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STATISTICAL ANALYSIS OF WATER QUALITY PARAMETERS OF ANSUPA LAKE, ODISHA(INDIA).

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Abstract

Water is god grace for everyone. Water is one of the very few vital needs for human beings. Water should be refined for better lifestyle of each and every individual. So, it is our duty to conserve the water resources. The present work aims to analyse the water quality parameters like Dissolved oxygen (DO), pH, electrical conductivity (EC), nitrate (NO_3), phosphate (PO_4) and Biological oxygen demand (BOD) and their statistical analysis such as mean, standard deviation, standard error, sample variance, range, skewness, kurtosis and coefficient of variance of three different seasons *i.e.* monsoon, summer and winter. The correlation coefficient were determined for monsoon, summer and winter to inter-relate the different parameters. The results of correlation, identifies the strong correlation, moderate and weak correlation between parameters.

Key words : Water quality, statistical analysis, correlation coefficient, moderate.

Introduction

The earth consists of 4 different spheres *i.e.* biosphere (means life), lithosphere (means land), hydrosphere (means water) and atmosphere (means air). Hydrosphere is the total amount of water present on the planet. The hydrosphere includes various types of water resources such as oceans, glaciers and fresh water. Water is the most valued natural source and it fulfils all the major needs of an organisms, plants, animals and humans (Aydin, 2018).

Water is very essential for the survival of all living organisms in the planet, it is being threatened as human population increases day-by-day and demands for high quality of water for domestic purposes also increasing (Choudhury, Borkataki *et al.,* 2015). India is naturally hold up large number of freshwater bodies like rivers, lakes and wetland (Bhatta and Patra, 2020). Due to direct discharge of untreated domestic, industrial wastes and agricultural runoff causes eutrophication in the lake *i.e.* the water is unfit for human use (Sharma *et al.,* 2015). It not only pollute the water but also have worse impact on aquatic animals (Bhatta and Patra, 2020). Thus, the quality and availability of water deteriorates day by day (Alaidi and Aldhahi, 2019). Water quality refers to the physical, chemical and biological property of water. In general, water quality tells weather the water is polluted or not *i.e.* useful for human or not. Water quality includes various physiochemical parameters like DO, pH, EC, NO_3, PO_4 and BOD (Vinod, Sanjay *et al.,* 2017). The aim of the present study is to determine the various water quality parameters and their statistical analysis of three different seasons *i.e.* monsoon, summer and winter.

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Materials and method

A. Lake Description

Ansupa lake is one of the most largest freshwater lake in Odisha, India (Das and Mohanty, 2008). It is a horseshoe shaped sweet water lake present on the left bank of river Mahandi, which is opposite of Banki, Cuttack (Odisha). It is about 350 acres *i.e.* 141 ha and max. length is 3 km and min. length is 1.5 km (Topography of Odisha). It is located between 20.459142p N to 85.603709p E. It is connected to river Mahanadi in its southern side with a channel called KabulaNala, through this channel flood water enters the lake. There is another channel called Haluhula Nala, which is present in the southeast side. The lake is surrounded by Saranda hills and Bishnupur

hills. The lake is famous for its picturesque landscape (Pattanaik and Reddy, 2007). It supports livelihood to several local people by agricultural activities in the catchment area, fishing in the lake. The lake has national importance as it attracts several migratory birds in winter season.

B. Site Description and Collection of Samples

The lake is divided into 3 different sites and 3 replicate samples from each site *i.e.* total 9 samples were collected from 3 different stations. The sampling stations of the lake is visited from April to January, 2019. Water from different sectors were collected from limnetic zone in Bisleri water bottle in between the time 7-9 am. Some parts of water samples often fixed with lugolýs iodine solution for fixing of bacteria and other parts are kept normal.

