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Physico -chemical assessment of surface water quality in Gangasandra tank of Tumkur district, Karnataka

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Abstract

Water plays a vital role in life and better quality of water is described by its physical, chemical, and biological characteristics. The present study deals with the surface water quality of Gangasandra tank of Tumkur district, Karnataka. pH values were found to be 6.9 to 7.87. The turbidity level fluctuated from 5 NTU to 8 NTU. The values of electrical conductivity ranged from 475 ìmhos/cm to 710 ìmhos/cm. TDS values varied from 285 mg/L to 460 mg/L Total hardness fluctuated from 110 mg/L to 190 mg/L. While calcium values ranged from 76.5 mg/L to 96.4 mg/L)and magnesium values from 69.8 mg/L to 88.6 mg/L Chloride values fluctuated from 69.7 mg/L to 91.4 mg/L. Total alkalinity values deviated from 95 mg/L to 150 mg/L. Fluoride values varied between 0.3 mg/L and 0.8mg/L. BOD values ranged from 6 mg/L to 21 mg/L However, nitrate and sulfate values ranged from 0.12- 0.84 mg/L and 25.8-39.5 mg/L respectively. CO_2 levels ranged from 33.8 to 42 mg/l. Dissolved oxygen was found to be within the permissible limit of 6.5 mg/L to 8.5 mg/L. COD value fluctuated from 6 mg/L to 24 mg/L. The water of Gangasandra tank of Tumkur district, Karnataka had little threats such as anthropogenic activities, agricultural activities, and over-exploitation. Water quality is influenced by environmental factors, which cause variations in nutrients. Seasonal variations in water quality are due to extrinsic and intrinsic factors of the water body. The physico-chemical analysis of water in this tank showed that the water is within the safe limits of irrigation and fisheries. Hence, it is recommended that suitable water quality management is essential to avoid any contamination.

Key words : Surface water analysis, Gangasandra tank, Mesotrophic status, Tumkur.

The aquatic ecosystem has been contaminated with different types of pollutants and the major reasons for this situation are industrial, agricultural, and domestic effluents

produced by human activities[22]. The problems of environmental pollution and its deleterious effects on aquatic biota, including fish received focused interest during the last decades[27].

Water quality is the physical, chemical, and biological characteristics of water[8]. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose[14]. The most common standards used to assess water quality are related to drinking water, irrigation, fisheries, the safety of human contact, and the health of ecosystems.

Aquatic organisms and the physical and chemical components of their environment are interrelated and interact with each other. Flow and water chemistry are the primary factors governing life in aquatic habitats, and both are closely related to seasonal variations. Studies on the seasonal variations in the hydrological conditions of the water body constitute an important aspect of fishery research, especially because the chemical environment exerts a considerable influence on aquatic organisms. The physico-chemical characteristics are very important in the study of any environment, especially the aquatic environment. Apart from the general interest in understanding the conditions of water and its impact on the aquatic biota, observations on the short-term changes in the physico-chemical parameters may also have practical implications in pollution studies[18].

Water quality indicates the chemical, physical, biological, and radiological characteristics of water[8] the determinants of good growth in the water body include pH, Conductivity, and dissolved oxygen. Hardness, alkalinity, temperature, free CO_2, and contents of chloride, nitrate, sulfate, etc. different studies were carried out on the winter season variation physicochemical parameters of water from different ponds as well as other water bodies in different areas[19,21] industrial, sewage, and municipal wastes are being continuously added to the water reservoirs affecting the physico-chemical quality of water making it unfit [9]. The main objectives of the present study are to know the physico-chemical characteristics of Gangasandra tank water and compare them with WHO as well as BIS standards and to find out the suitability of water for drinking and fisheries.

Study Area :

Gangasandra tank (Figure 1) is located in the Tumkur District of Karnataka state this tank is 8 km away from Tumkur city, a perennial tank with a water spread area of 83.2 hectares. Water is used for irrigation and drinking purposes by the farmers. This water reservoir was selected for the current study because this tank was extensively used in fish farming.

Figure 1. Views of Gangasandra tank during summer and winter months

Figure 2. Location of the study area

Physico-chemical parameters :

Surface water samples were collected for analysis of different physical and chemical parameters. The temperature of the water was measured by using a mercury bulb thermometer. pH was measured with a pH meter. Electrical conductivity was measured by a conductivity meter. Total alkalinity of dissolved oxygen was estimated by the Winkler method fixation of the sample was done in the field using magnesium sulphate and potassium iodide. Free carbon dioxide was measured by titrating against 0.05 N sodium hydroxide using a phenolphthalein indicator[1]. Hardness was measured titrimetrically against EDTA. Nitrate and phosphate were estimated by using the UV visible spectrophotometer by following the standard procedure. The remaining water parameters were analyzed as per the standard methods[1].

