Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI:10.21474/IJAR01/5184
DOI URL: http://dx.doi.org/10.21474/IJAR01/5184

RESEARCH ARTICLE

"WATER QUALITY ANALYSIS OF KHADAKPURNA RESERVOIR IN BULDANA DISTRICT – MAHARASHTRA".

Mhaske T. K. and D. S. Talwankar.
Department of Botany, G. S. Science, Arts and Commerce College, Khamgaon, Dist. – Buldana, State – Maharashtra, India.

Manuscript Info

Manuscript History

Received: 15 June 2017
Final Accepted: 17 July 2017
Published: August 2017

Keywords:-
Physico-chemical parameters, Monthly variation, Fresh water potability, Khadakpurna reservoir.

Abstract

Natural water occurring in the environment is not chemically pure water. While circulating in the environment water contacts with atmosphere, rocks and soil. In this way many different compounds pass in to the water, either inorganic or organic. Water is one of the most important and abundant compound of the ecosystem, it profoundly influence life due to rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are causing varied pollution affects the entire biosphere, plants and organisms living in the bodies of water. Its effect is damaging to the natural biological communities.

Present investigation to study of Khadakpurna reservoir, district Buldana. (M.S.) with regards to various physico-chemical parameters were carried out period of two years such parameters are temperature, pH, Transparency, Turbidity, TDS, Conductivity, Alkalinity, Chloride, Hardness, Dissolve Oxygen, Carbon dioxide, Iron, Ammonia, Nitrite, Nitrate, Sulphate, Silicates, Phosphate, Biological Oxygen Demand, Chemical Oxygen Demand. All the parameters are in acceptable limits hence, from the study it has also been concluded that water from Khadakpurna reservoir is suitable for drinking and fishing purpose.

Introduction:-

Water is a universal and the most vital solvent essential to the existence of all living organisms particularly man (Adeneyi, 2004). In India, there are several large reservoirs exist besides large natural lakes and innumerable small tanks and ponds. Reservoirs are made by constructing dams across the river to serve a variety of purposes like industrial process, irrigation, navigation, domestic water supply, fish culture recreation and generation of hydroelectricity (Rao*et al.*, 2003). Water covers about 70% of the earth surface only 2.53% is fresh water while the remaining is salt water (UNESCO, 2003).

However the water of the Ponds, Lakes, Reservoirs, and Rivers are polluted mainly due to discharged waste water from residential areas, solid wastes, sewage outlets, washing detergents, automobiles oil wastes, fishing facilities and agricultural pesticides from land (Bhuiyan and Gupta, 2007). Impairment of water quality in reservoir arises largely from anthropogenic contamination and natural mineralization. The physico-chemical parameters serve as pollution indicator in water quality monitoring which is a fundamental tool in the management of fresh water resources, monitoring can be conducted for the purpose of identifying trends in water quality over time, to study

Corresponding Author:-Mhaske T. K.
Address:-Department of Botany, G. S. Science, Arts and Commerce College, Khamgaon, Dist. – Buldana, State – Maharashtra, India.

water quality problem (Bala and Lawal, 2008). The present investigation has been undertaken to measure Physico-chemical analysis of Khadakpurna reservoir, Khadakpurna reservoir is constructed on Khadakpurna River of Godavari basin near Garkhed Village, Deulgaon Raja Tehsil in Buldana District, State Maharashtra. It situated at 20°9' 30" N and 76°4' 30" E, only 60 km away from district place. The dam is about 2160 meters in length with catchment area of 5133.18 sq km. The project is having 160.606 mcum capacity of water storage, which includes 93.404 mcum live, and 67.202 mcum dead water stocks.

Fig-1:-Topographic map showing location of Khadakpurna reservoir, Deulgaon Raja.

Materials, methods and study areas:-

Water samples were collected from four different locations L-1 Takarkhed, L-2 Garkheda, L-3 SingaonJha and L-4 Gavhan regularly at monthly intervals using clean sterilizes plastic bottles. Collected sample were analyzed within 24 hours for various characteristics at Botany department of G.S. College, Khamgaon, District Buldana (M.S.). The present investigation observed data between two years from August-2013 to July-2014 and August-2014 to July-2015.

