Water Quality Index in Four Sites of the Cherlapally Lake, Telangana State

R. Amrutha Kalyani
Student
Department of Environmental Science
University College of Science, Osmania University,
Hyderabad, Telangana State, India

Prof. S. Gangadhar Rao
Assistant Professor
Department of Environmental Science
University College of Science, Osmania University,
Hyderabad, Telangana State, India

B. Nageshwarao
Assistant Scientist
Department of Atomic Energy
Nuclear fuel Complex, Hyderabad, Telangana State,
India

B. Thirupathi
Student
Department of Botany
University College of Science, Osmania University,
Hyderabad, Telangana State, India

Abstract

The research study was conducted in the water samples collected from, Cherlapally Lake, Cherlapally village, Ranga Reddy district, Telangana state, India. The water quality index was studied in four sites of the Cherlapally Lake and reported during the year 2013. The following physical- chemical parameters like pH, Temperature, Turbidity, BOD, DO, Coli-form, Nitrates, Phosphates, Total solids were analyzed and compared between the WQI ratings. The parameters like BOD, DO, Coli-form bacteria were rating from 0-25, which was considered highly polluted lake. According to the water quality standards the lake is coming under bad quality and unfit for drinking purpose.

Keywords: Heavy Metals, Cherlapally Lake, Pollution Status, Water Quality, Hyderabad

I. INTRODUCTION

Water is an essential natural resource for humans and also it plays a key role on life and environment. Because of its unique chemical and physical properties it can dissolve majority of substances and there for called as a universal solvent. It is an important makes up essential element of life on Earth. All life depends on water for survival. Water is major and critical component of all the life on earth. Some organisms are making up to 95% water. Without water there would be no vegetation and no oxygen on earth, for every living body to breathe and the Globe would look in a different way. Approximately ¾th of the earth's surface area is covered by water, but in that only 1/4th of water is drinkable and useful for humans.

Water quality is the measure of the state or condition of water resources relative to the requirements of the biotic species and human needs. It is defined as the physical, chemical, biological and organoleptic (taste-related) characteristics of water Johnson *et al.*, (1997), United Nations, (2007). Water quality in aquatic systems is important because it maintains the ecological processes that support biodiversity. However, declining water quality due to environmental perturbations threatens the stability of the biotic integrity and therefore hinders the ecosystem services and functions of aquatic eco systems.

Table - 1
Water quality criteria for fresh water classification

Classes	*DO*	*BOD*	*pH*
A-I class	*>6 mg/L*	*<2 mg/L*	*6.5-8.5*
A-II class	*> mg/L*	*<3 mg/L*	*6.5-8.5*
A-III class	*>4 mg/L*	*<4 mg/L*	*6.0-9.0*
A-IV class	*>4 mg/L*	*>4 mg/L*	*6.5-8.5*
A-V class	*<4 mg/L*	*>4 mg/L*	*6.0-8.5*

Table - 2
Hardness and the water quality as described by Ralph C .Heath; (1982)

Hardness		*mg/L as $CaCo_3$*	*Water Quality*
mg/L of $CaCo_3$	*meq /L of $CaCo_3$*		
<50	*<1*	*0-60*	*Soft*
50-150	*1-3*	*60-120*	*Moderately hard*
150-300	*3-6*	*120-180*	*Hard*
>300	*>6*	*>180*	*Very hard*

Table - 3
Groundwater classification on the basis of TDS (Carroll, 1962)

Total Dissolved Solids (mg/L)	*Category*
Up to 1000	*Fresh Water*

1000 – 10,000	*Brackish Water*
10,000 – 100, 000	*Saline Water*
Above – 100,000	*Brine Water*

Table - 4
Classification of Water based on Hardness (Sawyer and McCarty, 1967)

S. No.	*Water Class*	*Water Class*
1.	*0 – 75*	*Soft*
2.	*75 – 150*	*Moderately Hard*
3.	*150 – 300*	*Hard*
4.	*Over 300*	*Very Hard*

A. Water Quality: (Dick, et al., 1975)

Water quality criterion is described as numerical concentration or narrative statements recommended to support and maintain a designated water use.

Water quality objective is a numerical concentration or narrative statement which has been established to support and to protect the designated uses of water at a specific site, river basin or part(s) thereof.