C. Analysis Of Various Water Quality parameters

Various types of water quality parameters of three different seasons were measured such as DO, pH, EC, NO_3, PO_4 and BOD. The following parameters were taken to the laboratory and determine by using standard methods given in the table 1 (Jamuna, 2018).

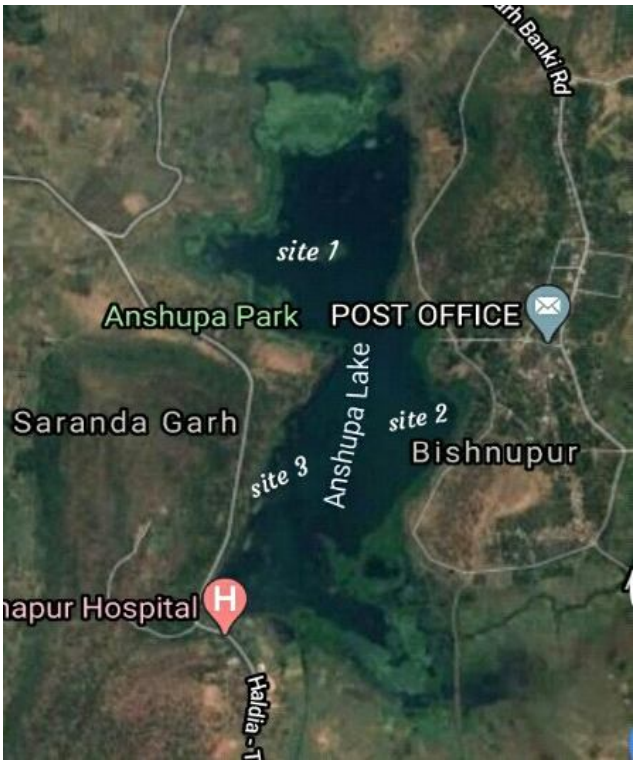

Fig. 1: Satellite image of Ansupa lake showing 3 different sampling sites.

Table 1: Water quality parameters, units and methods of determination.

Parameters	Units	Methods of determination
Dissolved oxygen (DO)	mg/l	wrinklerýs reagent
Electrical conductivity (EC)	μscm^{-1}	Digital conductivity meter
Nitrate (NO_3)	mg/l	APHA (4500-No3_E), 2017
Phosphate (PO_4)	mg/l	APHA (4500-P-O), 2017
Biological oxygen demand (BOD)	mg/l	Wrinklerýs reagent

Mean:

It is defined as the average value.

Standard deviation:

It is denoted as σ (Greek letter sigma). Standard deviation is the amount of variability or dispersion.

$$\sigma = \sqrt{\frac{\in (x - X)^2}{n - 1}}$$

Where, σ = standard deviation

x = each value in the data set

X = sample mean

n = no. of samples

Standard deviation is the square root of variance.

Standard error mean:

Standard error mean is defined as the reciprocal of standard deviation to the square root of no. of samples.

$$SE = \frac{\sigma}{\sqrt{n}}$$

Where, SE = standard error mean

= standard deviation

n = no. of samples

Standard deviation is always greater than standard error mean.

Sample variance:

Variance is defined as the square of standard deviation.

Where, sample variance

X = sample mean

x = each value in the data set

n = no. of samples

Range:

Range is defined as the difference between the maximum and minimum data value.

Range = (max. value) – (min. value)

Skewness

Skewness refers to the degree of asymmetry of a given data around its mean.

If the skewness will be close to 0, then the distribution of data is symmetric in nature. Positive skew refers that the tail is on right side of distribution and negative skew indicates tail is on left side (Èisar, 2010).

Kurtosis

Kurtosis refers to the relative flatness or peakedness of a distribution in comparison to the normal distribution. There are three types of kurtosis *i.e.* (a). mesokurtic refers to the excess kurtosis of zero or close to zero (if data follows a normal distribution). (b). leptokurtic indicates a positive excess kurtosis. (c). platykurtic refers to the negative excess kurtosis (Sood and Sharma, 2016).