Analysis of physico-chemical properties:-

For the physico-chemical water analysis, the used standard methods were used. At the study site, when collected water sample were investigate Temperature, pH, Transparency. Water temperature analyzed by thermometer, pH – PH meter, EC – Conductivity meter, Transparency – Secchi disc, TDS – TDS meter, Turbidity – Turbidity meter, chemical parameters such as free CO_2, Carbonates, Bicarbonates, Chloride, Calcium hardness, Magnesium hardness, BOD, COD analyzed by titrometric methods. Iron, Ammonia, Nitrite, Nitrates, Phosphorus, Sulphates, Silicates were analyzed by photometrical, all these parameters analyzed as per the Standard methods of APHA (1989) and Trivedy and Goel (1986).

Air Temperature (℃):-

The air temperature is one of the important factors in aquatic environment since it regulated physico-chemical as well as biological activities (Kumar *et al*., 1996). The values recorded in this study show changes in temperature; its level has fluctuated due to seasonal effect. Air temperature recorded as minimum value of 20.2 ℃ in the month of October-2013 at L-1 and maximum 31.1 ℃ in the month of May-2014 at L-4. Next year minimum value was recorded 18.0 ℃ in the month of October-2013 at L-1 and Maximum 32.2 ℃ in the month of May-2015 at L-4. (Graph No-1)

Water Temperature (℃):-

Water temperature measurement is useful in indicating trends for various chemical, bio-chemical and biological activities. High seasonal variation was observed at all the sites water. Water temperature is one of the enormous significance as it regulated various abiotic characteristics and activities of an aquatic ecosystem (Hutchinson, 1957, Alabaster and Lioyd, 1980). Temperature is a physical factor that alters the water characteristics and consider as an

important for in controlling the fluctuation of plantation and functioning of aquatic ecosystem (Wetzel, 1975, Dwivedi and Pande, 2002). During First year water temperature varied minimum 17.8℃ at L-2 in the month of October-2013 and maximum 29℃ at L-4 during the month of May-2014. Next year minimum value 16 ℃ at L-1 in the month of October-2014 and maximum value 27.2 ℃ was observed in the month of May-2015 at L-4. (Graph No-1)

pH:-
The limnological value of pH is a limiting factor and work as an index of general environmental condition (Welch, 1952). Sharma *et al.,* (1984) States that in India, many small confined water pockets are particularly alkaline in nature. During First Year the minimum pH value 7.01 was recorded in the month of November-2013 at L-1 and maximum 8.62 in the month of April-2014 at L-2. During next year minimum value 7.06 in the month of September-2014 at L-3 and maximum value 8.72 in May-2015 at L-2.(Graph No-1).

Transparency (cm):-
Water transparency depends on the amount of particles in the water. Particles can be inorganic (e.g. sediment from erosion) or organic (such as algae, phytoplankton). Transparency of water related to the depth that light will penetrate water. The transmission of light in to a body of water is extremely important since the Sun is the primary source of energy for all biological phenomena. During first year monthly variation in transparency the minimum value 58.40 cm was recorded at L-3 in the month of October-2013 and maximum value 139.7 cm was recorded in month of February-2014. Next year minimum value 70.60 cm was recorded in month of October-2014 at L-4 and maximum 119.5 cm at L-1 in the month of February-2015. Low value of transparency during rainy season may be due to silt brought in to the reservoir from adjoining catchment area through rain water while high value due to gradual settlement of suspended particles. (Graph No-5)

Turbidity (mg/l):-
Turbidity in an expression of the optical properties that cause light to be scattered and absorbed rather than transmitted in a straight line through the water. Turbidity in water caused by presence of dissolved organic and inorganic particles. The major source of turbidity in the open water zone of most reservoirs is typically phytoplankton, but closer to shore, particulates may also be clays and slits from shoreline erosion, organic detritus from stream and waste water discharges. During first year reservoir water showed the minimum value 0.50 mg/l at L-1 in the month of March-2014 and maximum value 3.92 mg/l at L-3 in August-2013. Next year minimum value 0.30 mg/l at L-2 in the month of June-2015 and maximum 3.92 mg/l at L-4 in the month of July-2015. (Graph No-3)