Water quality standard control can be defined as an objective recognized in enforceable environmental laws or regulations of a level of Government.

Precautionary principle is the by virtue of which action to avoid the potential impact of the release of hazardous substances shall not be postponed on the ground that scientific research has not fully proved a causal link between those substances, on the one hand, and the potential adverse impact.

Water Quality Assessment is an evaluation of the beneficial use impairment that is occurring, or could potentially occur, due to the presence of a particular chemicals or other constituent. It is not an assessment of the frequency of exceedance of a water quality standard.

Water Quality Standard Compliance is based on an assessment of the frequency of exceedance of a water quality standard in ambient water receiving the discharge/runoff. Such compliance does not ensure that the beneficial uses of the water body are being protected or that significant over-regulation is not occurring.

B. Water Quality Index

A water quality index provides a single number that expresses overall water quality at a certain location and time based on several water quality parameters. The objective of an index is to turn complex water quality data into information that is understandable and useable by the public. This type of index is similar to the index developed for air quality that shows if it's a red or blue air quality day. The use of an index to "grade" water quality is a controversial issue among water quality scientists. A single number cannot tell the whole story of water quality; there are many other water quality parameters that are not included in the index. The index presented here is not specifically aimed at human health or aquatic life regulations. However, a water index based on some very important parameters can provide a simple indicator of water quality. It gives the public a general idea the possible problems with the water in the region.

The study was conducted on Cherlapally Lake, which was constructed in1970. It is located in 17.49'67"N latitude and 78.55'26" E longitude and having surface area of 2.6Km. The lake has fresh water in earlier and appears as full-tank throughout the year and dry in summer. This water was the main source for drinking, fisheries and agriculture purpose. Rice was the main crop grown from this water. Earlier lake water is not polluted. In the recent 15 years the Lake started receiving sewage waste water from Kapra Village and Kushaiguda industrial areas. In addition to this mostly heavy metals releasing industries have come up in the surrounding of the lake. Therefore, there is possibility of increasing water pollution and changes entire water quality of the lake. For this purpose, experiments were conducted to know the pollution status and water quality parameters in the Cherlapally Lake. The present study was carried out during the year 2013.

II. REVIEW OF LITERATURE

A. Review of Literature on Water Quality

Dhembare *et al*., (1998), have studied on water quality and reported that living organisms should have good quality of water and the quality of water was described to assess physical, chemical and microbial characteristics of water.

Makhmoor Ahmad Rather, Harendra K. Sharma *et al.,* (2013), carried out their research work on quality assessment of local packaged water. For that they determined the physico-chemical and bacteriological quality of packaged drinking water brands available in retail shops in Gwalior city in India, and compared them with drinking water quality standards. To assess the quality of packaged water samples, 10 local brands of packaged water (labeled from A to J) were evaluated within 3 months. The results showed that most of the packaged water brands have soft water. Total coliforms bacteria were observed in some brands and faecal coliforms were absent in all brands. Physico-chemical parameters in all brands were within permissible limits when compared with BIS and WHO guidelines for drinking water. Due to presence of coliforms bacteria in some of the packaged water brands, the study concluded that the packaged water was not thoroughly checked for quality control.

In a report by Reuters (1999), world's major rivers are being seriously depleted and polluted by half of them and degrading the surrounding ecosystem, thus threatening the health and livelihood those who depend upon them for irrigation, drinking and industry. As per the World Commission report the depletion, pollution, degradation and poisoning of rivers for the 21st century, nearly 25 million people fled their homes in 1998.

Saxena K.K and Chauhan R.S(1993), in their report which quoted that according to the CPCB, the major rivers in India indicated that majority of them (14)are polluted and thousands of People who lived surrounding of river Yamuna gotattacked by malaria, cholera and jaundice diseases.

According to Klohn and Wolter (1998), agriculture farms have the biggest contribution for water pollution than contribution by industries and municipalities. Where ever agricultural fertilizers and pesticides were used, contaminations were reported on groundwater aquifers. Thus, water coming out of agricultural field which go in to the rivers are highly degraded and polluted.

