Bulletin of Pure and Applied Sciences
Geology (Geological Science), Vol.42F, No.2,
July-December 2023: P.187-200
Original Research Article

Print version ISSN 0970 4639
Online version ISSN 2320 3234
DOI: 10.48165/bpas.2023.42F.2.2
Available online at www.bpasjournals.com

Study of Variation in Physico-Chemical Parameters Controlling the Water Quality of Wetlands in Khultabad Region of Maharashtra

[1]Pimparkar A.M., [2] Patil S.N.*, [3]Bartakke V.V., [4]Patil A.S., [5]Mahajan Y.J., [6]Patil N.S., [7]Kadam A.K., [8]Patil B.D.

Author's Affiliations:
[1,2,5,6,7,8]School of Environmental and Earth Sciences, Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon, Maharashtra State 425001, India
[3]IISER, Pune, Maharashtra, India
[4]Office of Deputy Director, Nashik Division, Groundwater Surveys and Development Agency (GSDA), Government of Maharashtra State, India

***Corresponding Author:** Prof. S.N. Patil, School of Environmental and Earth Sciences, Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon Maharashtra 425001, India
E-mail: drsnpatil9@gmail.com

(Received on 22.06.2023, Revised on 13.08.2023, Approved on 22.09.2023, Accepted on 03.10.2023, Published on 15.12.2023)

How to cite this article: Pimparkar A.M., Patil S.N., Bartakke V.V., Patil A.S., Mahajan Y.J., Patil N.S., Kadam A.K., and Patil B.D. (2023). Study of Variation in Physico-Chemical Parameters Controlling the Water Quality of Wetlands in Khultabad Region of Maharashtra. *Bulletin of Pure and Applied Sciences-Geology,* 42F(2), 187-200.

Abstract:
Wetlands are essential for preserving the hydrological cycle, the diversity of the world's ecosystems, the regulation of the climate, and human wellbeing. Humans can benefit directly from wetlands ecosystems in addition to receiving indirect services from them. The world is experiencing serious environmental issues due to the rapid depletion of natural resources, posing a threat to ecosystems. The wetland resource is mainly contaminated from sewage or wastewater disposal, encroachment, commercial and industrial activity. In view of this current study compares the water of wetlands in Khultabad tehsil of the Aurangabad district of Maharashtra. The samples were collected in Pre-monsoon in January 2022. A total of 28 water samples were analyzed collected from wet lands situated in the central part of Aurangabad district, Maharashtra. The samples were tested for pH and temperature, electrical conductivity, turbidity, total dissolved solids, dissolved oxygen, chemical oxygen demand (COD), biological oxygen demand (BOD), total hardness, bicarbonate, chlorides and nitrate. For developing suitable policies and carrying out priorities, knowledge of the fundamental and integrated facts on wetlands is crucial. All the selected parameters are showing higher values due to the continual discharge of waste effluents into it. According to the study, there should be urgent action is needed to restore water quality and support any long-term plans for wetland restoration.

Keywords: *Physico-chemical parameters, Water quality, Wetland, Aurangabad*

INTRODUCTION

Wetlands are the hidden heroes of the climate problem. Inland wetland habitats are widely recognized as being essential for assisting populations in adapting to a changing climate. They also absorb excess water and help minimize floods and droughts. Consistently growing population, intensive human activity, unplanned growth/development, lack of management, inadequate legislative execution, and a lack of understanding about the critical function of wetlands have all contributed to the global loss of wetlands (Xu et al., 2019; Mercado et al., 2018). Wetlands feature a diverse natural plant and animal life when they are healthy.

These can function as water filtering systems, removing silt, nutrients, and contaminants. Wetlands' ability to maintain and enhance water quality is under threat as a result of human activities and harsh weather events affecting water flows, nitrogen balance, and biodiversity. Wetlands are under threat because of fast population growth, urbanization, and economic expansion (Shan et al., 2021; Dar et al., 2021). Natural sources of stress on wetlands include subsidence, drought, storms, erosion, and so on, as well as human threats such as encroachment, overexploitation, reclamation, agricultural, commercial, and residential development (Zhai et al., 2021). Sediments, fertilizers, pesticides, salinity, heavy metals, weeds, low dissolved oxygen, pH, and other pollutants are the principal polluters that cause deterioration of water from natural sources such as lake, wetland, and river (Datta et al., 2022; Desai et al., 2020). People's use of water for different activities generates a large amount of wastewater, which is disposed of through sewage systems and eventually reaches natural water resources such as rivers, lakes, ponds, and wetlands (Stefanakis, 2019). Untreated wastewater and other wastes are generally drained directly into natural water supplies (Singh et al., 2020). Most localities have a bootless regulatory authority, which is primarily accountable for improper system activities that affect the environment. Unplanned industrial expansion took up a lot of area, used up a lot of natural resources, and produced a lot of gaseous, liquid, and solid waste (Ambelu et al., 2013. Roy-Basu, et al 2020; Kadam et al., 2022). Most of the garbage created by cities and businesses is immediately released into the surrounding environment on open surface land and in bodies of water (Chaudhuri et al., 2022). It is necessary to determine how wastewater disposal contributes to water contamination. If we want to lessen the severity of water pollution, we must reduce wastewater disposal and treat wastewater to satisfy the criteria' set norms before disposal in natural resources (Liu et al., 2021).

Cities are expanding at a rapid rate because of rapid industrialization and growing population, putting natural resources under strain (Suvarnaet al., 2022; Dubey et al., 2021; Li et al., 2020; Bao et al., 2019; Song et al., 2020). The plentiful supply of water is meeting the population's industrial and household water demands. Many contaminants are dumped into water bodies by rainfall from urban and agricultural areas. Soil particles, fertilizers, insecticides, grease, and oil from automobiles and trucks are all pollutants. Wetlands have the potential to enhance water quality by eliminating contaminants from surface waterways. Apart from these man-made dams and reservoirs, people in their villages created lakes/ponds/wetlands to fulfill their water needs before 4-5 decades (Akpabio and Umoh 2021). The old wisdom established such lakes/ponds/wetlands using the geography of the hamlet. Wetlands are one of the most prolific ecosystems in the biosphere, equivalent to tropical evergreen forests, and play an important part in a region's ecological sustainability (Junk et. al., 2013; Bassi et al., 2014; Tomas et al., 2019, Junk et al., 2002). Wetland loss must be viewed not just as a biodiversity crisis, but also as a development crisis, since it may lead to increased water, food, and climate insecurity for society. They are an important aspect of human society since they provide many critical necessities for life on Mother Earth, including as drinking water, protein production, water purification, energy, food, flood control, recreation, research, education, sinks, and climate stabilizers. Wetland values, although overlapping with cultural, economic, and biological issues, are intertwined. Though the city of Aurangabad receives an abundant supply of water from the Jayakwadi Dam, it is critical to maintain the wetlands in and around the city to protect it from natural disasters such as floods and to provide continuous fresh water supply in drought times.