Statistical analysis :

One-way ANOVA with posthoc Tukey HSD with Bonferroni and Holm multiple tests for physico-chemical characteristics of Gangasandra tank water is analyzed by statistical software of astatsa.com

WHO & BIS drinking water quality standards and monthly analysis of water quality parameters in the Gangasandra tank of Tumkur district are depicted in Tables 1 and 2 respectively.

Table-1. Drinking water quality standards

Parameter	Permissible limit	
	WHO, 1997	BIS, 1991
Colour, Hazen unit, max	Nil	5.0
Turbidity, NTU	5.0	5.0
Odour	Nil	Unobjec-tionable
Dissolved solids	500	500
Total hardness	100	300
Calcium hardness	75	75
Magnesium hardness	30	30
Alkalinity	200	200
Dissolved oxygen	4-6	4-6
Chloride	250	250
Nitrate	45	45
Iron	0.3	0.3
pH	6.5-8.5	-
BOD	5	-
Potassium	12	-

The water temperature was measured between 21^{O}C and 25^{O}C. The highest water temperatures were in April and May. Water temperature is the most important factor influencing the chemical, biochemical, and biological properties of water bodies. A similar study on water temperature was observed by Pawar and Pulle[23] at the Pethwadaj dam of

Maharastra. The water temperature variations found in this study could be due to normal climate variations, seasonal effects, differences in sampling time, or, as suggested by Jayaraman *et al.*,[12].

pH of water is a measure of hydrogen ion concentration in water and indicates whether the water is acidic or alkaline. Water pH affects the metabolism and physiological activities of aquatic organisms. A water pH in the range of 6.0 to 9.0 is best for aquatic life. In the present study, water pH ranged between 6.9 in August and 7.87 in February 2023. which is as per the desired limits of WHO and BIS standards.

The turbidity of water ranged from 5 to 8 NTU. The turbidity was recorded as maximum in June whereas, the minimum value was recorded in November. Monsoon generally causes high turbulence and mixing of water leading to an increasing concentration of total solids including suspended particulate matter. Study of similar lines by Kamble *et al.*,[15] recorded turbidity ranged from 230 to 289 NTU in the Rui dam of Maharashtra.

Total alkalinity is the buffering capacity of water, it is constituted chiefly by carbonate and bicarbonates of calcium, magnesium, potassium, sodium, and other bases. The alkalinity ranged from 95 mg/L to 150 mg/L alkalinity was inversely related to the water level. The reported high alkalinity during February 2023 was followed by a steep fall in August month. In a related view. (Mishra *et al.*,[20]) reported high and low alkalinity in season. Total hardness varied from 110 to 190 mg/l. Upadhyay[33] reported total hardness was high during winter months similar results were observed in the present study.