Carty (1991) and Allaoui (1998), have reported that pollution was chromic problem in developing countries like India. Where there was rapid growing in pollution, there development demands were increased and governments should have different investment priorities. In developing countries, on an average, maximum of all domestic sewage and 3/4th of all industries were discharging their waste into surface waters without any treatment.

Good quality water for drinking purpose to human society is very essential for health; the greatest danger to human health is water pollution. Many rivers and streams are highly polluted due to industrial and sewage discharge in developing countries by S. B. Jonnaladda *et al., (2001*).

To assess water quality and trophic status of Raipur reservoir by Meenakshi Saxena, (2012), and has studied various parameters of reservoir water, monthly as well as seasonal fluctuations. The nutrients including calcium, silicates, sulphates, phosphates, nitrates and potassium are in sufficient quantities for the growth of aquatic plants and animals in the reservoir. The above study indicated that the Raipur reservoir is under category of meso-eutrophic water body.

B. Review of Literature on Water Quality Index

P. J. Puri, M. K. N. Yenkie et al., (2011), worked on three different lakes for water quality index (WQI) on surface waters. They have done comparison of three seasons as summer, winter and rainy on water quality index calculator given by National Sanitation Foundation (NSF) information system. The result of various studies on lakes showed fair water quality in monsoon season which then changed to medium in winter and poor for summer season.

Bhargava et al., (1982),found that quality index of water was far beyond the prescribed limit for the total length of water stretch in river Ganga at Kanpur and also revealed that the Ganga water has the capacity in bringing down the B.O.D, because of having the capacity of fast regenerating due to presence of well adopted micro-organisms in the river. Ganga water was rich in polymers which were due to excretion by various species of bacteria. The turbidity was removed by coagulation due to these polymers which were excellentcoagulants and help in setting the suspended particles present in water atthe sewage discharge point.

BinuKumari, Mukul R. Mondal (2014), have made an attempt to understand the ground water quality of Dhanbad town area in Jharkhand state, India by Physico- chemical characterization and water quality index. Samples were collected from different hand pumps of the Dhanbad town area .Various physico-chemical parameters were determined by standard methods and The results showed that 75% of the water samples falls in the category B (Good water) and 25% of the water sample falls in the category C (Poor water), which is mainly due to high TDS and total hardness.

Bhaven N. Tandel, Dr. JEM Macwan et al., (2011), was studied on the water quality index of strategically selected lake in South Gujarat Region, India by monitoring of seasonal variation. It is found that in all cases the change in WQI value followed a similar trend throughout the study period. The lake water is found of good quality (WQI - 67.7 to 78.5) during both seasons. However, it is found that water quality of lake changes slightly from winter season to summer season on account of the increase in microbial activity as well as increase in pollutants concentration.

Agbaire P. O. and Obi C.G. (2009), have investigated the influence of seasonal changes on the properties of water from Ethiope River at Abraka. Composite samples from six different sampling points were collected and analysed for both dry and wet seasons. Wet season has mean pH as 6.82, temperature 27.73°C conductivity 81.7µs/cm, TDS 0.26mg/l TSS 16.21, DO 16.80mg/l, BOD 4.50mg/l. The results for dry season has mean pH 6.82, temperature 29.150C, conductivity 87.2µs/cm, TDS 0.34mg/l, TSS 15.21mg/l, DO 17.45mg/l, BOD 4.38mg/l. The result of heavy metal content showed that they were within the permissible levels. This water is having high WQI and fit for drinking.

Robert Damo and PirroIcka Fan S. Noli (2013), have studied drinking water quality in the city of Pogradec, Albania. Daily samples were taken from six fixed points in the city and they were analyzed and the assessment of water quality was made by using the water quality index (WQI) of the Canadian Council of Ministries of the Environment (CCME). Finally they reported the drinking water quality in the city of Pogradec was good, and that turbidity is the main problem in quality.

Water Quality Index (WQI) was applied in Dokan Lake, Kurdistan region, Iraq using water quality by Abdul Hameed M and Jawad Alobaidy et al., (2010). The results indicated that water quality of Dokan Lake was polluted. The impact of various anthropogenic activities was evident on some parameters such as the EC and BOD. It was suggested that monitoring of the lake was necessary for proper management and also a very helpful tool (WQI) that enables the public and decision makers to evaluate water quality of lakes in Iraq.