Coefficient of variance

It is defined as the measure of relative dispersion (Parmar and Bhardwaj, 2012).

$$CV = \frac{\sigma}{X} \times 100\%$$

Where, CV= coefficient of variance

= standard deviation

X= mean

Correlation Coefficient

It is defined as the correlative relationship between two different variables. The value of the correlation coefficient lies between +1 to -1 (Shroff, Vashi *et al.,* 2018). (a) If the value of correlation coefficient is between +0.8 to +1, then it is said to be strong correlation. (b) if the range of correlation coefficient is between +0.5 to +0.8, then it is said to be moderate correlation. (c) if the correlation value is between 0.0 to then it is said to be weak correlation.

Results and Discussion

The water quality parameters like DO, pH, EC, NO_3, PO_4 and BOD were determined for the water samples collected from Ansupa lake and also various types statistical methods were applied such as mean, standard deviation, standard error mean, variance, range, skewness, kurtosis, coefficient of variance and correlation coefficient

Table 2: Statistical analysis of various water quality parameters of Monsoon Season.

Parameters	Mean mg/l	SD	SE	Variance	Range	Skewness	Kurtosis	Cofficient of variance
DO	7.67	1.01	0.339	1.03	3.1	-0.05	-0.632	13.16
pH	6.86	0.22	0.073	0.049	0.75	-1.02	1.574	3.20
EC	149.65μ/scm	22.23	7.41	494.17	64.1	0.156	-1.213	14.85
Nitrate	3.06	0.77	0.256	0.593	1.78	-0.134	-2.198	25.16
Phosphate	0.055	0.024	0.008	0.0005	0.064	0.143	-1.746	43.63
BOD	2.54	0.387	0.129	0.150	1	-0.317	-1.321	15.23

Table 3: Statistical analysis of various water quality parameters of Summer Season.

Parameters	Mean mg/l	SD	SE	Variance	Range	Skewness	Kurtosis	Cofficient of variance
DO	8.73	1.155	0.385	1.335	2.6	0.840	-1.670	13.23
pH	7.121	0.345	0.115	0.119	0.8	0.448	-1.967	4.844
EC	107.13μ/scm	3.845	1.281	14.77	9.8	-0.365	-1.692	3.587
Nitrate	1.407	1.062	0.354	1.‘129	3.08	0.165	-0.881	75.47
Phosphate	0.030	0.010	0.0035	0.0001	0.034	-0.468	-0.154	33.3
BOD	3.93	0.676	0.225	0.457	1.7	-0.578	-1.646	17.20

Table 4: Statistical analysis of various water quality parameters of Winter Season.

Parameters	Mean mg/l	SD	SE	Variance	Range	Skewness	Kurtosis	Cofficient of variance
DO	6.633	0.561	0.187	0.315	1.2	-0.253	-2.390	8.457
pH	6.637	0.153	0.051	0.023	0.48	-0.676	0.072	2.305
EC	89.88μ/scm	6.766	2.255	45.78	18.4	0.363	-1.273	7.527
Nitrate	1.936	1.055	0.351	1.114	2.77	-0.470	-1.485	54.493
Phosphate	0.254	0.270	0.090	0.073	0.619	0.617	-1.828	106.299
BOD	2.855	0.304	0.101	0.09	0.8	-0.615	-1.549	10.647

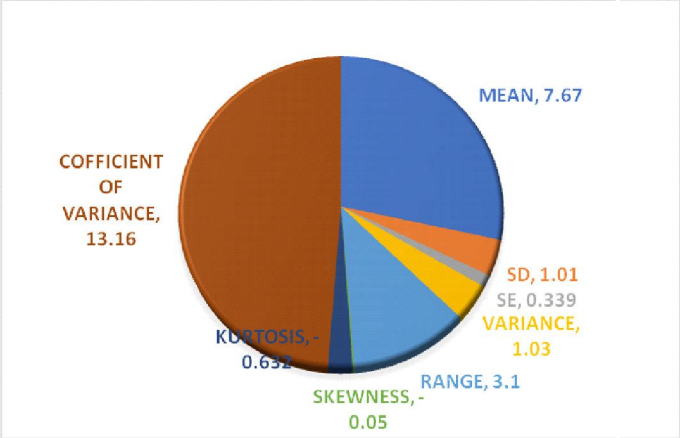

Fig. 2: 3D pie chart of statistical analysis of monsoon season.

