DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA

(RESEARCH PROJECT)

ANALYSIS OF WATER POLLUTION USING DIFFERNET PHYSICO-CHEMICAL PARAMETERS

A

Project

Submitted to

Dr. Bhimrao Ambedkar University, Agra

for the degree of

Master of Science

in

Chemistry

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(M.sc VIIIth Semester)

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Year: 2022-2023

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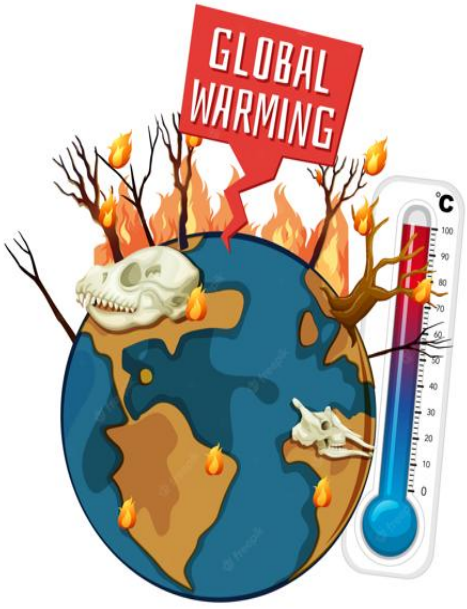


The fearful future of water pollution!

ABBREVIATION

The following table describes the significance of various abbreviations and acronyms used throughout the research project.

Abbreviation	Meaning
BHC	Benzene Hexachloride
BIS	Bureau of Indian Standard
BOD	Biological Oxygen Demand
CPCB	Central pollution control board
COD	Chemical Oxygen Demand
DDT	Dichloro-diphenyl-trichloroethane
DIC	Dissolved Inorganic Carbon
DO	Dissolved Oxygen
EC	Electrical Conductivity
EDTA	Ethylene diammine tetraacetic acid
HCL	Hydrogen chloride
pH	Potential of Hydrogen
PPM	Parts Per Million
TA	Total Alkalinity
TDS	Total Dissolved Solid
US EPA	United States Environment Protection Agency
WHO	World Health Organization

ABSTRACT

This study was conducted at Department of Chemistry, Agra College, Agra during year 2023 as a semester exam for Master of Science in chemistry. The data regarding water pollution analysis using physico-chemical parameters was obtained and compiled through a thorough review of various published research articles of international reputed journal and relevant books. Water is one of the most important of all natural resources known on earth. Water covers about 70% Earth's surface. It is important to all living organisms, most ecological systems, human health, food production and economic development. Safe drinking water is a basic need for all humans. The safety of drinking water is important for the health. The safety of drinking water is affected by various contaminants which included chemical and microbiological. Such contaminants cause serious health problems. Due to this contaminants quality of drinking water becomes poor. Sometimes such poor quality water causes many diseases in the humans so that quality of water must be tested for both the chemical as well as microbial contaminants. During the study it was found that maximum number of physical and chemical parameters were within the desirable limit, as suggested by WHO and BIS.

The WHO reports that 80% diseases are waterborne. Industrialization, discharge of domestic waste, radioactive waste, population growth, excessive use of pesticides, fertilizers and leakage from water tanks are major sources of water pollution. These wastes have negative effects on human health. Different chemicals have different affects depending on their locations and kinds. Bacterial, viral and parasitic diseases like typhoid, cholera, encephalitis, poliomyelitis, hepatitis, skin infection and gastrointestinal are spreading through polluted water. It is recommended to examine the water quality on regular basis to avoid its destructive effects on human health. Domestic and agriculture waste should not be disposed of without treating.

The objective of the present research is to provide information on the physico-chemical characteristics and detailed ecological studies of potable water and lake water in order to discuss it's suitability for human consumption. Physico-chemical and Biochemical aspects of the water have been investigated to assess the quality of water. The variations of the physico-chemical properties of water samples directly influence of the biotic communities and primary productivity of water bodies.

KEYWORD: pollution, sources of water pollution, harmful chemicals, infectious diseases , potable water and lake water, physico-chemical and investigation, ecological studies, comparative studies Water.