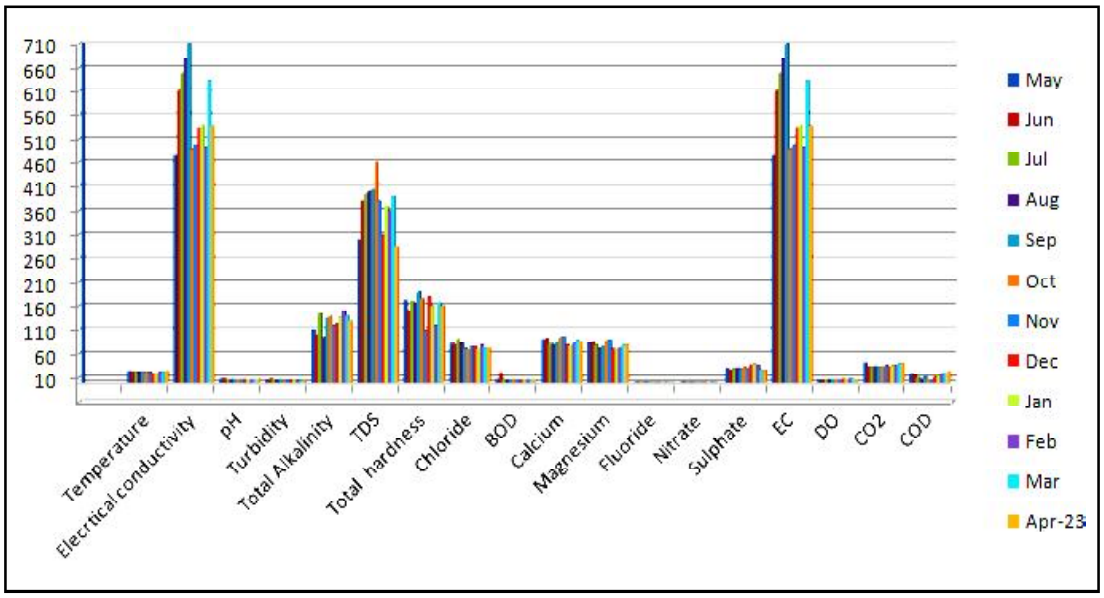

Figure 3. Month-wise water quality parameters in Gangasandra tank, Tumkur district

Table-2. Month-Wise water quality parameters in Gangasandra tank, Tumkur

Parameters	May 22	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr 23
Temperature(^{O}C)	24	23.5	23	22	23	22.5	22	20	21	23	23.2	25
Electrical conductivity (µmhos/cm)	475	610	650	680	710	490	498	534	538	494	634	538
pH	7.87	7.2	7.0	6.9	7.0	7.1	7.0	7.1	6.9	7.0	7.1	7.2
Turbidity(NTU)	5	8	6.5	6	6.5	5.5	5	5.3	5.4	5	5.1	5
Total Alkalinity(95 mg/L)	110	100	145	95	135	140	120	125	138	150	140	130
TDS(mg/L)	300	380	395	400	405	460	380	310	370	360	390	285
Total hardness (mg/L)	172	150	170	166	190	175	110	180	160	120	168	160
Chloride(mg/L)	81.2	79.8	91.4	81.9	71.8	69.7	75.6	75.9	70.5	78	71.98	73.4
BOD(mg/L)	6.5	21	6.9	6	6.1	6.5	6.2	6.0	6.4	6.5	6.9	6.7
Calcium(mg/L)	90.5	92.6	80.67	79.8	84.5	95.2	96.4	78.4	76.5	80.6	88.67	86.4
Magnesium(mg/L)	82.4	84.2	78.8	71.6	76.7	87.5	88.6	70.7	69.8	72.5	80.08	78.3
Fluoride(mg/L)	0.6	0.7	0.4	0.3	0.6	0.5	0.65	0.8	0.5	0.48	0.65	0.55
Nitrate(mg/L)	0.18	0.24	0.31	0.42	0.5	0.84	0.34	0.38	0.42	0.48	0.22	0.12
Sulphate(mg/L)	30.2	26.2	29.4	31.4	29.4	33.42	30.3	38.2	39.5	36.4	27.42	25.8
DO(mg/L)	6.0	6.2	6.5	6.4	7.0	7.1	7.0	8.0	7.5	7.2	6.5	6.6
CO_2 (mg/L)	42	33.8	34	34.5	34	35	36	35	36	37	40	40.5
COD(mg/L)	18	16	10	8	12	7	6	11	15	18	20	24

Table-3. Descriptive statistics of water parameters

Treatment	A(pH, Tur,EC)	B(TA, TDS,TH)	C(Cl, BOD,Ca)	D(Mg, F,NO3)	Pooled Total
Sum	7,770.5500	7,884.0000	2,111.4200	952.3600	18,718.3300
Mean	215.8486	219.0000	58.6506	26.4544	129.9884
Sum of squares	4,044,674.2707	2,178,008.0000	162,594.9282	74,281.0020	6,459,558.2009
Sample variance	67,640.3384	12,897.4857	1,107.3992	1,402.4814	28,156.5901
Sample std. Dev.	260.0776	113.5671	33.2776	37.4497	167.7993
Std. Dev. Of mean	43.3463	18.9278	5.5463	6.2416	13.9833

Table-4. One-way ANOVA of water parameters

Source	Sum of squares	Degrees of freedom	Mean square	F statistic	P-value
Treatment	1,119,722.7164	3	373,240.9055	17.9772	6.3201e-10
Error	2,906,669.6651	140	20,761.9262		
Total	4,026,392.3815	143			