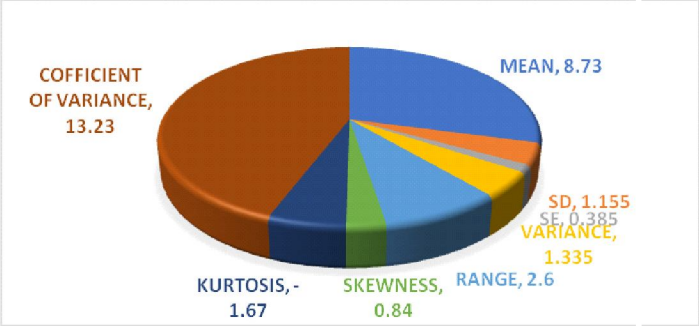

Fig. 3: 3D Pie chart showing statistical analysis of summer season.

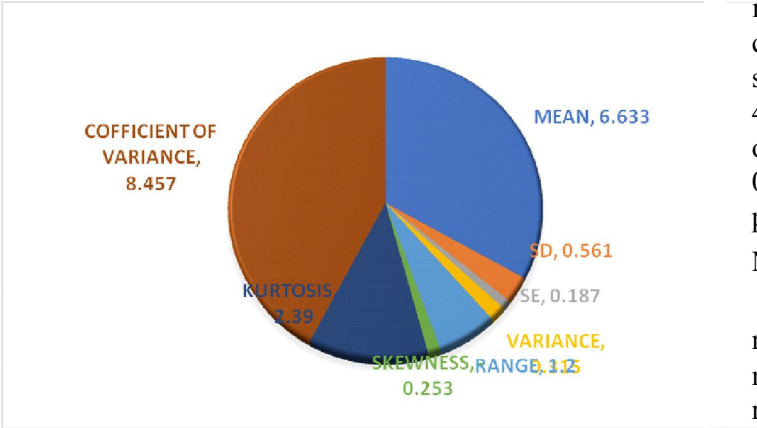

Fig. 4: 3D pie chart showing statistical analysis of winter season.

for three different seasons *i.e.* monsoon, summer and winter. The statistical analysis of water quality parameters of different season were given in table 2, 3 and 4.

Dissolved Oxygen (DO) in mg/l

DO is the most important water quality parameters and it is a key test of water pollution. More the DO, better is the water quality. The average value, standard deviation and standard error of three different seasons like monsoon, summer and winter were (7.67, 8.73 and 6.633); (1.01, 1.155 and 0.561) and (0.339, 0.385 and 0.187) resp. Variance and coefficient variance of monsoon, summer and winter were (1.03, 1.335 and 0.315); (3.1, 2.6 and 1.2) resp. Skewness of monsoon is -0.05, summer is 0.840 and winter is 0.253. kurtosis is same for three different seasons *i.e.* platykurtic. Here the range is 3.1 for monsoon, 2.6 for summer and 1.2 for winter.

pH

pH is defined as the negative logarithm of hydrogen ion concentration. It is the measure of acidity or alkality. SD, SE and mean of pHof three seasons were (SD: 0.22. 0.345 and 0.153); (SE: 0.073, 0.115 and 0.051) and (Mean: 6.86, 7.121 and 6.637) resp. Range, variance and coefficient of variance were (Range: 0.75, 0.8 and 0.48); (Variance: 0.049, 0.119 and 0.023) and (CV: 3.20, 4.844 and 2.305) resp. In monsoon, skewness is -1.02, in summer skewness is 0.448 and in winter it is -0.673. kurtosis in monsoon is leptokurtic type, in summer it is platykurtic type and in winter it is same as monsoon.