INTRODUCTION

Water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. Karikari and Ansa[1] studied that only earth is the planet having about 70 % of water. But due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity it is highly polluted with different harmful contaminants. Leroy[2] told that it is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. Oketola[3] and coworker have been studied the difficulties of the biological phenomenon fully because the chemistry of water revels much about the metabolism of the ecosystem and explain the general hydro - biological relationship.

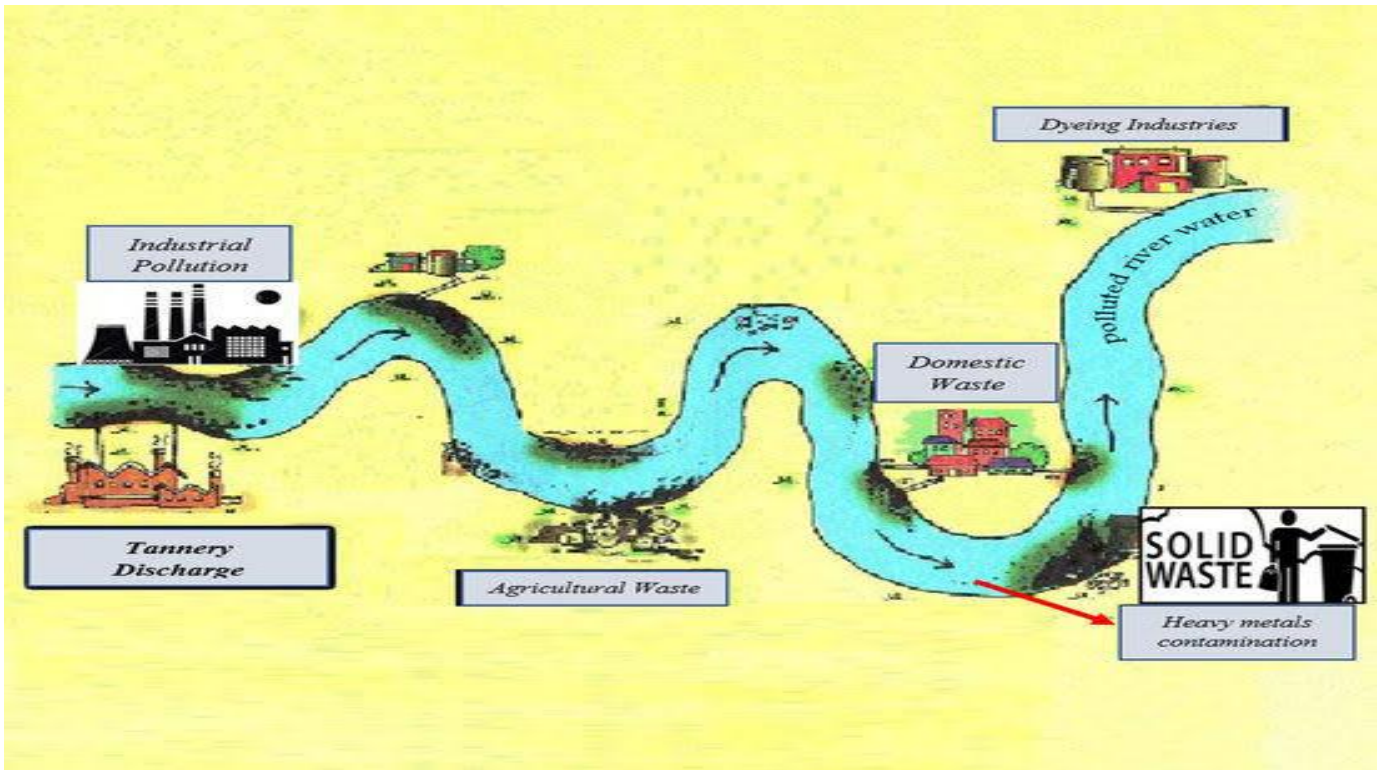
BACKGROUND - The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. Natural water contains different types of impurities are introduced in to aquatic system by different ways such as weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities. Muduli and panda[4] included mining, processing and the use of metal based materials. The increased use of metal-based fertilizer in agricultural revolution of the government could result in continued rise in concentration of metal pollutions in fresh water reservoir due to the water run-off. Also faucal pollution of drinking water causes water born disease which has led to the death of millions of people.