The selected study area was a part of river Godavari system, consisting of seven stations for WQI by Er. Srikanth Satish Kumar Darapu and Er. B. Sudhakar et al., (2007).They reported that WQI of the study area falls under grade-IV (for irrigation) medium pollution. The study indicated heavy pollution at Mancherial which hints at a number of industries around.

Mophin-Kania K and Murugesan A.G. (2011), were carried out to assess the quality of river Tamirabarani of Tamil Nadu, India. The results showed water quality reduced during the month of April where as remaining months showed the quality up to fair level. Correlation study between physicochemical properties also reveals significant negative relationship with the Water Quality Index (WQI) scores. They concluded that the index function makes easy interpretation of results which in-turn increases the effectiveness of management strategies to bringing back the originality of the river.

Ramganga is an important river in Bareilly (U.P). Hence an attempt has been made by Ravi Kumar Gangwar, Jaspalsingh et al., (2013), to study Water Quality Index (WQI) and pollution or changes in the quality of water. The quality of river water was classified into permissible, slight, moderate and severe on the basis of the pollution strength at three sampling stations in three seasons. Assessment of WQI of River Ramganga includes physico-chemical parameters which indicated the extent of pollution. The main causes of reduction in water quality were lack of proper sanitation, unprotected river sites, high anthropogenic activities and direct discharge of industrial effluents.

III. MATERIAL AND METHODS

A. Sample Collection Sites

Samples of water were collected from 4 different sites in three seasons that are summer, winter and rainy of the Cherlapally Lake which are site-1(In-let), site-2(Out-let), site-3(middle of the lake) and site-4 (2km away from the lake) and analyzed for various water quality parameters. The outcome results were compared with WHO standards (World Health Organization) to find out the actual pollution status of the Lake.

B. Water Quality Parameters

In this study 9 water quality parameters were analysed, that are pH, temperature, turbidity, total solids (TDS+TSS), nitrates, phosphates, coli-form bacteria, BOD, DO. pH were measured using pH meter and noted the temperature on the spot of collection. TDS (Total dissolved solids), TS (Total Solids), alkalinity, phosphates, Nitrates, were estimated using standard methods (APHA, 1998). Dissolve oxygen was determined by Winkler's method. Nitrate was determined by U.V-Spectrophotometric method. Phosphorus was determined by vanado molybdo phosphoric acid colorimetric method.

IV. RESULTS

A. Water Quality Index Legend

Table – 5
Water Quality Index Legend

Range	*Quality*
90-100	*Excellent*
70-90	*Good*
50-70	*Medium*
25-50	*Bad*
0-25	*Very Bad*

B. Water Quality Index in Site-1

Table – 5
Showing the water quality index values recorded for various parameters in site-1 of the Cherlapally Lake in three seasons.

Site-1	*Summer WQI*	*WQI Rating*	*Rainy WQI*	*WQI Rating*	*Winter WQI*	*WQI Rating*
pH	*92*	*Excellent*	*93*	*Excellent*	*92*	*Excellent*
Temperature	*11*	*Very Bad*	*13*	*Very Bad*	*15*	*Very Bad*
Turbidity	*33*	*Bad*	*24*	*Very Bad*	*44*	*Bad*
Nitrates	*45*	*Bad*	*48*	*Bad*	*45*	*Bad*
Phosphates	*93*	*Excellent*	*95*	*Excellent*	*92*	*Excellent*
Total Solids	*50*	*Medium*	*50*	*Medium*	*50*	*Medium*
BOD	*5*	*Very Bad*	*5*	*Very Bad*	*5*	*Very Bad*
DO	*3*	*Very Bad*	*4*	*Very Bad*	*4*	*Very Bad*
Coliform	*5*	*Very Bad*	*5*	*Very Bad*	*6*	*Very Bad*
Total WQI	*33*	*Bad*	*33*	*Bad*	*34*	*Bad*