Electrical Conductivity (EC) in µs/cm

EC is defined as the electric current present in the water. Mean value of monsoon, summer and winter were 149.65, 107.13 and 89.88 resp. SD and SE of monsoon, summer and winter were (SD: 22.23, 3.845 and 6.766) and (SE: 7.41, 1.281 and 2.255) resp. Range of monsoon is 64.1, summer is 9.8 and winter is 18.4. variance and coefficient of variance of 3 different seasons *i.e.* monsoon, summer and winter were (Variance: 494.17, 14.77 and 45.78) and (CV: 14.85, 3.587 and 7.527) resp. skewness of monsoon is 0.156, summer is -0.365 and in winter is 0.363. The kurtosis of three different season is same *i.e.* platykurtic.

Nitrate (NO_3)in mg/l

Nitrate in the water bodies comes from agricultural runoff, washing clothes etc. SD of the 3 seasons *i.e.* monsoon, summer and winter were 0.77, 1.062 and 1.055 resp. SE and mean of monsoon is 0.256, 3.06; summer is 0.354, 1.407 and winter is 0.351, 1.936. In monsoon variance and range is 0.593, 1.78; in summer is 1.129, 3.08 and in winter variance and range is 1.114, 2.77. kurtosis is same for all 3 seasons. Skewness and coefficient of variance is -0.134 and 25.16 for monsoon, 0.165 and -0.470 for summer and for winter skewness is -0.470 and coefficient of variance is 54.493.

Phosphate (PO_4)in mg/l

It helps in the rapid growth of aquatic plants in the water bodies. Due to high concentration of PO_4 it causes eutrophication of the lake. Mean, SD, SE and range of monsoon season were 0.055, 0.024. 0.008 and 0.064; summer season were 0.030, 0.010, 0.0035 and 0.034 and

Table 5: Correlation coefficient of monsoon season.

	DO	pH	Conductivity	Nitrate	Phosphate	BOD
DO	1					
pH	-0.09685	1				
Conductivity	0.877173	0.122965	1			
Nitrate	-0.01331	-0.08253	-0.28859	1		
Phosphate	0.264963	0.395438	0.276436	0.039856	1	
BOD	0.595676	0.528547	0.654583	0.156072	0.405774	1

Table 6: Correlation coefficient of summer season.

	DO	pH	Conductivity	Nitrate	Phosphate	BOD
DO	1					
pH	0.000209	1				
Conductivity	-0.04673	-0.47715	1			
Nitrate	0.510118	0.131765	-0.03558	1		
Phosphate	0.777905	-0.05567	-0.46744	0.517487	1	
BOD	0.650981	-0.15427	0.169746	0.892092	0.625233	1

Table 7: Correlation coefficient of winter season.

	DO	pH	Conductivity	Nitrate	Phosphate	BOD
DO	1					
pH	0.453108	1				
Conductivity	0.810488	0.501466	1			
Nitrate	0.043885	-0.24877	-0.01852	1		
Phosphate	-0.65677	-0.39779	-0.53491	0.531481	1	
BOD	-0.54596	-0.78743	-0.78751	0.107557	0.252323	1

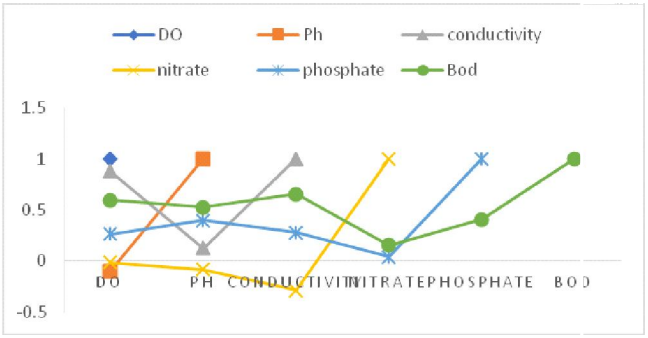

Fig. 5: Showing graph of correlation coefficient of monsoon season.