Table-5. Tukey HSD data

Parameters	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD
A vs B	0.1312	0.8999947	insignificant
A vs C	6.5458	0.0010053	** p<0.01
A vs D	7.8865	0.0010053	** p<0.01
B vs C	6.6771	0.0010053	** p<0.01
B vs D	8.0177	0.0010053	** p<0.01
C vs D	1.3407	0.7537916	insignificant

Table-6. Scheffe data

Treatments	Scheffé T-statistic	Scheffé p-value	Scheffé inference
A vs B	0.0928	0.9997869	insignificant
A vs C	4.6286	0.0001693	** p<0.01
A vs D	5.5766	3.3265e-06	** p<0.01
B vs C	4.7214	0.0001182	** p<0.01
B vs D	5.6694	2.2007e-06	** p<0.01
C vs D	0.9480	0.8256668	insignificant

Table-7. Bonferroni and Holm results: All parameters are compared.

Treatments Pair	Bonferroni and Holm T-statistic	Bonferroni p-value	Bonferroni inference	Holm p-value	Holm inference
A vs B	0.0928	5.5572150	insignificant	0.9262025	insignificant
A vs C	4.6286	4.9875e-05	** p<0.01	2.4938e-05	** p<0.01
A vs D	5.5766	7.3354e-07	** p<0.01	6.1128e-07	** p<0.01
B vs C	4.7214	3.3738e-05	** p<0.01	2.2492e-05	** p<0.01
B vs D	5.6694	4.7328e-07	** p<0.01	4.7328e-07	** p<0.01
C vs D	0.9480	2.0685942	insignificant	0.6895314	insignificant

Table-8. Bonferroni and Holm data: Parameters relative to pH, EC, and Turbidity are compared

Treatments Pair	Bonferroni and Holm T-statistic	Bonferroni p-value	Bonferroni inference	Holm p-value	Holm inference
A vs B	0.0928	2.7786075	insignificant	0.9262025	insignificant
A vs C	4.6286	2.4938e-05	** p<0.01	1.6625e-05	** p<0.01
A vs D	5.5766	3.6677e-07	** p<0.01	3.6677e-07	** p<0.01

Electrical conductivity varied from 475 to 710µmhos/cm respectively. It was maximum in September 2022. The EC value depends on several factors the presence of ions, their concentration, mobility, valancy, and temperature of measurement[29]. The electrical conductivity of the water sample correlates with the concentration of TDS of water. The range of TDS of analyzed water samples varied between 285 and 460 mg/L. All samples are non-saline as per the salinity classified suggested by Robinove *et al*.,[26]. TDS increases the nutrient status of the water body which results in the eutrophication of aquatic bodies[30].

The chloride ranged from 69.7 to 91.4 mg/L chloride of all samples was below the permissible limit. The optimum concentration of chloride ions in freshwater aquaculture is lacking. 1-100ppm concentrations are usually considered to be favourable[4].

The nitrate concentration of the water samples ranged from 0.12 to 0.84 mg/L. the maximum nitrate content was found in the October month. Minimum nitrate was observed during the winter season in all the sites of the Dodge water reservoirs of Tasgaon tahsil, Maharastra by Jakhar and Rawat[11].

Calcium concentration in the water body varied from 76.5 to 96.4 mg/L. The results indicate that the samples were well

above the permissible limits of WHO (1993). The permissible limit is 75 mg/L. Calcium is responsible for the hardness of water and the addition of calcium in the freshwater system indicates that no removal has taken place; instead, it has precipitated in the lake water as the ionic strength has increased[12].

The magnesium concentration in the present study was also found (69.8-88.6 mg/ L) to be well within the permissible limit. The major cations present in natural waters are calcium and magnesium. Its main source is the leaching of rocks in the catchments. Its concentration restricts water use, while it is an important component in the exoskeletons of arthropods and shells in mollusks[10,24]. Next to calcium, another dominant cation in natural water is magnesium added to the lakes, by leaching of rocks in the catchments. It is a vital component of chlorophyll. A very high concentration of magnesium imparts an unpleasant taste to the potable water[24].

BOD has been used to measure the organic material load in an aquatic ecosystem which supports the growth of micro-organisms. In the present study, BOD levels varied from 6 to 21 mg/ /L and it was minimum in August and maximum in June month. Hence, the BOD values were above the limits of WHO and BIS standards. Kamble *et al.,*[15] recorded high BOD values (7.5 - 28.0 mg/L) from the Rui Dam of Maharashtra.