Total Dissolved Solids (mg/l):-
Total dissolved solids are the solids present in water in the dissolve state. The monthly variation in the TDS ranges from 149.20 mg/l to 315.15 mg/l. During first year the low amount of TDS was 149.20 mg/l recorded in the month of March-2014 at L-2 while 315.15 mg/l maximum in the month of September-2013 at L-4. Next year minimum value 154.30 mg/l in the month of April-2015 at L-2 and maximum 270.50 mg/l was recorded in the month of August-2014 at L-4. The findings are in close conformity with the finding of (Manjare*et al.,* 2010). (Graph No-2)

Electrical Conductivity (µmhos/cm):-Electrical Conductivity of the water depends on the nature and concentration of salts. High values of conductivity could be due to high ionic concentration, pollution status, tropic level, some domestic effluents and other organic matter in water (Ahluwalia, 1999, Fokmare and Musaddique, 2001). During first year water showed the minimum value 123 µmhos/cm at L-1 in the month of May-2014 and maximum value 384 µmhos/cm at L-3 in August-2013. Next year minimum value 114 µmhos/cm at L-1 in the month of April-2015 and Maximum 378 µmhos/cm at L-4 in September-2014. The values of electrical Conductivity showed seasonal variation being minimum during summer season and maximum during rainy season. (Graph No-5)

Carbonate and Bicarbonate alkalinity(mg/l):-
Alkalinity defined as quantitative capacity to neutralize an acidic solution, the alkalinity to natural water is mainly imparted by three predominant bases; carbonates (CO_3) bicarbonates (HCO_3) and hydroxides (OH). Thus, alkalinity is estimated as total or due to individual base. In fresh water, the total inorganic carbon concentration depends on pH, which is governed by reaction involving the carbonate system. When CO_2 dissolve in water, carbonic acid formed, this in turn dissociates in to HCO_3& CO_3 ions. All these reactions are reversible. At pH-5 and below free CO_2 dominates in water and above pH 9.5, CO_3 is quantitatively significant and between 7 & 9 pH, HCO_3 dominates (Wetzel, 1975). During first year reservoir water showed the minimum carbonate value 4.00 mg/l at L-1and L-2 in

the month of September-2013 and maximum value 24.00 mg/l at L-2 in the month of January-2014. Next year minimum value 2.00 mg/l at L-2 in the month of August-2014 and Maximum 22.00 mg/l at L-4 in the month of May-2015.

During first year Bicarbonate alkalinity was minimum value 64.00 mg/l in the month of September-2013 at L-2 and it was maximum 166.00 mg/l in January-2014 at L-3. Next year minimum value 108.00 mg/l was recorded in the month of August-2014 at L-2 and maximum value 178.00 mg/l was recorded in the month of April-2015 at L-4. (Graph No-5)

Chloride (mg/l):-
Chlorides are common constituents of all natural waters. Higher of it impart a salty taste to water. Chlorides are mainly come from inorganic salt like NaCl, KCl and $CaCl_2$. Which are generally provided by soil, natural layers of chloride salts, Municipal, industrial sewage and animal wastes (Gopalkrushna, 2011). During first year reservoir water showed the minimum values of chlorides 14.18 mg/l was recorded similar months of October-2013, November-2013, December-2013 at L-1 but average minimum value was recorded 15.95 mg/l in the month of December-2013 and maximum 56.72 mg/l was recorded in the month of June-2014 at L-4. Next year minimum value 14.18 mg/l in the month of November-2014 at L-2 and maximum 56.72 mg/l in the month of May-2015 at L-3. The chloride content of studied water sample was within permissible limit of 250 mg/l (BIS, 1991). (Graph No-5)

Total Hardness (mg/l):-
Hardness is governed by the concentration of Calcium and Magnesium salts. TH values are mainly due to weathering of Ca and Mg rich rock in the area (Zeitoum and Mehana, 2014). During first year reservoir water showed the minimum amount of hardness 26 mg/l was recorded in the month of September-2013 at L-2, L-3 and Maximum 92 mg/l in the month of April-2014 at the L-4. During next year minimum value was 22 mg/l recorded in the month of July-2015 at L-1 and maximum was 90 mg/l recorded in the month of May-2015 at L-1, L-2. The higher value of hardness was during summer season due to decrease water level and evaporation of water. Similar trend was reported by Sahib, (2011). However, hardness of this reservoir was within the permissible limit (WHO, 1984). (Graph No-2)