STUDY AREA

Marathwada region comprises of eight districts. The regional headquarter is at Aurangabad. The province lies between 17037′ to 20039′ north latitude and 74033′ to 78022′ east longitude. The geographical area is 6,413 Sq. KM. The region comprises of 76 tahsils and is situated on plateau having plain terrain with undulations. The

province lies in the center of the state. It is drained by the main river Godavari popularly known as 'Deccan Ganges' and comprises many large and small irrigation projects. The region also experiences the extension of Ajantha and Balaghat hill ranges. It is bounded by Amarawati region in the north, Nashik region in the west, Pune region in the south and it is bounded by Karnataka and Andhra state in the south and south east.

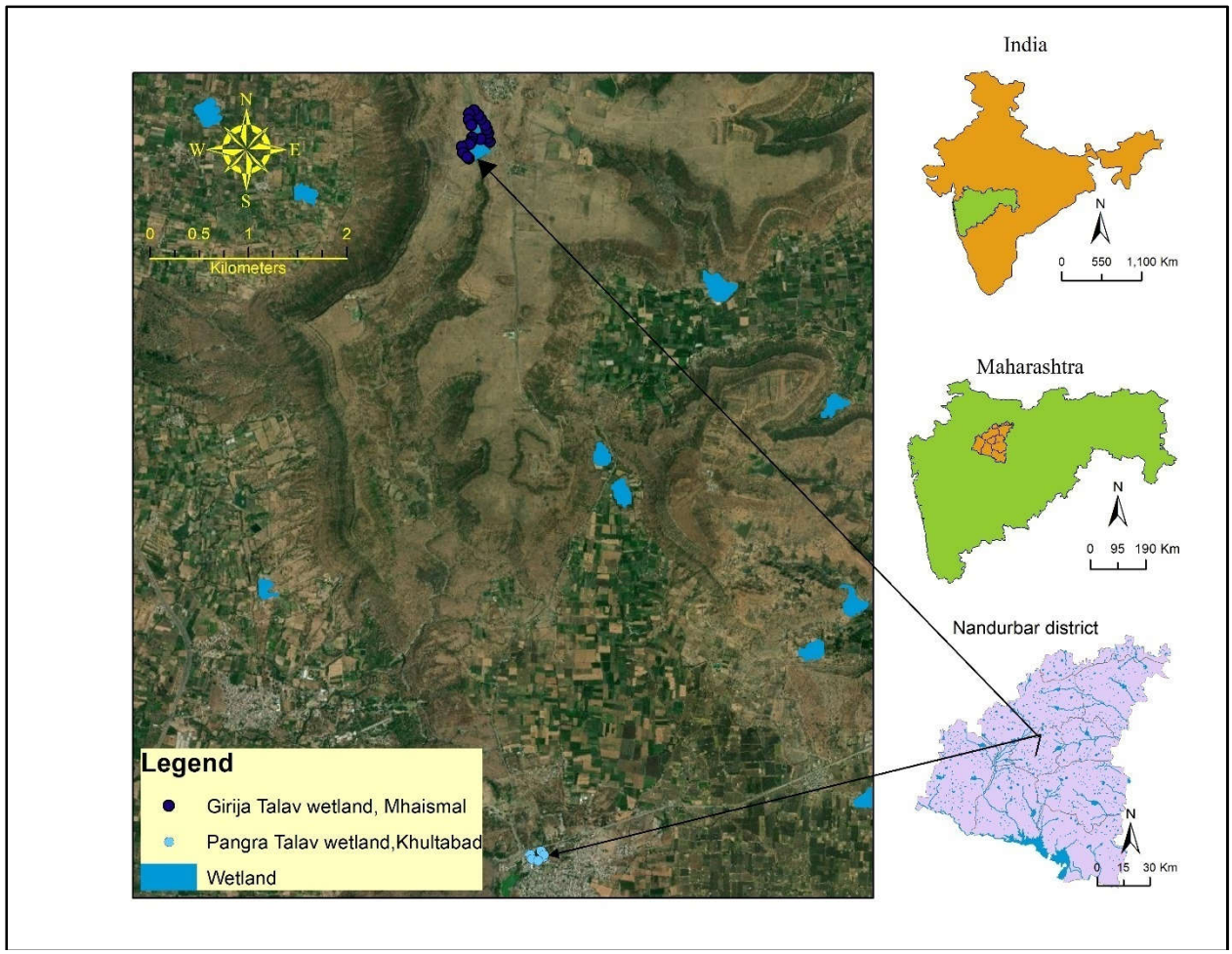

Figure 1: Location map of study area

Geological outline and climate of study area:

The region receives erratic rainfall and it has the characteristic of short rainfall and the time gap between the two successive rains. The area is largely occupied by the Deccan Traps. However, there are exposes of granite and Vindhyans in the Nanded District. The Deccan traps are of the age upper Cretaceous to lower Eocene. The thickness of each lava flow varies from few meters to 40-45 meters. The basalts are of vesicular, zeolitic, jointed, and columnar weathered in nature.

Annual mean temperatures range from 17 to 33 °C, with the most comfortable time in the winter, e.g., October to February. In the cold season, the district is sometimes affected by cold waves in association with the eastward passage of western disturbances across north India, when the minimum temperature may drop down to about 2 °C to 4 °C (35.6 °F to 39.2 °F). Most of the precipitation occurs in the monsoon period from June to September. Thunderstorms

occur between November to April. Average annual rainfall is 710 mm.

METHODOLOGY

Present study focus on physico-chemical assessment of various parameters of water samples collected from both the wetlands under study. Grab Sampling method was used for collection of sewage samples. Total 20 water samples were collected from the Girija Talav wetland, Mhaismal and eight water samples were collected from the Pangra talav wetland of Khultabad depending on their areas. Plastic cans with labeling of time, date and latitude along with longitude of sampling site were used for collection of samples, as explain by (CPCB, 2008). Temperature & pH were measured directly at sampling sites and sample for dissolved oxygen was fixed by adding $MnSO_4$ solution and alkali iodide azide solution in BOD bottles at site. The collected samples were brought to laboratory for further laboratory analysis of other physico-chemical parameters. The parameters like pH, EC, TDS, COD, BOD, DO, HCO3, SO4, Cl and NO3 were analyzed for water samples in the laboratory using established methods as described by APHA, 2012.

RESULTS AND DISCUSSION

Total 12 physico-chemical parameters were determined from the 28water samples collected in the Pre-monsoon in January 2022. The results are tabulated in Table-1. The physico-chemical parameters range i.e., minimum, maximum value with mean and standard deviation were determined.

