	-0.16	-0.34	-0.26	0.05	0.23	0.07	0.19	0.12	0.04	-0.36	0.02	0.09	0.04	-0.13	0.29	1		
BOD	0.06	-0.06	-0.08	-0.12	0.04	0.04	-0.01	-0.13	-0.07	-0.14	0.08	0.09	0.15	0.02	-0.04	0.11	0.07	-0.02	1	
COD	0.16	-0.13	0.102	0.14	0.06	0.21	-0.31	-0.25	0.05	0.08	0.08	-0.19	-0.08	-0.13	0.09	0.01	0.05	-0.02	-0.15	1