Calcium Hardness (mg/l):-
Calcium is an important Constituent in natural waters. It is known that calcium contents play an important role in biological productivity of lakes and ponds (Ellis *et al.,* 1948). Present investigation showed minimum 15.12 mg/l in the month of September-2013 at L-3 and maximum 49.56 mg/l in the month of April-2014 at L-1. During next year minimum value 17.64 mg/l was observed in the month of July-2015 at L-1 and it was maximum 47.25 mg/l in the month of May-2015 at L-4. Minimum values of calcium ion concentration during rainy season might be due to greater dilution of addition of rain water whereas maximum during summer season might be due to leaching from rocks and soil. The maximum desirable limit of calcium in drinking water is 75 mg/l (WHO, 1984) Calcium content in water of this reservoir is within the desirable limit. (Graph No-2)

Magnesium Hardness (mg/l):-
Magnesium is absolutely essential for chlorophylls bearing plants and algae. Magnesium is an important component of basic igneous, volcanic, and metamorphic and sedimentary rocks. During first year minimum value 10.46 mg/l was observed in the month September-2013 at L-2 and maximum 42.33 mg/l in the month of April-2014 at L-4. Next year it was minimum 4.36 mg/l in the month of July-2015 at L-1 and maximum value 43.38 mg/l was recorded in the month of May-2015 at L-2. These values were found in the limit prescribed by BIS, (1991). (Graph No-2)

Dissolved Oxygen (mg/l):-
Oxygen content is impotent for direct needs of organisms and affects the solubility of many nutrients and therefore the periodicity of aquatic ecosystem (Wetzel, 1983). Minimum dissolved oxygen of water was 2.10 mg/l recorded in the month of May-2014 at L-3 & L-4 and maximum 4.9 mg/l was recorded in the month of November-2013 at L-1 during first year investigation. During second year the minimum dissolve oxygen of water 2.9 mg/l was recorded in the month of April-2015 at L-3 and maximum 5.5 mg/l was in the month of November-2014 at L-2. Lower dissolve oxygen values were observed during summer season due to increased temperature and oxygen level increased during winter season because of decreased temperature. The same trend of dissolved oxygen maximum in winter season and minimum in summer season (Tiwari*et al.,* 2012 and Sinha*et al.,* 2011). (Graph No-3)

Iron (mg/l):-
Iron is an essential element for almost all living species. Iron is an abundant element in the earth's crust, but exists generally in minor concentration in natural water system. There are many iron sources in fresh water lakes. In natural condition, iron primarily comes from the products of weathered rocks, and soil around watersheds, controlled by many factors, such as geological process, soil composition, environmental temperature, precipitation and hydrology (Harris, 1992). During first year investigation iron value was minimum 0.08 mg/l in the month of June-2014 at L-1, L-2 and maximum 0.61 mg/l in the month of April-2014 at L-4. Next year minimum 0.08 mg/l value was recorded in the month of June-2015 at L-2 and maximum 0.72 mg/l in the month March-2015 at L-4. (Graph No-4)

Ammonia (mg/l):-
The occurrence of ammonia in the water source is often associated with pollution due to sewage infiltration, use of nitrogen fertilizer or livestock wastes (Prasath*et al.,* 2013). Ammonia occurs in natural water due to ammonotelic organisms. During the study periods observed the lowest value of ammonia 0.021 mg/l in the month of December-2013 on sampling location L-1 and highest 1.064 mg/l was observed in the month of May-2014 at L-3. During next year lowest value 0.038 mg/l was recorded in the month of December-2014 at site of L-4 and it was highest 0.6 mg/l in the month of March-2015 at L-3, L-4. (Graph No-4)

Nitrite (mg/l):-
Nitrite being the intermediate oxidation state between ammonia and nitrate, can appear as a transient species by the oxidation of ammonia or by the reduction of nitrate and also often released in to the water as an extracellular product in to planktonic organisms (Santschi*et al.,* 1990 and Chandran*et al.,* 1984). During first year the lowest value 0.017 mg/l observed in the month of March-2014 at L-1 and it was highest 0.077 mg/l in the month of September-2013 at L-3. Next year lowest value 0.011 mg/l observed in the month of October-2014 at L-1 and highest value 0.071 mg/l was in the month of April-2015 at L-4. (Graph No-4)