Table 1: Comparative of minimum, maximum and average concentration of parameters in the water samples collected from study area

Parameter	Pangra Talav wetland, Khultabad			% Sample Above BIS Std	Girija Talav wetland, Mhaismal			% Sample
	Avg	Min	Max		Avg	Min	Max	Above BIS Std
pH	8.50	8.39	8.53	0	8.26	8.20	8.38	0
Tur	8.42	6.44	9.41	0	3.69	2.74	5.38	0
EC	984.99	935.00	1015.40	100	464.67	418.72	540.32	10
T	23.75	23.30	24.20	0	23.62	23.20	24.20	0
TDS	573.75	539.00	594.00	100	268.10	245.00	311.00	0
COD	34.57	23.62	42.64	0	12.15	3.91	39.06	0
BOD	6.13	4.00	8.00	0	3.30	2.00	9.00	0
DO	3.09	1.90	5.40	0	6.71	5.20	8.50	0
HCO_3	243.31	199.00	276.00	0	142.29	117.65	168.00	0
SO_4	44.36	13.37	68.00	0	29.84	17.00	45.00	0
Cl	57.85	30.00	145.10	0	34.04	21.60	50.50	0
NO_3	37.20	6.00	47.00	0	9.40	6.00	15.00	0

The pH is a quantitative measure of acidic or alkaline nature of any aqueous solutions. It measures the hydrogen ion concentration in the aqueous solution. The pH scale ranges within 0 to 14 scales. The pH 7 is the neutral whereas the below 7 solutions being acidic and above 7 as alkaline. The Pangara Lake Khultabad observed having more alkaline pH compared to the Girija Lake, Mhaismal. The pH ranges from 8.20 to 8.38 at Mhaismal lakeand 8.39 to 8.53 at Kultabad lake. Increased carbonates and bicarbonates in the water may be the cause of the highest value (Ingale et al., 2018) the similar pH is found by the Bobdey et al., 2014 in the

lake wetland environment. Most of the sampling sites found inclined towards alkaline nature in both wetlands. The pH of both Lake is between the ranges (6.5-8.5/9) that are acceptable for domestic, recreational, irrigation, and water living organism (WHO, 2006; EPA 2003).

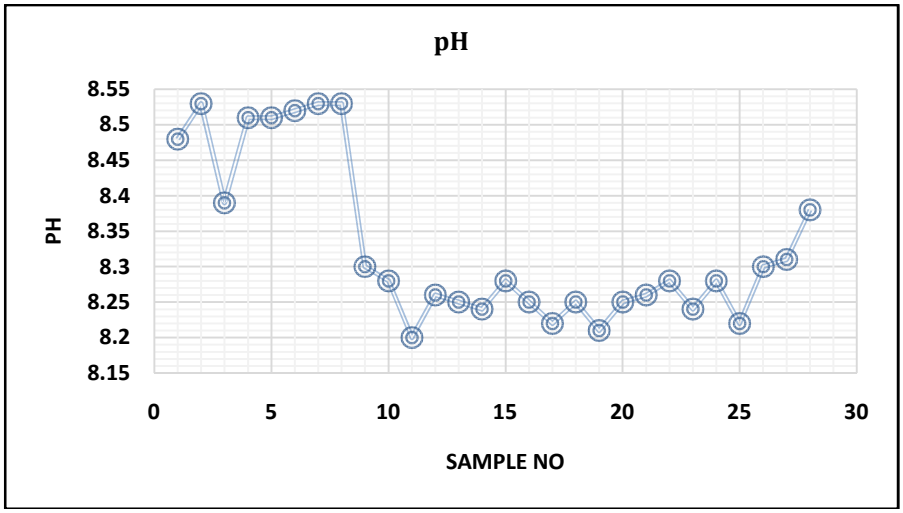

Figure 2: Graph denoting the variation in the pH values of water samples from study area

The temperature is an important physical parameter and having concern to control of water chemistry and biochemical reaction in the organisms. One of the important factors is water temperature since it promotes the development and spread of flora and fauna (AM Abdel-Satar et al., 2017). It measures average kinetic energy of water molecules and measured in linear scale of Degree Celsius. Temperature shown influence on amount of oxygen dissolved in water and rate of photosynthesis, metabolism, and productivity in water body of wastewater (Bhateria and Jain 2016). In the present investigation, no major fluctuation was observed in both the wetlands. There is no major difference recorded in which was ranged between 23.2 to 24.2 ^{0}C. In the cold-water viscosity increases and it has directly diminished impact on settling of solid particle rates. The temperature influences the oxygen concentration in water, as temperature increases dissolved oxygen content decreases in wastewater reported by (Missaghi et al., 2017).

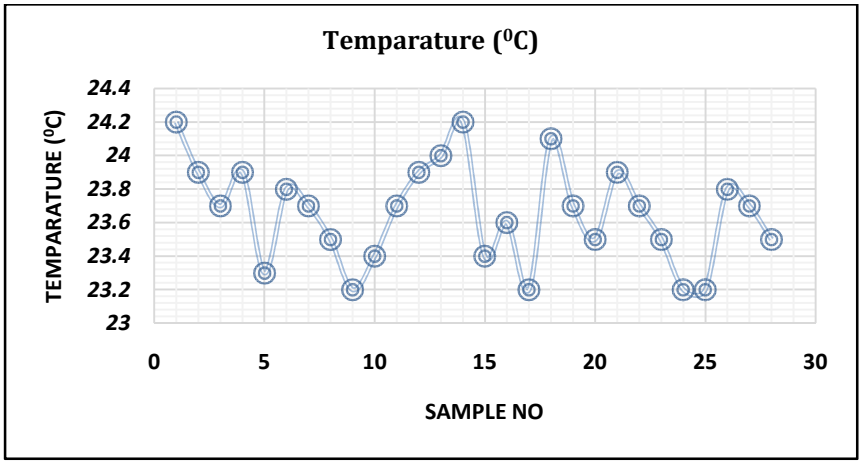

Figure 3: Graph denoting the variation in the temperature values of water samples from study area

Turbidity is the amount of haziness in the water/liquid and measures in Nephelometric Turbidity Unit (NTU). The natural water bodies get silt, sand, clay, chemical precipitate, bacteria, germs, and organic decaying matter and which may lead to higher turbidity in water (Boyd and Boyd 2020). The highest values may be caused by low water levels, higher temperatures, silt, clay, and suspended particles, while the lowest values may be brought on by silt and clay settling (Namdeo et al., 2017). In the present study the maximum and minimum values of turbidity were recorded as 2.95, 5.38 in Girija Lake wetlnd Mhaismal and 6.44 and 9.41 in Pangra Talav, Khultabad respectively. More investigation required to identify the exact reason for the abrupt results. The higher load of turbidity indicates excessive input of pollutants in water, and it may cause adverse impact on natural water body and its ecosystem (Goel, 1997, Davies and Smith 2001).