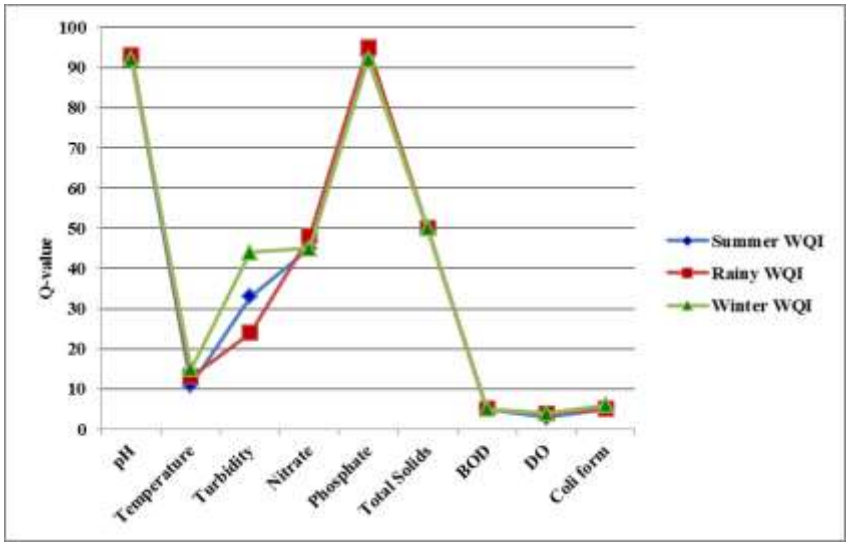

Fig. 1: Showing the water quality index (Q-values) recorded for various parameters in site-1 of the Cherlapally Lake in three seasons.

1) The WQI for 9 parameters in site-1 of the Cherlapally Lake is ranged from 25-50 and according to the water quality standards the lake is coming under bad quality and unfit for drinking purpose.
2) The water quality index value for BOD, DO, Coli-form bacteria is ranging from 0-25, which is considered highly polluted lake.
3) However Turbidity, Total solids ranged 50-70, which is considered medium polluted.

C. *Water Quality Index in Site - 2*

Table – 6
Showing the water quality index values recorded for various parameters in site-2 of the Cherlapally Lake in three seasons.

Site-2	*Summer WQI*	*WQI Rating*	*Rainy WQI*	*WQI Rating*	*Winter WQI*	*WQI Rating*
pH	*92*	*Excellent*	*92*	*Excellent*	*92*	*Excellent*
Temperature	*11*	*Very Bad*	*13*	*Very Bad*	*14*	*Very Bad*
Turbidity	*63*	*Medium*	*52*	*Medium*	*66*	*Medium*
Nitrates	*48*	*Bad*	*53*	*Medium*	*48*	*Bad*
Phosphates	*96*	*Excellent*	*96*	*Excellent*	*95*	*Excellent*
Total Solids	*50*	*Medium*	*50*	*Medium*	*50*	*Medium*
BOD	*5*	*Very Bad*	*5*	*Very Bad*	*5*	*Very Bad*
DO	*3*	*Very Bad*	*4*	*Very Bad*	*4*	*Very Bad*
Coliform	*7*	*Very Bad*	*15*	*Very Bad*	*16*	*Very Bad*
Total WQI	*36*	*Bad*	*38*	*Bad*	*38*	*Bad*