Nitrate (mg/l):-
In an aquatic ecosystem nitrates are formed on biological oxidation of organic nitrogenous matter received from raw domestic sewage, agriculture run-off and industrial waste containing organic waste matter. During first year minimum nitrate value 0.30 mg/l in the month of July-2014 at L-1 and maximum value 0.73 mg/l in the month of September-2013 at L-3. Next year minimum nitrate value 0.29 mg/l was recorded in the month of January-2015 at L-3 and maximum 0.71 mg/l in the month of October-2014 at L-4. Nitrates are abundant in during monsoon season reported by (Manikya, 1984.) (Graph No-4)

Sulphate (mg/l):-
Sulphates are found appreciably in all natural waters to detect the permanent hardness. Sulphate form an important constituent of hardness and used by organisms for protein synthesis. It enters in to water body by the weathering of sedimentary rocks, bathing and washing clothes (Jain *et al.,* 1996) Water samples investigated lowest value 0.54 mg/l in the month of April-2014 at L-1 and highest 2.08 mg/l was recorded in the month of August-2013 at L-4. Next year lowest 0.51mg/l value was observed in the month of January-2015 at L-1 and highest 2.17 mg/l was recorded in the month of September-2014 at L-3. (Graph No-4)

Silicate (mg/l):-
Silicates are the most abundant element found in rocks and always present in natural waters. The element is a major component of the structure of diatoms and algal growth takes place in water there will be a dramatic drop in the silica levels as the diatoms population raises. Higher value of silicates during summer months were because of their higher concentration at low water level and increase in solubility of silica at higher temperature, further during summer months silicates might have shown an increase due to lesser number of diatom (Jindal *et al.,* 1993).

Water samples investigated lowest value 0.27 mg/l in the month of September-2013 at L-2 and highest 0.97 mg/l was recorded in the month of January-2013 at L-1. Next year lowest 0.29 mg/l value in the month of September-2014 at L-2 and highest 0.99 mg/l was recorded in the month of March-2015 at L-4. (Graph No-4)

Phosphate (mg/l):-
Phosphates are essential nutrient for organism growth in water body. During first year investigated minimum phosphate value 0.32 mg/l was recorded in the month of March-2014 at L-1 and maximum 0.91 mg/l was recorded

in the month of September-2013 at L-3. Next year minimum value 0.25 mg/l was resulted in the month of February-2015 at L-1 and maximum value 0.87 mg/l was recorded in the month of August-2014 at L-4. The maximum value phosphate during monsoon months may be attributed to surface runoff agricultural, more domestic sewage & sewage water, washing detergents from surrounding area during rainy season. Catchment area activities are enriching phosphate in the pond (Tomat& Sharma, 2006). (Graph No-4)

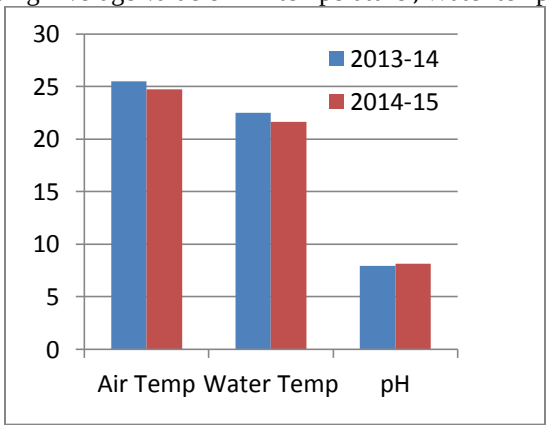
Biological Oxygen Demand (mg/l):-
BOD indicates the magnitude of water pollution by the oxidisable matter. BOD is dissolve oxygen required by micro-organisms for aerobic decomposition of organic matter present in water. BOD as an important parameter in aquatic ecosystem to establish the status of pollution (Jain and Dhanija, 2000). The present study minimum BOD 1.20 mg/l recorded in the month of November-2013 at L-2 and maximum value 3.7 mg/l was in the month of May-2014 at L-3. Next year minimum value 1.30 mg/l was recorded in the month of October-2014 at L-1 and it maximum 4.2 mg/l in the month of March-2015 at L-4. (Graph No-3)