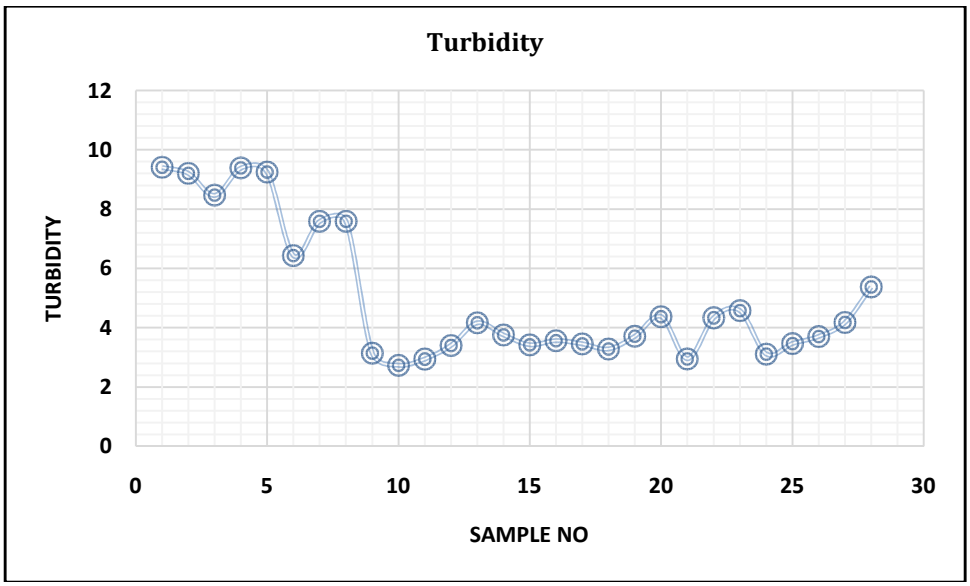

Figure 4: Graph denoting the variation in the turbidity values of water samples from study area

Electrical Conductivity is an indicator of dissolved content in water. The dissolved ions present in solution are imparting the conductivity property to solutions (Puri et al., 2010). The electricity conductivity means the measurement of water capacity to conduct electricity. It measures in a unit of micro-siemens per centimeter. The maximum and minimum electricity conductivity values were recorded 540 and 418 in Girija Lake wetland, Mhaismal and 935 and 1015.40 in Pagara Lake, Khultabad. The more EC in Khultabad lake may be due to existence of commercial activities like hotels and habitation on the edge of wetland. More investigation required to identify the exact reason for the abrupt results. The conductivity may vary due to influence of rainfall, but in urban area sewages having high conductivity due to disposal of soluble salts and materials in wastewater and due to dissolution of such organic and inorganic material the electricity conductivity might be increases (Pérez-Belmont et al., 2019).

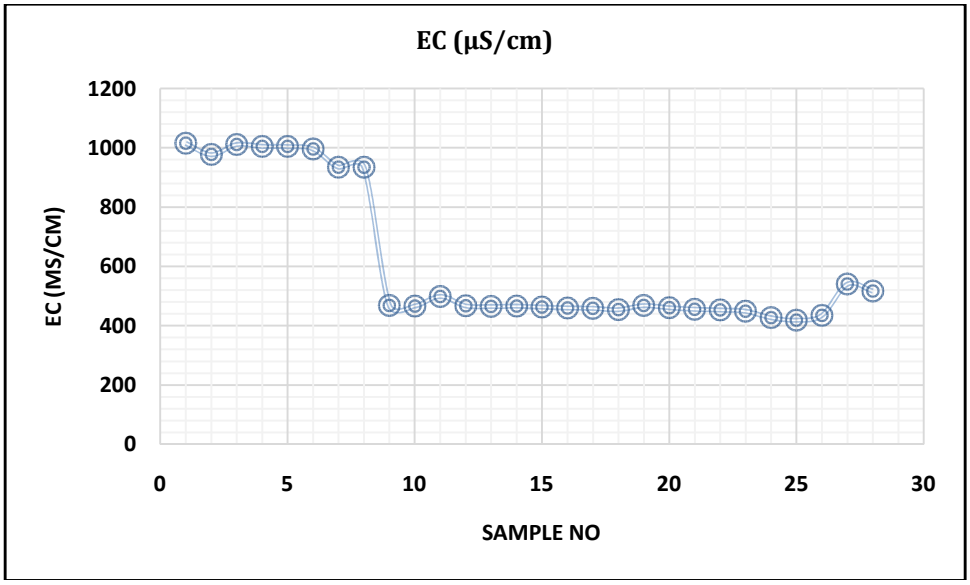

Figure 5: Graph denoting the variation in the EC values of water samples from study area

Total dissolved solids primarily represent the many types of minerals that are present in the water (Ingale et al., 2018). In present study, the total dissolved solids (TDS), the higher values of TDS recorded in both wetlands may be due to existence of hotels, habitation on the edge of Pangara Lake, Khultabad and cattle, cloth washing, bathing in the Girija Lake, Mhaismal. The higher values of TDS indicate the saline behavior of water, as similar reported by (Murhekar, 2011). TDS for all sample will be above the limit of BIS standard.

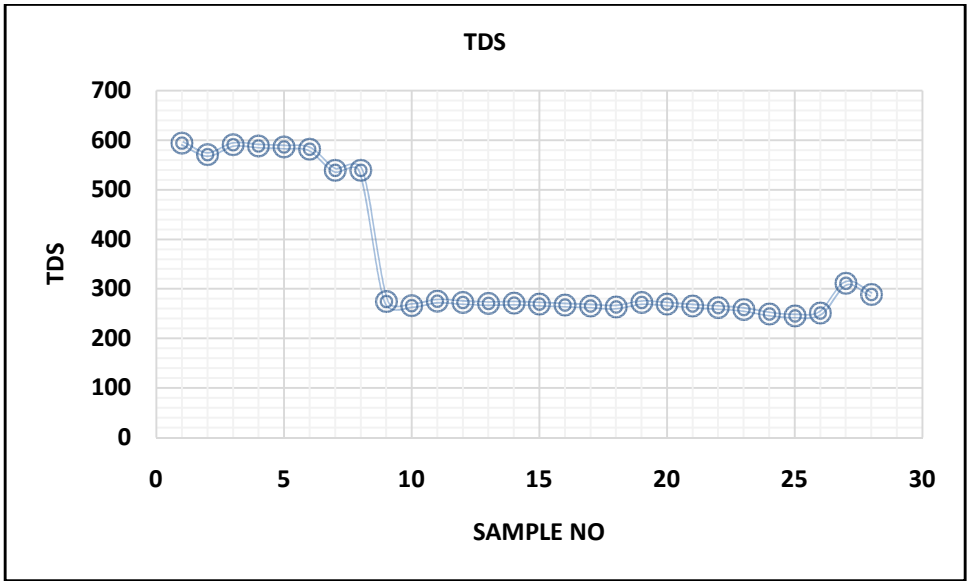

Figure 6: Graph denoting the variation in the TDS values of water samples from study area

The dissolved oxygen (DO)is essential parameter for maintain a healthy water condition and for survival of aquatic organism (Kulkarni 2016). Presence of oxygen level in water is a good indicator of healthy water body and the absence of oxygen indicates water bodies get severely degraded containing excess organic load in it (Shah and Joshi 2017). In

present investigation, the DO concentration in Girija Lake varies from 5.2 to 8.5 mg/L which indicates good health of water body. The Do ranges from 1.9 to 5.4 mg/L in Pangara Lake indicated degradation of fewer areas of the wetland due to ingress of waste water from nearby hotels and habitation. The value of DO is within the BIS-permitted range.