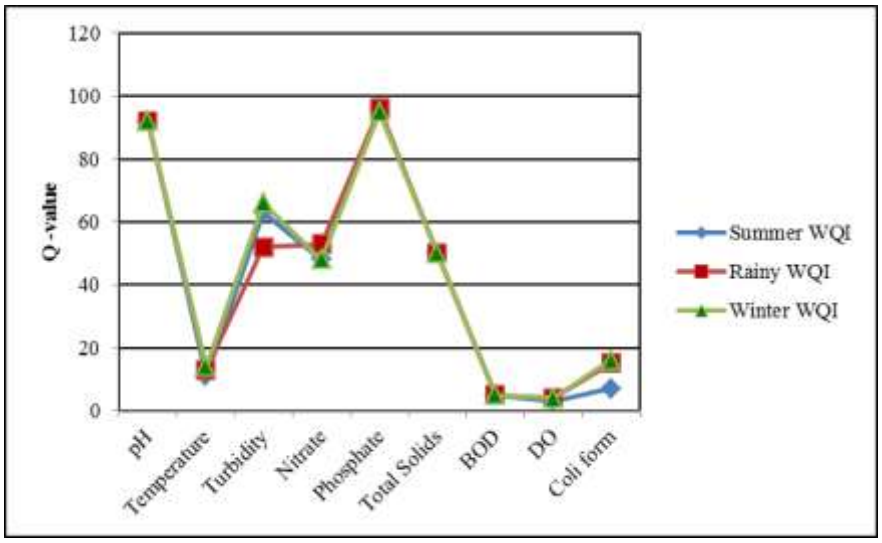

Fig. 2: Showing the water quality index (Q-values) recorded for various parameters in site-2 of the Cherlapally Lake in three seasons.

1) The WQI for 9 parameters in site-2 of the Cherlapally Lake is ranging 25-50 and according to the water quality standards the lake is coming under bad quality and unfit for drinking purpose.
2) The water quality index value for BOD, DO, Coli-form bacteria is ranging from 0-25, which is considered highly polluted lake.
3) However Turbidity, Nitrates and Total solids ranged 50-70, which is considered medium polluted.

D. Water Quality Index in Site-3

Table – 7
Showing the water quality index values recorded for various parameters in site-3 of the Cherlapally Lake in three seasons.

Site-3	*Summer WQI*	*WQI Rating*	*Rainy WQI*	*WQI Rating*	*Winter WQI*	*WQI Rating*
pH	*90*	*Excellent*	*92*	*Excellent*	*84*	*Good*
Temperature	*12*	*Very Bad*	*12*	*Very Bad*	*14*	*Very Bad*
Turbidity	*52*	*Medium*	*40*	*Bad*	*59*	*Medium*
Nitrates	*46*	*Bad*	*56*	*Medium*	*48*	*Bad*
Phosphates	*94*	*Excellent*	*94*	*Excellent*	*93*	*Excellent*
Total Solids	*50*	*Medium*	*50*	*Medium*	*50*	*Medium*
BOD	*5*	*Very Bad*	*5*	*Very Bad*	*5*	*Very Bad*
DO	*4*	*Very Bad*	*3*	*Very Bad*	*4*	*Very Bad*
Coliform	*7*	*Very Bad*	*8*	*Very Bad*	*8*	*Very Bad*
Total WQI	*35*	*Bad*	*35*	*Bad*	*35*	*Bad*

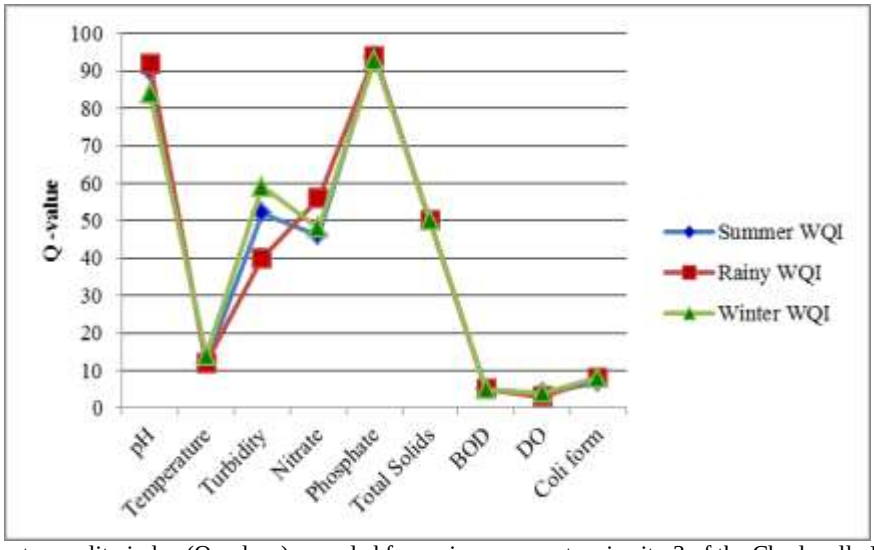

Fig. 3: Showing the water quality index (Q-values) recorded for various parameters in site-3 of the Cherlapally Lake in three seasons

1) The WQI for 9 parameters in site- of the Cherlapally Lake is ranging 25-50 and according to the water quality standards the lake is coming under bad quality and unfit for drinking purpose.
2) The water quality index value for BOD, DO, Coli-form bacteria is ranged from 0-25, which is considered highly polluted lake.
3) However Turbidity, Nitrate and Total solids ranged 50-70, which is considered medium polluted.
4) There is not much difference in Water Quality Index, between summer, rainy and winter seasons

E. Water Quality Index in Site-4

Table – 8
Showing the water quality index values recorded for various parameters in site-4 of the Cherlapally Lake in three seasons.