for winter season were 0.254, 0.270, 0.090 and 0.619 resp. The three different seasons showing same type of kurtosis *i.e.* platykurtic. Skewness of monsoon, summer and winter were -1.746, -0.154 and -1.828 resp. The three different seasons like monsoon, summer and winter coefficient of variance were 43.63, 33.3 and 106.299 resp.

Biological Oxygen Demand (BOD) in mg/l

It is defined as the fulfilment of oxygen to the microorganisms present in the water bodies for the decomposition of organic matters, dissolved solids in aerobic condition. In monsoon mean and SD is 2.54, 0.387; in summer is 3.93, 0.676 and in winter is 2.855, 0.304 resp. SE, Variance, range and CV were 0.129, 0.150, 1 and 15.23 resp. for monsoon season; 0.225, 0.457, 1.7 and 17.20resp. and for winter were 0.101, 0.092, 0.8 and 10.647 resp. Skewness is -0.317 for monsoon, -0.578 for summer and -0.615 for winter. For three different seasons same type kurtosis is present *i.e.* platykurtic.

Correlation coefficient is the statistical analysis between two variables. For better understanding, graphs were also shown.

The above table 5 showing strong correlation coefficient between DO and EC (0.87). Moderate correlation coefficient found between DO and BOD (0.59), pH and BOD (0.52) and EC and BOD (0.65). pH and PO_4 (0.39), DO and PO_4 (0.26), EC and PO_4 (0.27), PO_4 and BOD (0.40) were showing weak correlation coefficient.

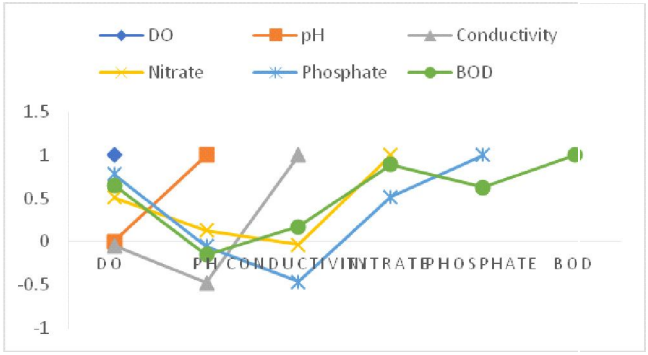

Fig. 6: Showing graph of correlation coefficient of summer season.

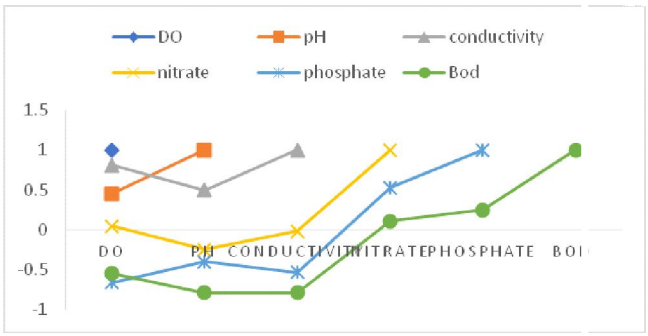

Fig. 7: Showing graph of correlation coefficient of winter season.

From the above table 6, it is found that NO_3 and BOD (0.89) showing strong correlation coefficient. DO and NO_3 (0.51), DO and PO_4 (0.77), NO_3 and PO_4 (0.51), DO and BOD (0.65) and PO_4 and BOD (0.62) were found to be moderate correlation coefficient. DO and pH showing weak correlation coefficient.