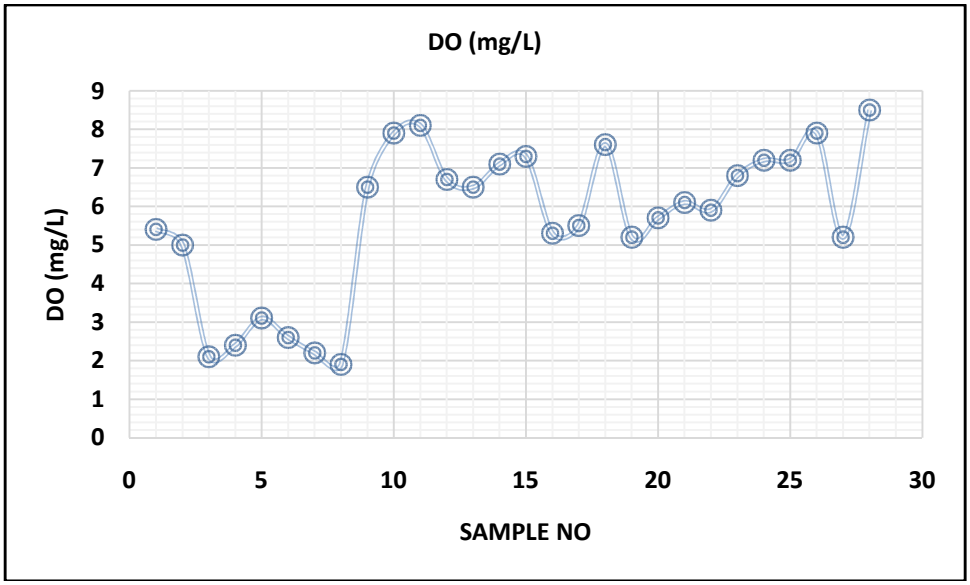

Figure 7: Graph denoting the variation in the DO values of water samples from study area

Water contains variety of organic material in which may not be possible to decompose through biological processes. In such cases the organic or inorganic matter gets exposed with oxygen and get oxidized slowly and convert it into the oxides (Geerdink et al., 2017). The COD is the amount of oxygen required for the oxidation of organic and inorganic materials present in water. In the present study the maximum and minimum COD values is 3.91mg/Land 39.06 mg/Lin Girija Lake wetland, Mhaismal and 23.62 to 42.64 mg/L in Pangara lake wetland, Khultabad. The higher values of COD may also indicate that, presence of cations and anion in water, as reported by (Soudani *et.al,* 2011) in study of municipal and industrial wastewater treatment.

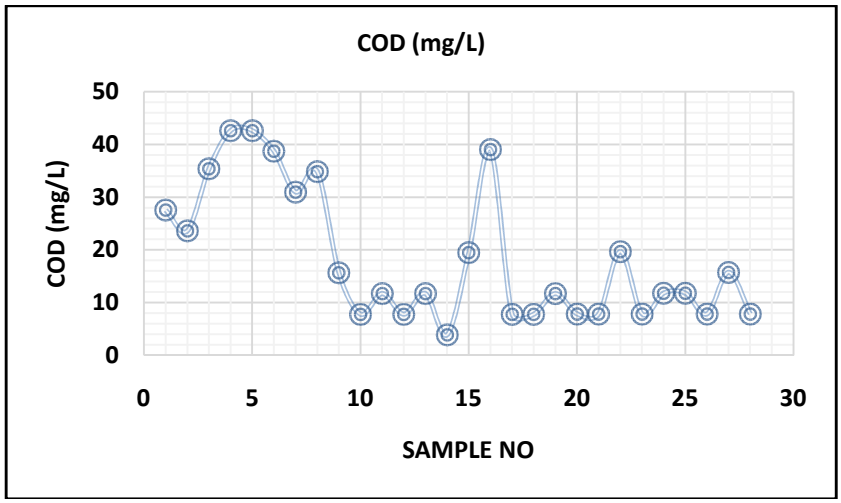

Figure 8: Graph denoting the variation in the COD values of water samples from study area

While the biological oxygen demand (BOD) is an important organic pollutant load indicating parameter in water analysis. In present investigation the BOD of the water samples collected and was analyzed for BOD. The results are summarized in observation table. From the analysis results it is shows that, the BOD values of Girija Lake wetland varies from 2 to 4 mg/Lwhereas BOD values in Pangara lake wet land varies from 4 to 8 mg/L. The COD and BOD parameters are the vital parameters pinpointing and contaminated condition of water body and helpful in assessment of pollution load present in water (Krishan et al., 2022).The value of BOD was within the allowable range in accordance the BIS.

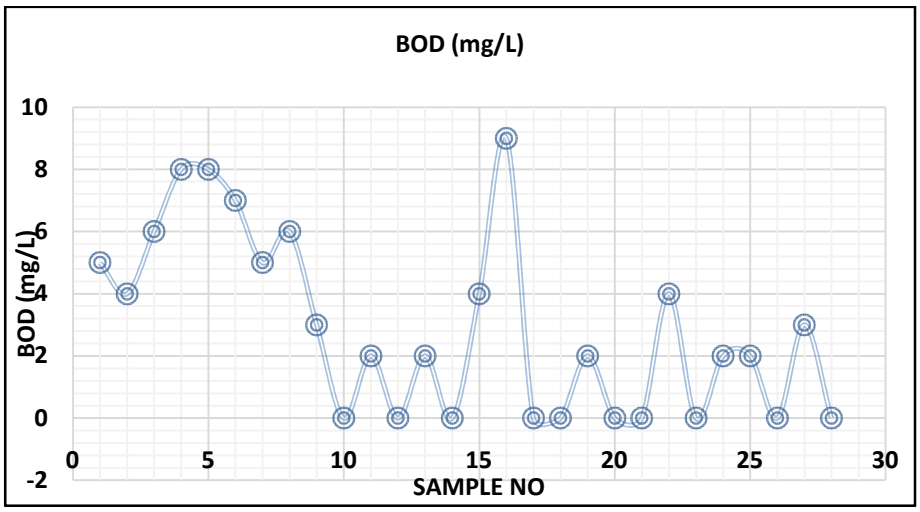

Figure 9: Graph denoting the variation in the BOD values of water samples from study area

Bicarbonate is present in water because of different hydroxides, bicarbonates, and carbonates, and it relates to the capacity of an aqueous solution to neutralize acids (Krishan et al., 2022). The content of Bicarbonate varied for Girija Lake wetland 117.65 to 168 mg/L whereas Pangara lake wetland varies from 199 to 276 mg/L. HCO_3 concentrations for Girija Lake wetland is well below the allowed limit of 200 mg/L at all sample stations (Bureau of Indian Standards (BIS) 2012), while for Pangara lake wetland all sample above the BIS standard.