People on globe are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. These are related to animal and plants and finally affecting on it. Industrial development (Either new or existing industry expansion) results in the generation of industrial effluents, and if untreated results in water, sediment and soil pollution. Having mainly excessive amounts of heavy metals such as Pb, Cr and Fe, as well as heavy metals from industrial processes are of special concern because they produce water or chronic poisoning in aquatic animals. High levels of pollutants mainly organic matter in river water causes an increase in biological oxygen demand, chemical oxygen demand, total dissolved solids, total suspended solids and fecal coli form. They make water unsuitable for drinking, irrigation or any other use.

There are trends in developing countries to use sewage effluent as fertilizer has gained much importance as it is considered a source of organic matter and plant nutrients and serves as good fertilizer. Farmers are mainly interested in general benefits, like increased agriculture production, low cost water source, effective way of effluent disposal, source of nutrients, organic matter etc, but are not well aware of its harmful effects like heavy metal contamination of soils, crops and quality problems related to health. Research has proven that long term use of this sewage effluent for irrigation contaminates soil and crops to such an extent that it becomes toxic to plants and causes deterioration of soil. This contains considerable amount of potentially harmful substances including soluble salts and heavy metals like Fe^{2+}, Cu^{2+}, Zn^{2+}, Mn^{2+}, Ni^{2+}, Pb^{2+}. Additions of these heavy metals are undesirable. Plants can accumulate heavy metals in their tissues in concentrations above the permitted levels which is considered to represent a threat to the life of humans, and animals feeding on these crops and may lead to contamination of food chain, as observed that soil and plants contained many toxic metals, that received irrigation water mixed with industrial effluent.

Rapu[5] reported that over 15% of rural dwellers depend on polluted river waters for their domestic needs. Khalil[6] claimed that over 70% of people get their water supply from surface water, which in most cases are polluted by agricultural chemical and industrial effluents. Shuaib[7] was of the opinion that over 40% depend on either polluted surface water or wells for their domestic activities.

OBJECTIVE - The quality of ground water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of the particular region. Industrial waste and the municipal solid waste have emerged as one of the leading cause of pollution of surface and ground water. In many parts of the country available water is rendered non-potable because of the presence of heavy metal in excess. The situation gets worsened during the summer season due to water scarcity and rain water discharge. Contamination of water resources available for household and drinking purposes with heavy elements, metal ions and harmful microorganisms is one of the serious major health problems. The recent research in Haryana (India) concluded that it is the high rate of exploration then its recharging, inappropriate dumping of solid and liquid wastes, lack of strict enforcement of law and loose governance are the cause of deterioration of ground water quality.



Most of the rivers in the urban areas of the developing countries are the ends of effluents discharged from the industries. African countries and Asian countries experiencing rapid industrial growth and this is making environmental conservation a difficult task. Sea water contains large number of trace metals in very small concentration. This is a challenging matrix for the analytical chemist due to the very low concentrations of many important trace metal.

SPECIFIC GOAL OF STUDY - More than two million people worldwide die each year from diarrheal diseases, with poor sanitation and unsafe drinking water being the leading cause of nearly 90% of deaths and affecting children the most (United Nations, 2016). More than 50 kinds of diseases are caused by poor drinking water quality, and 80% of diseases and 50% of child deaths are related to poor drinking water quality in the world. However, water pollution causes diarrhea, skin diseases, malnutrition, and even cancer and other diseases related to water pollution. Therefore, it is necessary to study the impact of water pollution on human health, especially disease heterogeneity, and clarify the importance of clean drinking water, which has important theoretical and practical significance for realizing sustainable development goals. Unfortunately, although many kinds of literature focus on water pollution and a particular disease, there is still a lack of research results that systematically analyze the impact of water pollution on human health and the heterogeneity of diseases. Based on the above background and discussion, this paper focuses on the analysis of water pollution using physico-chemical parameters.