Chemical Oxygen Demand (mg/l):-
COD is an indicator of organics in the water, without oxygen the entire aquatic community is threatened only live anaerobes & air breathing organisms.COD test which measure the oxygen required for the oxidation of all the substance present in the water, included those are not biologically decomposable. COD is a parameter to study of pollution in water. The COD of water increases with increasing concentration of organic matter (BIS, 2004). First year minimum value 7 mg/l was observed in the month of November-2013 at L-1 & maximum 19 mg/l was in the month of April-2014 at L-4. Next year minimum value 6 mg/l was in the month of December-2014 at L-1 and maximum 18 mg/l was in the month of May-2015 at L-4. (Graph No-3)

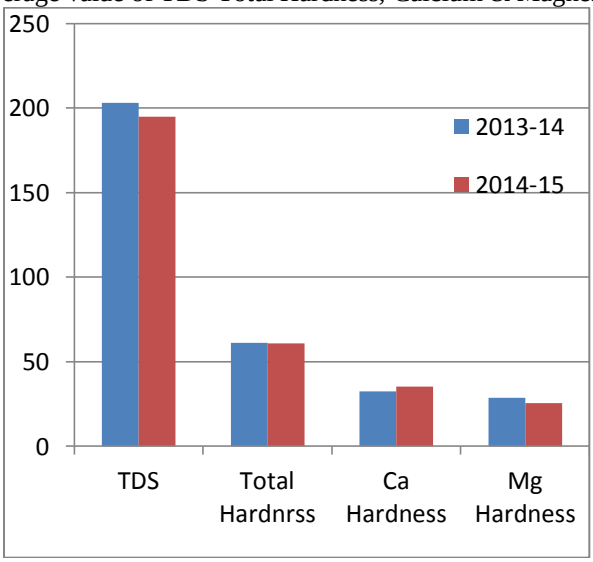
Conclusion:-

Khadakpurna reservoir, obtained all results of parameters are within permissible limit, when it compared with national & international standards. In study periods location Gavhan (L-4) generally all values are increases to compared other site values but not greater than standards values, it occur due to some amount domestic flow mixed in this site. It is also important to note that regular water monitoring to improve water quality and it can be used for human drinking, irrigation &pisciculture purpose. All parameters have been estimated and concluded that the water quality of this reservoir is a potable. Future care should taken, i.e. preventing domestic water flow to meet reservoir & alter flow route away from water bodies, avoiding washing clothes, bathing of cattle and agriculture wastage

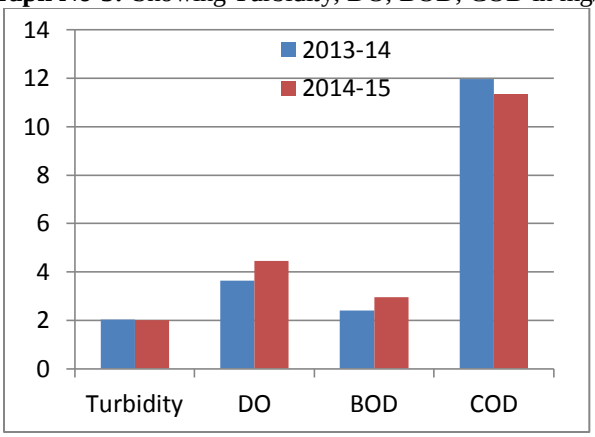
Graph No-1:- Showing Average value of Air temperature , Water temperature (℃) and pH.



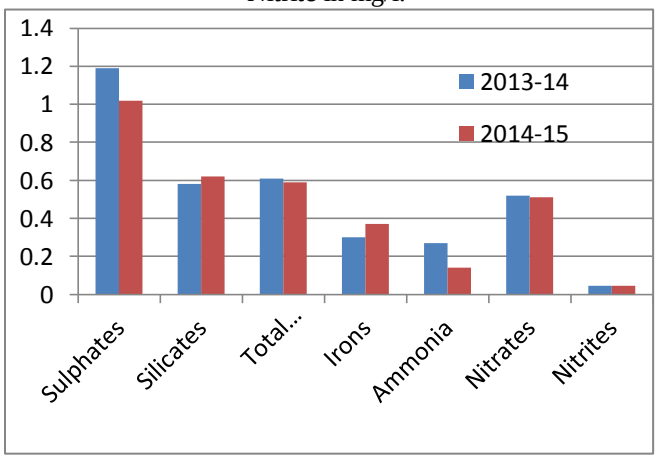
Graph-2:-Showing Average value of TDS Total Hardness, Calcium & Magnesium Hardness in mg/l.