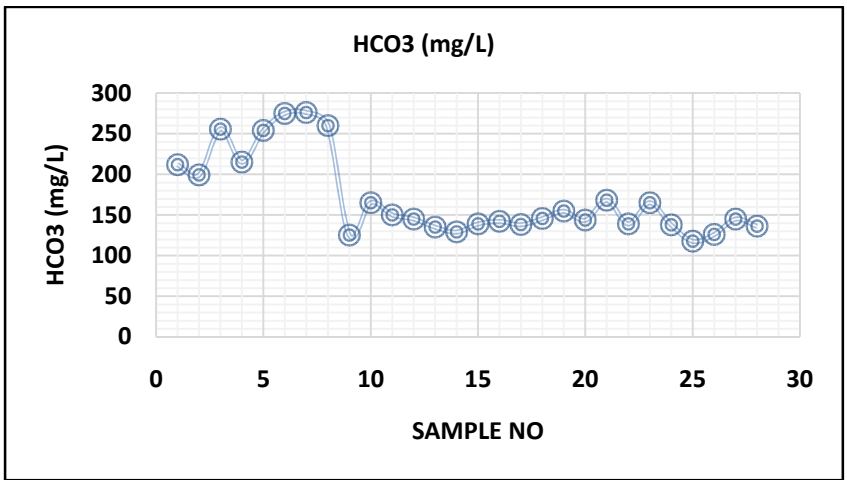

Figure 10: Graph denoting the variation in the HCO3 values of water samples from study area

The sulphate is the non-alkaline compounds with lot of quantity available in the earth crust and soil (Chandra et al., 2010).This sulphate containing compound present in the protein. The formation sulphate compound from the oxidation of hydrogen sulphide and sulphur containing compound in absence of oxygen in water. Many time SO_4 containing inorganic compound are the main source of sulphate in water body. In the present study the maximum and minimum concentration of sulphate were recorded as 17 mg/L to 45mg/L in Girija Lake wetland, Mhaismal and 13.37 mhl to 68mg/L in Pangara Lake wetland, Khultabad. The sulphate containing salts are easily soluble in water, but it has less impact on taste of water as compared to chlorides and carbonate. In the present investigation it was noted that concentration of sulphate is higher in summer season and that may be due to disposal of waste contains detergent from washing activities. The excess consumption of water containing a high level of sulphate may be linked with diarrhoea and gastrointestinal disorders (Agoro *et.al*, 2018).

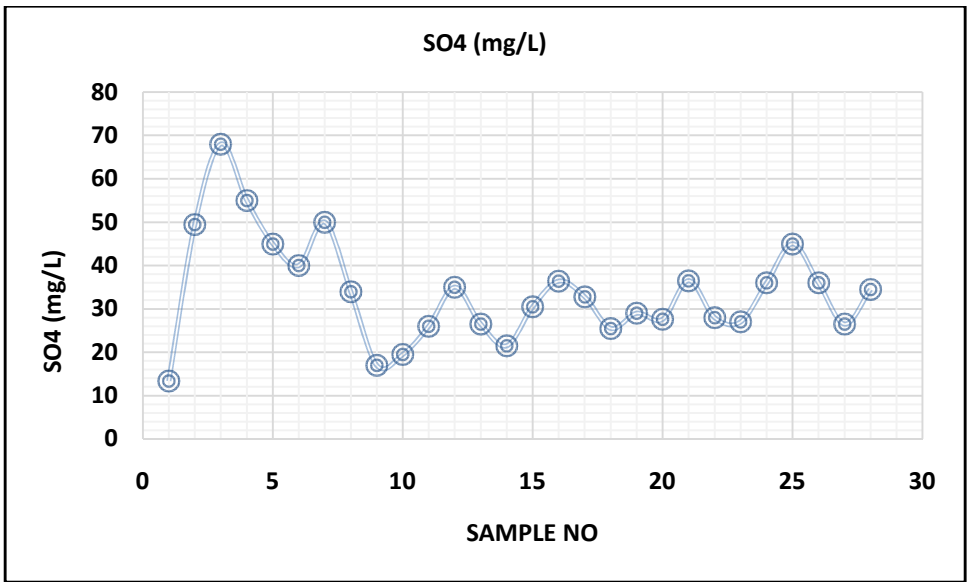

Figure 11: Graph denoting the variation in the SO4 values of water samples from study area

Chloride is one of the important parameters of water characterization. The source of chloride in water resources is from the surface runoff, cloth and vehicles washing, use of fertilizers, industrial/municipal solid wastes etc. Chloride containing salts are easily and rapidly soluble in water. Therefore, it can get entered in ground and surface water rapidly from the disposed salts. In present investigation the chloride concentrations are not abundant, and it ranges from 21.60 to 50.50 mg/L in Girija Lake wetland, Mhaismal and 30 to 145mg/L in Pangara Lake wetland, Khultabad. The comparatively more values observed in urban wetland of Khultabad may be due to commercial and domestic activity in the vicinity of wetland. The chloride content is positively correlated with alkalinity, Na, P, Ca, TDS in both the wetlands. The higher chloride concentration directly affect aquatic life and it may lead to depletion of O_2 level in the water body. This may affect on crop, plants and may change the soil structure and convert soil into saline soil as mentioned by (Sami and Mule, 2015).

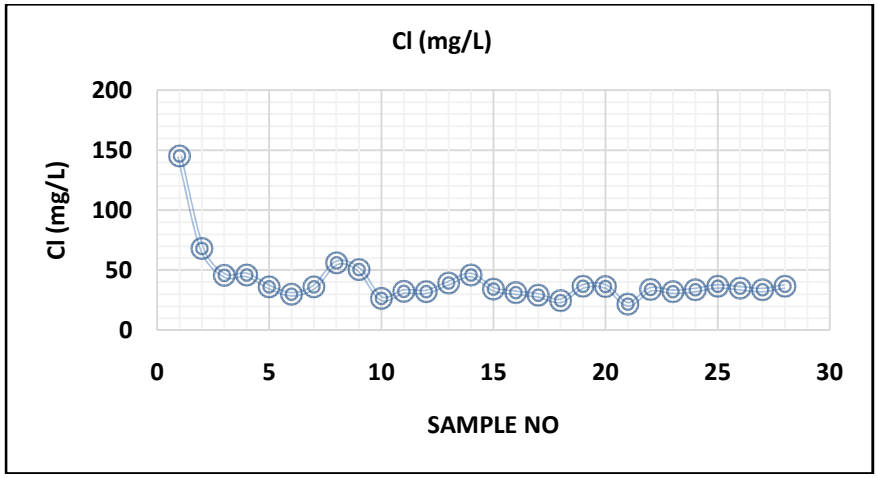

Figure 12: Graph denoting the variation in the Cl values of water samples from study area

Higher disposal of nitrates in water body results in the form of blooming of algae in it, higher which is an indication of eutrophication at high level. The continuing of higher of eutrophication in water body may converts aquatic ecosystem into terrestrial system slowly. The similar investigation recorded by (Sangpal *et.al*, 2011) and stated that, due to oxidation of ammonia nitrate quantity might be increased in water body and lowered due to denitrifying bacteria. In present investigation the nitrate concentrations are having higher values, and it ranges from 6.0 to 15.0 mg/L in Girija Lake wetland, Mhaismal and 6.0 to 47 mg/L in Pangara Lake wetland, Khultabad.