Fluoride content in Ganasandra tank water deviated from 0.3 mg/L (August) and 0.8 mg/l (December). WHO's recommended guideline limit of fluoride is 1.5 mg/L. In the Gdansk region, high fluoride levels (1.90-3.00mg/L) were detected in Malbork drinking water supplies[2]. Excessive amounts of fluoride may cause adverse health effects to humans and animals, there is a need for removal of fluoride from wastewater.

The sulfate concentration of the tank water samples varied from 25.8 to 39.5 mg/L. The result should be that the tank water has a permissible range of sulfate ions, physico-chemical water quality constraints are substantial to the firmness of marine and other water ecologies[25,28]. The research article of Pratima Patel and Singh[25,28] deals with the study of physico-chemical quality of tank water samples of the rainy season July-September 2021, in Gram Panchayat Karra district Satnaof Madhya Pradesh. They analyzed for various physico-chemical characteristics like temperature, color, turbidity pH. Electric conductivity, Chloride total alkalinity, total hardness, Calcium, Magnesium, and dissolved oxygen. Considering rainy season and observed values were compared with standard values.

Dissolved oxygen does not react with water chemically, its solubility is directly proportional to partial pressure. The solubility of oxygen varied with temperature. The principal sources of dissolved oxygen in water are atmospheric diffusion and the process of photosynthesis. In the present investigation, the dissolved oxygen in the Gangasandra tank was found to be within the permissible limit of 6.0 mg/L to 8.0 mg/L. A large number of investigators have stressed the importance of dissolved oxygen and the quality of water containing less amount of dissolved oxygen[5,16,17,31].

In this study, the CO_2 level was obtained in the range of 33.8 to 42 mg/L. It is attributed to the fact that the water is extra rich in CO_2 when precipitated water percolates through the soil, and additional CO_2 is dissolved out of soil air (De, 1985)/The COD test helps to indicate the presence of the organic substance. In the present investigation, the COD value ranged from 6 mg/l in November 2022 to 24 mg/L in April 2023. The lower value of COD in this tank is mainly due to the minimal discharge of domestic wastewater.

One-way ANOVA with post-hoc Tukey HSD Test with Scheffe, Bonferroni, and Holm multiple comparison tests for water quality parameters in Gangasandra tank

The p-value corresponding to the F-statistic of one-way ANOVA is lower than 0.05, suggesting that one or more treatments are significantly different. These post-hoc tests would likely identify which of the pairs of treatments are significantly different from each other.

Tukey HSD Test :

The p-value corresponding to the F-statistic of one-way ANOVA is lower than 0.01 which suggests that one or more pairs of treatments are significantly different. Tables 5 to 8 depict that pH, turbidity, and EC showed a significant relationship with chloride, BOD, calcium, magnesium, fluoride, and nitrate. Nevertheless, total alkalinity, TDS, and total hardness also show a relation among chloride, BOD, calcium, magnesium, fluoride, and nitrate at 0.01% level.

Maximum turbidity in the studied tank indicates higher rainfall as well as surface runoff in the study area. Thus the present study, concludes that the tank is not polluted so much, as most of the parameters except turbidity, BOD, and Total hardness are within permissible limits when compared with WHO and BIS standards, and the water quality parameters indicate that the tank is in mesotrophic stage. The water from the present tank is used for irrigation and fish culture. From the present observation, the nutrient load in the tank is moderate. The data certainly justifies the need to take up a detailed study on the impact of water quality parameters on the freshwater lentic Gangasandra tank, which should be taken up for further study in the future. Regular monitoring of tank water quality is essential. It is advocated to take urgent steps by government and NGO organizations to protect this precious natural resource. Hence, there is an urgent need to undertake appropriate management measures to restore the water quality of this tank.

References :

1. APHA. (2008). Clescerl, Leonore S., Greenberg, Arnold E., Eaton, Andrew D. (Editors). Standard Methods for the Examination of Water and Wastewater, 20th Edition. American Public Health Association, Washington, DC.
2. APHA. (1998). Standard methods for the examination of water and wastewater, American Public Health Association, Washington DC, 20th Edition: 10–161,
3. BIS (1991). Indian Standard Specification for Drinking Water IS 10500, Bureau of Indian Standards, New Delhi.