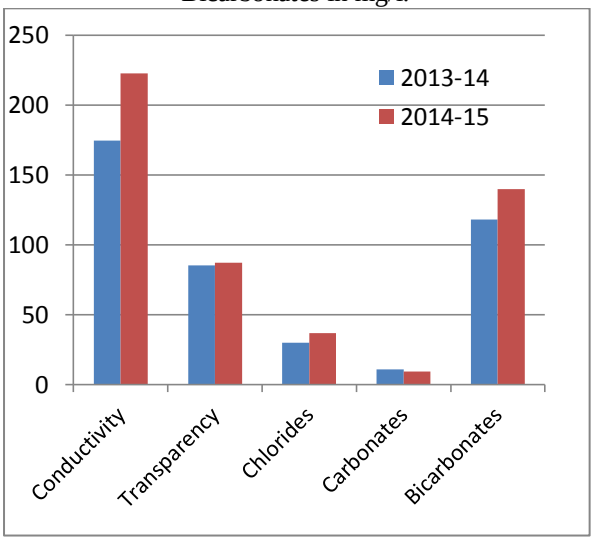
Graph No-3:-Showing Turbidity, DO, BOD, COD in mg/l.



Graph No-4 :-Showing average value of Sulphates, Silicates, Total Phosphate, Total Iron, Ammonia, Nitrates, and Nitrite in mg/l.



Graph No-5:-Showing average value of Conductivity (µmhos/cm), Transparency (cm), & Chlorides, Carbonates, Bicarbonates in mg/l.



Acknowledgement:-

I would like to thanks Principal Dr. D. S. Talwankar and Head, Department of Botany, G. S. Science, Arts and Commerce College, Khamgaon, Dist. – Buldana, (M.S) for providing laboratory facilities.

Bibliography:-

1. **Adeneyi I. F. (2004):** Concept of water quality in life environmentalist, Official Bulletin of Nigerian Society for environmental management (NISEM) O.A.U., 1(1).
2. **Ahluwalia A. A. (1999):**Limnological study of wetlands under SardarSarovar command area. Doctoral diss., Gujarat University, Ahmadabad.
3. **APHA-AWWA-WPCF (1989):** Standard methods for examination of water and waste water. American Public health Association, Washington D. C. (17th ed.,) 1452 pp.
4. **Bala M. L., Shehu R. A. and M. Lawal (2008):** Determination of the level of some heavy metals in water collected from two pollution – Prone Irrigation Areas around Kano Metropolis. *BayeroJounal of Pure and Applied Sciences,* 1(1): 36-38.
5. **Bhuiyan J. R. and S. Gupta (2007):** A comparative hydrobiological study of few ponds of Barak valley, Assam and their role as sustainable water resources, *Journal of Environmental Biology*, 28(4), pp799-802.
6. **BIS. (1991):** Indian Standards for Drinking Water, Bureau of Indian Standards, New Delhi, IS 10500.
7. **BIS. (2004):** Indian Standards for Drinking Water, Bureau of Indian Standards, New Delhi, IS 10500.
8. **Chandran R. and K. Ramamurty (1984):**Hydrobiological studies in the gradient zone of Vellar estuary. I. Physico-chemical parameters. Mahasagar, 17, pp. 69-77.
9. **Dwivedi B. K. and G. C. Pandey (2002):**Physico chemical factors and algal diversity of two ponds in Faizabad, India, *Poll, Res*. 21(3), 361-370.
10. **Fokmare A. K. and M. Musaddia (2001):** Comparative studies of physico-chemical and Bacteriological Quality of Surface and Ground water at Akole (M.S.). *Pollution Research, Vol. 4, No. 1*, pp. 56-61.
11. **Gopalkrushna M. H. (2011):** Determination of physico-chemical parameters of Surface water Sample in and around Akot city, International Journal of research in Chemistry and Environment, Vol. 1(2), pp. 183-187.
12. **Harris J. E. (1992):** Weathering of rock, corrosion of stone and rusting iron. Meccanica, 27, 233-250.
13. **Jain S. M., Sharma M. and R. Thakur (1996):** Seasonal variation in physico-chemical parameters of Halali Reservoir of VidishaDistt. M.P., India Ecobiology, 8:181-188.
14. **Jain Y. and S. K. Dhanija (2000):** Studies in a Polluted Centric Water Body of Jabalpur with Special Reference to Which Physico-Chemical and Biological Parameters. *J. Envi. Biol.*, Vol. 7, 83-88.
15. **Jindal R. and R. Kumar (1993):** Limnology of a fresh water pond of Nalagarh (Himalchal Pradesh, India). Physico-chemical complexes, *Advances in Limnology. p* 107-112.