The given above table 7 showing strong correlation coefficient between DO and EC (0.81). The moderate correlation coefficient were found between DO and pH (0.45), pH and EC (0.51) and NO_3 and PO_4 (0.53). NO_3 and BOD (0.1) and PO_4 and BOD (0.25), showing weak correlation coefficient.

Conclusion

The statistical analysis of water quality parameters of three different seasons were measured. The water quality parameters were within the permissible except BOD. The BOD value indicates that the water is moderately polluted. So steps should be taken for conservation of the lake. For better understanding of statistical analysis, pie chart of different seasons were given. A positive and strong correlation was observed between different parameters in various season. Graphs of different seasons were given for illustrating the results in a proper way. The results will be helpful to the policy maker and different stakeholder who are involved in the process of preservation of the lake.

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References

Alaidi, K.K., S. Borkataki and M.P. Choudhury (2015). An assessment of physiochemical water quality of Kolong river, Nagaon district (Assam), north east India. *Plant archives*, 15(2): 1093-1096.

Aydin, U.A. (2018). Statistical assessment of water quality parameters for pollution source identification in Bektas pond (Sinop, Turkey). *Global Nest Journal*, **20(1):** 151-160.

Bhatta, K. and H.K. Patra (2020). Economically important macrophytes of Chilika lagoon, Odisha, India. *International journal of advances science and technology*, **29(3):** 5131-5173.

Èisar, P. and S.M. Èisar (2010). Skewness and kurtosis in function of selection of network traffic distribution. Acta polytechnicaHungarica, vol.7, no.**2.**

Das, C.R. and S. Mohanty (2008). Integrate sustainable environmental conservation of Ansupa lake: A famous water resources and power sectors in orissa. *Water energy int. J.*, **65(4):** 62-66.

Jamuna, M. (2018). Statistical analysis of ground water quality parameters. *Int. J. Environ.sci. Technol.*, **10:** 151-164.

Kumar, V., S. Kumar, S. Srivastava, J. Singh and P. Kumar (2018). Water quality of river Ganga with reference to physiochemical and microbiological characteristics during kanwar mela 2017, at Haridwar, India: *A case study of agriculture and Environmental Science*, **13(1):** 58-63.

Medhi, K.K., S. Borkataki and M.P. Choudhury (2015). An assessment of physiochemical water quality of Kolong river, Nagaon district (Assam), North east India. *Plant archives*, **15(2):** 1093-1096.

Mishra, S., M.P. Sharma and A. Kumar (2015). Assessment of water quality in Surha lake based on physiochemical parameters, India. *J. Mater, Environ. Sci.*, **6(9):** 2446-2452.

Pattanaik, C. and C.S. Reddy (2007). Need for the conservation of wetland ecosystems: A case study of Ansupalake(orissa, India) using remote sensing based data. *Science and technology policy issues, Natlacad Scilett*, **30(5)**.

Parmar, K.S. and R. Bhardwaj (2012). Water quality index and fractal dimension analysis of water parameters. *Int. J. Environ. Sci. Technol.*,**10:**151-164.

Qureshimatva, U.M., R.R. Maurya, S.B. Gamit, R.D. Patel and H.A. Solanki (2015). Determination of physiochemical parameters and water quality index of Chandlodia lake, Ahmedabad, Gujurat, India. *J. Environ. And Analytical toxicology*, **5:** 4.

Shroff, P., R.T. Vashi, V.A. Champaneri and K.K. Patel (2015). Correlation study among water quality parameters of ground water of Valsad district bof south Gujurat (India). *Journal of fundamental and applied sciences*.

Sood, S., P. Sharma and P. Sharma (2016). Statistical analysis of ground water quality in rural areas of Uttar Pradesh city, India. Int. *Journal of Engineering research and applications*, **6(4):** 05-12.