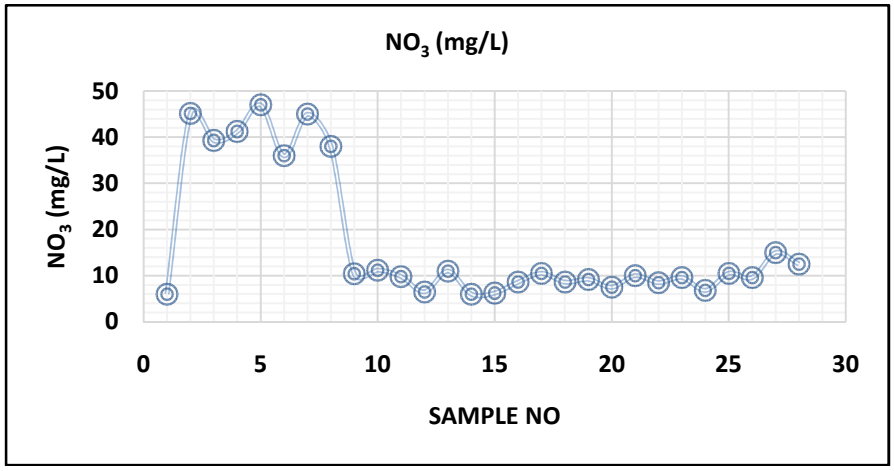

Figure 13: Graph denoting the variation in the NO_3 values of water samples from study area

CONCLUSION

The present study deals with the determination of physico-chemical parameters of water samples collected from the wetlands situated in the Khultabad tehsil of the Aurangabad district of Maharashtra. For developing suitable policies and carrying out priorities, knowledge of the fundamental and integrated facts on wetlands is crucial. The levels of parameters like Electrical Conductivity, Total Dissolved Solids, Calcium, Magnesium, COD, BOD, Sodium, Potassium

found more whereas the Dissolved Oxygen level is at an alarming low level. The recurrent discharge of waste effluents by diverse discharges pouring straight into the wetland by several man-made sources, surface runoff, and unregulated dumping of solid waste with a very low rate of dilution results into degradation of wetland. In natural water bodies, nitrogen and phosphorus can function as plant fertilizers and encourage excessive plant, algae, and cyanobacteria development. These nutrients can also come through pet waste, sewage and septic systems, agricultural and lawn fertilizers, and other sources. The poisonous compounds that might be produced by such development could suffocate wildlife and natural plants. This study will be help as baseline for planners and managers to take immediate action to avoid further eutrophication of the water body. Wetlands feature a diverse natural plant and animal life when they are healthy. These can function as water filtering systems, removing silt, nutrients, and contaminants. Wetlands' ability to maintain and enhance water quality is under threat as a result of human activities and harsh weather events affecting water flows, nitrogen balance, and biodiversity. The provision such as artificial aerator, control on ingress of wastewater and solid waste from nearby habitation and commercial units. In conclusion, the wetland sare more vulnerable to the pollution due to reasons mentioned above and need immediate action for its conservation and preservation. The installation of automated aerators in a few locations may aid in limiting future deterioration.

Acknowledgement:
The authors are grateful to the Director, School of Environmental and Earth Sciences, Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon, for providing necessary research facilities.

REFERENCES

1. Agoro Mojeed A, Omobola O. Okoh, Martins A. Adefisoye, Anthony I. Okoh, (2018). Physicochemical properties of wastewater in three typical South African sewage works, Polish Journal of Environmental Studies, 27(2), 491-499.
2. Akpabio, E. M., & Umoh, G. S. (2021). The practical challenges of achieving sustainable wetland agriculture in Nigeria's Cross River basin. Water International, 46(1), 83-97.
3. Ambelu, A., Mekonen, S., GSilassie, A., Malu, A., & Karunamoorthi, K. (2013). Physicochemical and biological characteristics of Two Ethiopian wetlands. Wetlands, 33, 691-698.
4. Bao, J., Gao, S., & Ge, J. (2019). Salt and wetland: traditional development landscape, land use changes and environmental adaptation on the central Jiangsu Coast, China, 1450–1900. Wetlands, 39(5), 1089-1102.
5. Bassi, N., Kumar, M. D., Sharma, A., & Pardha-Saradhi, P. (2014). Status of wetlands in India: A review of extent, ecosystem benefits, threats and management strategies. Journal of Hydrology: Regional Studies, 2, 1-19.
6. Bhateria, R., & Jain, D. (2016). Water quality assessment of lake water: a review. Sustainable Water Resources Management, 2, 161-173.
7. Boyd, C. E., & Boyd, C. E. (2020). Suspended solids, color, turbidity, and light. Water Quality: An Introduction, 119-133.
8. Chandra, R., Nishadh, K. A., & Azeez, P. A. (2010). Monitoring water quality of Coimbatore wetlands, Tamil Nadu, India. Environmental monitoring and assessment, 169, 671-676.
9. Chaudhuri, A. S., Gaur, N., Rana, P., & Verma, P. (2022). Ecohydrological Perspective for Environmental Degradation of Lakes and Wetlands in Delhi. In Geospatial Technology for Landscape and Environmental Management (pp. 143-163). Springer, Singapore.
10. Dar, S. A., Bhat, S. U., & Rashid, I. (2021). The status of current knowledge, distribution, and conservation challenges of wetland ecosystems in Kashmir Himalaya, India. Wetlands Conservation: Current Challenges and Future Strategies, 175-200.
11. Datta, S., Sinha, D., Chaudhary, V., Kar, S., & Singh, A. (2022). Water pollution of wetlands: a global threat to inland, wetland,

and aquatic phytodiversity. In Handbook of Research on Monitoring and Evaluating the Ecological Health of Wetlands (pp. 27-50). IGI Global.

12. Davies-Colley, R. J., & Smith, D. G. (2001). Turbidity suspeni., ed sediment, and water clarity: a review 1. JAWRA Journal of the American Water Resources Association, 37(5), 1085-1101.

13. Desai, R. V., Suryawanshi, R. A., & Golekar, R. B. (2020). Assessment of Groundwater Quality in Dakshin Mand River Basin, District Satara, Maharashtra (India). 55-65.

14. Dubey, M. S., Deshpande, S. M., & Golekar, R. B. (2021). Assessment of Groundwater Quality for Drinking and Irrigation Purposes in Warora Area of Central India. 187-204.

15. EPA (Ethiopian Environmental protection Authority) Guideline Ambient Environment Standards for Ethiopia. Prepared by EPA and UNIDO under ESDI project 2003, US/ ETH/99/068/Ethiopia. Addis Ababa.

16. Geerdink, R. B., van den Hurk, R. S., & Epema, O. J. (2017). Chemical oxygen demand: Historical perspectives and future challenges. Analytica Chimica Acta, 961, 1-11.