16. **Kumar A., Gupta H. P. and D. K. Singh (1996):** Impact of Sewage pollution on chemistry and primary productivity of two fresh water bodies in SantalParagana (Bihar) INDIA. *J. Ecol*. 23 (2): 82-86.
17. **Manjare S. A., Vhanalakar S. A. and D. V. Muley (2010):** Analysis of Water Quality Using Physico chemical parameters, Tamdalge Tank in Kolhapur District, Maharashtra; *International Journal of Advanced Biotechnology and Research* 1(2): 115-119.
18. **Manikya Reddy P. (1984):**Ph.D Thesis, Osmania University, Hyderabad.
19. **Prasath B. B., Nandkumar R and S. Dinesh Kumar (2013):** Seasonal variation in physico-chemical characteristics of pond and ground water of Tiruchirappalli. India *J. Environ. Biol*., 34(2): 529-537.
20. **Sahib S. Sunudeen (2011):**Physico-chemical parameters and phytoplankton it the Parappar reservoir of Kerala, *J. Ecobiology*, 28 (1 & 2): 187-190.
21. **Santschi P., Honer P., Benoit G. and M. B. Brink (1990):** Chemical process at the sediment water interface, Marine Chemistry, 30, pp. 269-315.
22. **Sharma M. S., Sharma L. L. and V. S. Durve (1984):** Eutrophication of lake Pichhola in Udaipur, Rajasthan. *Poll. Res.*, 3(2): 39-44.
23. **Sinha S. N. and M. Biswas (2011):** Analysis of physico-chemical characteristics to study the water quality of a Lake in Kalyani, West Bengal. *Asian J. Exp. Sci*. Vol. 2(1): 18-22.
24. **Tiwari M. and M. M. Ranga (2012):** Assessment of diurnal variation of physico-chemical status of Khanapura Lake, Ajmer, India. *Res. J. Chem. Sci*. 2(7): 61-64.
25. **Tomat S. and P. Sharma (2006):**Physico-chemical status of Upper Lake (Bhopal, India). Water quality with special reference to phosphate & nitrate concentration and their impact on Lake Ecosystem. Asian. *J.Exp.Sci*. 20 (2), 2006, 289-296.
26. **Trivedy R. K. and P. K. Goel (1986):** Chemical and Biological Methods for Water Pollution Studies, (Environmental Publication, Karad, Maharashtra. United States Environmental Protection Agency, (2009) 816-f-09-004).
27. **UNESCO. (2003):** Water for people, Water for Life: UN World Water Development Report (WWDR), Paris, United Nations Educational, Scientific and Culture Organization.
28. **Welch M. N. (1952):** Limnology, McGraw Hill Book Co. Inc. NY.pp.538.
29. **Wetzel R. G. (1975):** Limnology, W.B. Sunders company pub. Philadelphia, London, Toronto 740.
30. **WHO. (1984):** Guideline for drinking water quality. World health organization, Geneva Wetzel R.G. (1983); Limnology, II. Ed. Saunders College Publ. New York.
31. **Zeitoum M. M. and E. S. Mehana (2014):** Impact of Water Pollution with Heavy Metals on Fish Health: Overview and updates, *Global Veterinaria*, 12(2): 219-231.