LITERATURE REVIEW

I have studied Enetimi et. al.[8] research on physiochemical quality assessment of river it was asserted that river quality assessment is essential to the sustenance of aquatic biodiversity, the environment and public health. They also indicated that mild anthropogenic activities have caused changes in parameters assessed such as iron, pH, magnesium, calcium with increase in total dissolved solids. Furthermore, they were of the opinion that if mitigation measures are not put in place, anthropogenic effects could rise beyond tolerant or permissive limits, which could affect the sustenance of the river. The concentration levels of Pb, Cd, Fe and Mn were in surplus because fertilizers and pesticides used for agricultural activities, manufacturing land-use along the watershed area and other anthropogenic activities were the major causes for the elevated concentrations of the metals in rivers.

Tajuddin and co-workers[9] studied that India has been considerably contaminated by heavy metals, physiochemical and biological pollutants. In addition, Biological pollution indicates anthropogenic sources caused by poor sewerage system whereas the heavy metals and physiochemical pollution indicate industrial sources. Ugwu and Wakawa[10] conducted field analysis on adverse effect of the monsoon as well as diverse anthropogenic activities on the bacterial population of water bodies which has led to decrease in bacterial calculations in the heavy rain period owing to flushing effect. Kumar[11] conducted analysis on High saturation levels of dissolved oxygen and low concentrations of phosphates nitrate, sodium and potassium in surface waters varies as a result of season of the year. Onyegeme et. al.[12] studied research on physico-chemical parameters that High value of biological oxygen demand (BOD) and Coli form count in dry season indicated deterioration of water quality which was due to the effluents which showed that for drinking purposes, the water is not of an ample quality in the absence of any purification; but for other leisure activities like swimming and industrial use, the river water was still of an adequate quality. Agbabiaka and Oyeyiola[13] carried out field analysis on Turbidity and BOD of surface water bodies were as a result of mining of dolomite and soil wearing away. Parameters such as the pH, total dissolved solids (TDS), dissolved oxygen (DO), BOD and chemical oxygen demand (COD), alkalinity, hardness, chloride, nitrate-nitrite were found to be abnormal due to large amount of oxygen demanding wastes entering into the river from domestic sources.

Iyama and Edori[14] undertook analysis of The quality of a given water body is governed by the physical, chemical and biological factors all of which interact with one another and greatly influence its productivity, bio monitoring in conjunction with physical and chemical observation of water quality is potentially useful in assessing water bodies. Rajiv, Hassan et. al., conducted field analysis of physico-chemical and microbial different river waters in Western Tamil Nadu, India and claimed that in order to mitigate the impact human societies have on natural waters, it is becoming increasingly important to implement comprehensive monitoring regimes. He further highlighted that monitoring water resources will quantify water quality, identify impairments and help policy makers make land use decisions that will not only preserve natural areas, but improve the quality of life.

Meligaand Salifu[15] carried out field research on assessment of the physico-chemical parameters that the pH, DO, BOD, chlorides, phosphates and nitrates has changeable levels of pollution from unpolluted to exceptionally-polluted levels depending on the pragmatic

seasons of the year which have a posturing danger to the fish health and biodiversity. Dimowo and co-workers[16] studied research on Water surface such as faucal coli form bacteria in the satisfactory limit set by the World Health Organization (WHO) for drinking water, metals such as lead and iron and physical characteristics such as turbidity and oil and grease, had been surpassed at all the sites they studied leading to extremely contaminated/poor condition for drinking or domestic use.

Cosmas and et. al.[17] conducted Research on comparative assessment of the physic-chemical parameters that industrial activity and its effluents have contaminated surface water with large amount of heavy metal, Ca, Chlorides and total hardness were in hight levels. Raja and venkatesan[18] carried out research on assessment on surface water pollution and its impact in and around Punnam area of Karur district, TamilNadu, India and reported that there was variation in the parameters like total hardness, total alkalinity, dissolved oxygen, conductivity, and pH of surface water bodies. They founded that dissolved oxygen was maximum during wintry weather which was deducted as a factor of cool atmospheric temperature. According to them, however, during the summer season, conductivity, total hardness and total alkalinity were found to be at upper limits. Additionally, they reported that most of the parameters were high in summer which might be as a result of hot temperature, high loss and small water level and lowest in wintry weather due to improved water level.