4. Chattopadhyay, G.N. (1998). Chemical Analysis of Fish Pond Soil and Water. Daya Publishing House, Delhi- 110035. pp 13-66.
5. Croom, R.L. and Tyler, P.A. (1988). *Hydrobiologia, 161:* 245-253.
6. De, A.K. (1985). *Journal of Indian Chem Society 62-3.* 1038.
7. Diersing N (2009). Florida Water quality: Frequently asked questions. Brooks National Marine Sanctuary, Key West.
8. Diersing, Nancy (May 2009). "Water Quality: Frequently Asked Questions". *PDA*. NOAA. http://floridakeys.noaa.gov/pdfs/wqfaq.pdf. 2009-08-24.
9. Dwivedi, B.K. and G. C. Pandey, (2002). *Pollution Research, 21:* 361-370.
10. Ganesan, S. and Sultana Mazher (2009). *J. Aqua. Biol., 24*(2): 131-141.
11. Jakher GR and M. Rawat (2003). Rajasthan *Indian Journal of Aquatic Biology (2):* 79-83.
12. Jayaprakash, M., S. Srinivasalu, M.P. Jonathan, and V. Ram Mohan, (2005). *Marine Pollution Bulletin. 50:* 583-608.
13. Jayaraman, P. R., T. Ganga Devi, and T. Vasudevan Nayar, (2003). *Poll. Res.*, *22*(1): 89-100.
14. Johnson, D.L., S.H. Ambrose, T.J. Bassett, M.L. Bowen, D.E. Crummey, J.S. Isaacson, D.N. Johnson, P. Lamb, M. Saul, and A.E. Winter-Nelson, (1997). *Journal of Environmental Quality 26 :* 581-589.
15. Kamble S.M., A.H Kamble and S.Y Narke (2009). *J. Aqua. Biol., 24*(): 86- 89.
16. Karibasappa, H., H. B. Aravinda and S. Manjappa (2009). *Nature Environment and Pollution Technology 8*(2): 297-300.
17. Kaul, V., J.K. Handoo, and R. Raina, (1980). *Proc. Indian Natn. Sci. Acad., 46*(4): 528-541.
18. Kulkarni A. S., Medha Tendulkar, Sayali Mavalankar and A.M. Guhagarkar (2009). *J. Aqua. Biol*., *24*(2): 82-85.
19. Kumar N. (1997). *Ecol. Env.& Cons. 3:* 3–4.
20. Mishra, A.K., S. Mishra, G. Selvakumar, S.C. Bisht, S. Kunda, J.K. Bisht and H.S. Gupta, (2008). *Annals of Microbiology 58*(4): 1-8.
21. Nasim AA (2017). *International Journal of Current Microbiology and Applied Science 6*(2): 971-987.
22. Paul, M.J. and J.L. Meyer (2001). *Review of Ecology and Systematic, 32:* 333-365.
23. Pawar, S.K. and J.S. Pulle, (2005). *J. Aqua. Biol. 20*(2): 123-128.
24. Piska, R.S. (2000). Concepts of Aquaculture; Lahari Publication Hyderabad.
25. Pratima Patel and S.K. Singh (2021). *IJSRED-V5I1P45* : 1-10.
26. Robinove, C.J., R.H. Langford, and J.W. Brookhart, (1958), "Saline water resource of North Dakota", In US Geological Survey Water Supply, Paper No. 1428, pp 72.
27. Sabae, S, and M. Ali., (2004). *Journal of Egyptian Academic Society for Environmental Development, 5:* 145-167.
28. Sargaonkar, A. and V. Deshpande, (2003). *Environmental Monitoring and Assessment, 89:* 43–67.
29. Sastry, K.V., P. Rathee and V. Sukla (1999). Ground Water Characteristics of Rohtak

and Bahadurgarh. Environmental Ecology, 17, pp 108-105.

30. Singh, R.P. and P. Mathur, (2005). *Indian Journal of Environmental Science, 9:* 57-61.
31. Swarnlatha, N. and A. Narasinga Rao, (1993). *Indian J. Microbial. Ecol., 3:* 4148.
32. Tiwari, S., S. Dixit, and S.K. Gupta (2004). *Poll. Res., 23*(4): 829-832.
33. Upadhyay, M, and Vijay Laxmi Gupta. (2013). Analysis of water quality using physicochemical parameters of Khudia Dam in Mungeli District Chhattisgarh.
34. WHO (1997) Guidelines for drinking-water quality, 2nd ed. Vol. 3. Surveillance and control of community supplies. Geneva, World Health Organization.
35. https://www.indianetzone.com/57/tumkur_district.htm