Site-4	*Summer WQI*	*WQI Rating*	*Rainy WQI*	*WQI Rating*	*Winter WQI*	*WQI Rating*
pH	*88*	*Good*	*92*	*Excellent*	*71*	*Good*
Temperature	*12*	*Very Bad*	*13*	*Very Bad*	*14*	*Very Bad*
Turbidity	*93*	*Excellent*	*88*	*Good*	*93*	*Excellent*
Nitrates	*42*	*Bad*	*42*	*Bad*	*45*	*Bad*
Phosphates	*93*	*Excellent*	*93*	*Excellent*	*93*	*Excellent*
Total Solids	*50*	*Medium*	*50*	*Medium*	*50*	*Medium*
BOD	*5*	*Very Bad*	*5*	*Very Bad*	*42*	*Bad*
DO	*3*	*Very Bad*	*3*	*Very Bad*	*4*	*Very Bad*
Coliform	*12*	*Very Bad*	*11*	*Very Bad*	*61*	*Medium*
Total WQI	*38*	*Bad*	*38*	*Bad*	*45*	*Bad*

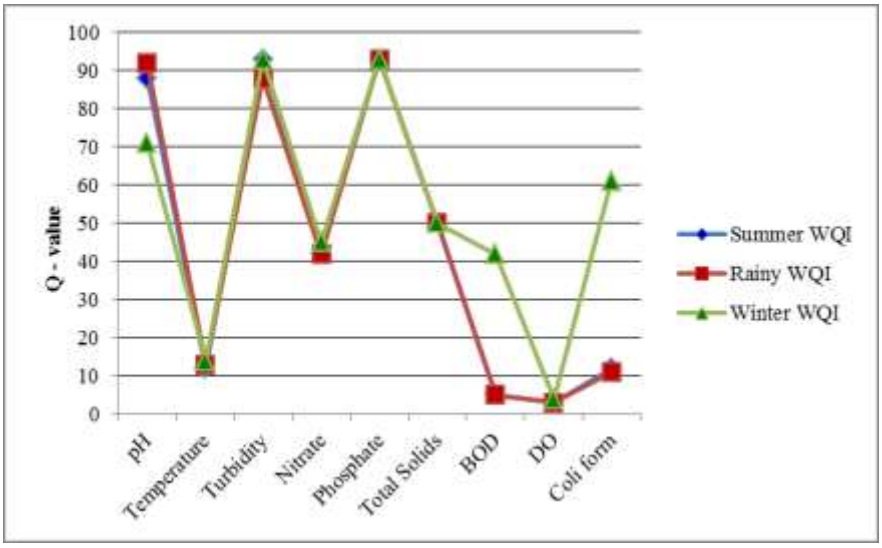

Fig. 4: Showing the water quality index (Q-values) recorded for various parameters in site-4 of the Cherlapally Lake in three seasons.

1) The WQI for 9 parameters in site-4 of the Cherlapally Lake is ranged from 25-50 and according to the water quality standards the lake is coming under bad quality and unfit for drinking purpose.
2) The water quality index value for BOD, DO, Coli-form bacteria is ranging from 0-25, which is considered highly polluted lake.
3) However Turbidity, Total solids ranged 50-70, which is considered medium polluted.

V. CONCLUSION

Water Quality Index values between seasons

1) The WQI for 9 parameters in site-1, site-2, site-3 and site-4 of the Cherlapally Lake was ranging from 25-50 and according to the water quality standards the lake is coming under bad quality and unfit for drinking purpose.
2) The WQI values for BOD, DO, Coli-form bacteria were ranging from 0-25, which was considered highly polluted lake.
3) However Turbidity, Total solids, Nitrates ranged from 50 to 70, which were considered medium polluted.

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