Table.1: Summary of Characteristics of some of the Studies on Pollution of Surface Water

Sr No	Topic	Method	Results	Recommendation	Conclusion
1.	Physico-chemical and Microbial Analysis of Different River Waters in Western Tamil Nadu, India.	Laboratory analysis and questionnaire	Turbidity and BOD showed elevated values compared to limits. Maximum values of magnesium and calcium may be credited to the mining of dolomite and soil wearing away.	This study would help to create and develop awareness among the people to maintain the quality of the river waters. Water quality monitoring and management should be in place in order to	Results obtained showed slight variations between water qualities of the rivers. The comparative analysis suggests the distinct nature of different river water and it depends on geographical location, time zone and geological foundation.
2.	Assessment of Some Physico-chemical Parameters of River Ogun	Laboratory analysis and questionnaire	The result showed that dissolved oxygen, hydrogen ion concentration, total hardness and nitrate were above the maximum permissible	To prevent mass extinction of aquatic organisms due to anoxic conditions, proper regulations should be implemented to reduce	Since most of the parameters measured were above the maximum permissible limits of the national and international standards, it can be concluded that the water is unfit for domestic uses,
3.	Assessment of Physico-chemical and Biological Parameters of Imaboro	Laboratory analysis and questionnaire	The mean observations for the various water quality parameters in the sampled months of June	People should besensitized on the danger of dumping refuse inside the river, molecular techniques be adopted for accurate identification	Most physico-chemical parameters of Imaboro river fall within permissible limits. However, the water showed evidence of pollution
4.	Analysis of the Water	Physical observation,	The mean observations for	The local authorities should make provisions	The relatively lower concentrations of heavy

	Quality of Imonite Creek in Ndoni, Rivers State, Nigeria	laboratory analysis	the various water quality parameters in the sampled months of June, September, November and January respectively are BOD, mg/l (0.27, 0.28, 0.33, 0.33), DO mg/l (3.8, 3.78, 2.72, 2.73), pH (7.43, 7.53)	for task forces to ensure strict compliance by the natives on water quality standard.	metals and TDS indicated that the Imonite Creek was not polluted by the organic and inorganic contaminants entering the water body around Ndoni in the Niger Delta of Nigeria.
5.	A Comparative Assessment of the Physico-chemical and Microbial Trends in Njaba River,Niger Delta Basin,	Laboratory analysis and questionnaire	Results of the analysesindicated that average pH, electrical conductivity and the Total Dissolved Solids (TDS) of the Njaba River in 2003 were 6.3, 22 µS/cm and 13.5 mg/l, respectively. Mean values in 2008 for the same parameters were	The pH can be corrected (raised) using sodium bicarbonate (soda ash) while the microbial assay can be improved upon by boiling and subjection to treatment using chlorine.	The physical and biochemical properties of the Njaba River water samples within the period (2003 to 2008) under investigation indicated an increase (at a slow rate) of contaminant loads. The trend indicated some environmental problems (low pH, poor microbial assay and
6.	Seasonal Variations in Physico-chemical and Bacteriological Parameters of Ulasi River, Okija, Anambra State.	Water sampling andnlaboratory analysis.	Results obtained for turbidity are 205 ± 0.70 (downstream), 25.70 ± 0.00 (upstream) for wet season and 138 ±0.60 (downstream).	A management plan to restrict the dumping of wastes into Ulasi River is needed. Educating the people was also recommended and strict enforcement of laws.	This study demonstrates the influence of rural land use and seasonal effect on water quality in Ulasi River. The data clearly shows that the downstream is more polluted than upstream.
7.	Microbial Assessments of Soil Sediments of Foma River, Ita-Nmo, Ilorin, Nigeria.	Water sampling and laboratory analysis.	pH values were generally in the optimal range of 6.14 - 7.97; Dissolved solids values expressed in mg/l were generally high throughout the months with a range of120 – 7800 mg/l and Temperature values expressed in 0C ranged–	The local authorities should make provisions for task forces to ensure strict compliance by the natives on water quality standard.	Pollution of surface wateroccurs when too much of an undesirable or harmful substance flows into a body of water, exceeding the natural ability of that water body to remove the undesirable material, dilute it to a harmless concentration, or convert it to a harmless form. This can be from point
8.	Physico-chemical quality assessment	Laboratory analysis and field observation	Results of sampling showed that temperature of the river ranged	Sensitization of people residing around the river and government Intervention aimed at	River quality assessment is essential to the sustenance of biodiversity, the