17. Goel, P.K., (1997). Water pollution causes, effects and control. New Age International (P) Ltd., publishers, New Delhi.

18. Ingale, P. P., Bobdey, A. D., & Gorghate, N. D. (2018). Comprehensive hydrobiological status of Bhiwapur Lake of Maharashtra, India: an environmental aspect. Journal of the Chinese Advanced Materials Society, 6(4), 655-665.

19. Junk, W. J. (2002). Long-term environmental trends and the future of tropical wetlands. Environmental conservation, 29(4), 414-435.

20. Junk, W. J., An, S., Finlayson, C. M., Gopal, B., Květ, J., Mitchell, S. A., ... & Robarts, R. D. (2013). Current state of knowledge regarding the world's wetlands and their future under global climate change: a synthesis. Aquatic sciences, 75(1), 151-167.

21. Kadam, V. B., Tejankar, A. V., Venkateshwarlu, M., Maity, R., & Sirsat, S. K. (2022). Magnetic Properties of Urban Topsoil from Aurangabad (India)—Implications to Industrial Pollution and Road Traffic. Water, Air, & Soil Pollution, 233(7), 258.

22. Krishan, A., Khursheed, A., & Mishra, R. K. (2022). Evaluation of water quality using water quality index, synthetic pollution index, and GIS technique: a case study of the river Gomti, Lucknow, India. Environmental Science and Pollution Research, 29(54), 81954-81969.

23. Kulkarni, S. J. (2016). A review on research and studies on dissolved oxygen and its affecting parameters. International Journal of Research and Review, 3(8), 18-22.

24. Li, Z., Jiang, W., Wang, W., Chen, Z., Ling, Z., & Lv, J. (2020). Ecological risk assessment of the wetlands in Beijing-Tianjin-Hebei urban agglomeration. Ecological Indicators, 117, 106677.

25. Liu, W., Iordan, C. M., Cherubini, F., Hu, X., & Fu, D. (2021). Environmental impacts assessment of wastewater treatment and sludge disposal systems under two sewage discharge standards: A case study in Kunshan, China. Journal of Cleaner Production, 287, 125046.

26. M. Abdel-Satar Amaal, H. Al-Khabbas Manal, R. Alahmad Waed, M. Yousef Wafaa, H. Alsomadi Rani. Quality assessment of groundwater and agricultural soil in Hail region, Saudi Arabia. Egyptian J. Aquatic Res., 2017, 43, 55–64.

27. Mercado, V. (2018). Analysis of urban wetland governance: A case study on the Las Piñas–Parañaque Critical Habitat and Ecotourism Area (LPPCHEA) in Metro Manila, Philippines.

28. Missaghi, S., Hondzo, M., & Herb, W. (2017). Prediction of lake water temperature, dissolved oxygen, and fish habitat under changing climate. Climatic Change, 141, 747-757.

29. Namdeo, A. K., Pradeep, S., Abha, S., & Sarita, S. (2013). Hydrobiology of a tropical reservoir with special reference to seasonal flux in certain physico-chemical parameters. International Journal of Advanced Life Sciences (IJALS), 6(4), 325-332.

30. Pérez-Belmont, P., Alvarado, J., Vázquez-Salvador, N., Rodríguez, E., Valiente, E., & Díaz, J. (2019). Water quality monitoring in

the Xochimilco peri-urban wetland: experiences engaging in citizen science. Freshwater Science, 38(2), 342-351.

31. Puri, P. J., Yenkie, M. K. N., Battalwar, D. G., Gandhare, N. V., & Dhanorkar, D. B. (2010). Study and interpretation of physico-chemical characteristic of lake water quality in Nagpur city (India). Rasayan J. Chemistry, 3(4), 800-810.

32. Roy-Basu, A., Bharat, G. K., Chakraborty, P., & Sarkar, S. K. (2020). Adaptive co-management model for the East Kolkata wetlands: A sustainable solution to manage the rapid ecological transformation of a peri-urban landscape. Science of the Total Environment, 698, 134203.

33. Sami Taha Ahmed Aladimy & M B Mule: (2015). Study of Physico-Chemical parameters of waste water generated from Aurangabad city of Maharashtra. International journal for science and advance research in technology. (IJSART), Vol. 1: 143-152

34. Sangpal R R, V D Kulkarni and Y M Nandurkar, (2011). An assessment of the physico-chemical properties to study the pollution potential of Ujjaini reservoir, Solapur, Maharashtra. ARPN Journal of agricultural and biological science, vol.6 No.3: 34-38

35. Shah, K. A., & Joshi, G. S. (2017). Evaluation of water quality index for River Sabarmati, Gujarat, India. Applied Water Science, 7, 1349-1358.

36. Shan, V., Singh, S. K., & Haritash, A. K. (2021). Present Status, Conservation, and Management of Wetlands in India. In Advances in Energy and Environment (pp. 235-256). Springer, Singapore.

37. Singh, J., Yadav, P., Pal, A. K., & Mishra, V. (2020). Water pollutants: Origin and status. In Sensors in water pollutants monitoring: Role of material (pp. 5-20). Springer, Singapore.

38. Song, S., Albert, C., & Prominski, M. (2020). Exploring integrated design guidelines for urban wetland parks in China. Urban Forestry & Urban Greening, 53, 126712.

39. Soudani Amina, Mohamed Chiban, Mohamed Zerbet & Fouad Sinan, (2011). Use of Mediterranean plant as potential adsorbent for municipal and industrial waste water treatment. Journal of environmental chemistry and ecotoxicology, Vol.3 (8) :199-205

40. Stefanakis, A. I. (2019). The role of constructed wetlands as green infrastructure for sustainable urban water management. Sustainability, 11(24), 6981.

41. Suvarna, K., Pendke, M. S., Patil, S. N., & Patil, B. D. (2022). An Integrated Remote Sensing & GIS Techniques Based Approach to Study Spatial Distribution of Parameters Controlling Groundwater Contamination in Parbhani Tehsil of Maharashtra State, India. Bulletin of Pure & Applied Sciences-Geology, 41(2), 212-227.

42. Tomas, W. M., de Oliveira Roque, F., Morato, R. G., Medici, P. E., Chiaravalloti, R. M., Tortato, F. R., ... & Junk, W. J. (2019). Sustainability agenda for the Pantanal Wetland: perspectives on a collaborative interface for science, policy, and decision-making. Tropical Conservation Science, 12, 1940082919872634.

43. WHO. Guidelines for safe recreational water environments, Volume 2 Swimming pools and similar environments. Geneva, 2006.

44. Xu, T., Weng, B., Yan, D., Wang, K., Li, X., Bi, W., ... & Liu, Y. (2019). Wetlands of international importance: Status, threats, and future protection. International Journal of Environmental Research and Public Health, 16(10), 1818.

45. Zhai, T., Wang, J., Fang, Y., Liu, J., Huang, L., Chen, K., & Zhao, C. (2021). Identification and prediction of wetland ecological risk in key cities of the Yangtze River Economic Belt: From the perspective of land development. Sustainability, 13(1), 411

****