	of river Orashi in Eastern Niger Delta of Nigeria		from 26.77 - 28.07 and 26.37 - 27.13oC in dry and wet seasons respectively. The pH of the sampling stations in this study, was lower in dry season (6.21 - 6.52) and higher in wet season (6.98 -	cushioning anthropogenic activities around the river.	environment and public health. Our results showed that the river quality assessment of Orashi river indicated mild anthropogenic activities in terms of parameters assessed. However, if mitigation measures are not put in place,
9.	Assessment of surface water Pollution and its Impact in and around Punnam Area of Karur District,	Laboratory analysis and review of related literature	The pH values of all the sample shows in the range of pH 7.3 to 8.7, which indicates they were within the desirable limit except sample 6. The mild alkalinity may be due to the bicarbonates.The alkalinity of the samples 1, 2, 4 and 7are found to	It is suggested to exercise all the necessary precaution before the water is used for drinking and irrigation. Otherwise, it may lead to much adverse health effect.	The water quality parameter of the various areas around Punnam clearly indicates that the water samples are highly polluted. It is observed that the water taken from PasupathipalayamKulathur, Chathiram are alarmingly get polluted followed by Kuttakadai. These are as
10.	Comparative Assessment of Water Quality in the Major Rivers of Dhaka and West Java	Water sampling and laboratory analysis	The pH value was ranging from 7.1–8.4 for the sampling points in both countries. It can be seen that the ionic environment in rivers are identical and lies within the standard range recommended by the WHO. Conductivity is a measurement of the	The result of the study suggests there is urgent need for systematic monitoring along with remediation to reduce pollutant inputs and by developing functional sewage treatment plant.	It is concluded from the present study that the rivers in West Java, Indonesia and Dhaka, Bangladesh have been considerably contaminated by heavy metals, physiochemical and biological pollutants. The biological pollution indicates anthropogenic sources caused by poor sewerage system

METHODOLOGY

This research made use of a review of academic / journal articles, conference papers and textbooks. It was assembled twenty-five (25) materials for this research but was able to use fifteen (15) which environmental effects of surface water pollution. This enabled the researcher to make a synthesis of various researchers' views on environmental effects of surface water pollution.

SAMPLE COLLECTION- To collect water samples for a physico-chemical analysis, these steps are followed:

Equipment Preparation: Clean and rinse sample bottles with the water to be tested. Use containers made of glass or high-quality plastic to avoid contamination.

Sampling Site Selection: Choose locations representative of the water body, considering factors like depth, proximity to pollution sources, and water flow.

Sample Collection: Submerge the bottle just below the water surface to avoid collecting surface debris. Fill the container completely, leaving minimal headspace to reduce air exposure. Cap the bottle immediately to prevent evaporation or contamination.

Labeling: Label each sample with essential information like date, time, location, and any specific details about the sampling point.

Temperature Measurement: Record the water temperature at the time of collection using a calibrated thermometer.

pH Measurement: Measure the pH of the sample using a pH meter of pH paper, ensuring the instrument is properly calibrated.

Dissolved Oxygen (DO) Measurement: Collect a separate sample for DO analysis, filling the container to the brim to minimize air contact. Measure DO promptly using a dissolved oxygen meter.

Conductivity Measurement: Measure the electrical conductivity of the water using a calibrated conductivity meter.

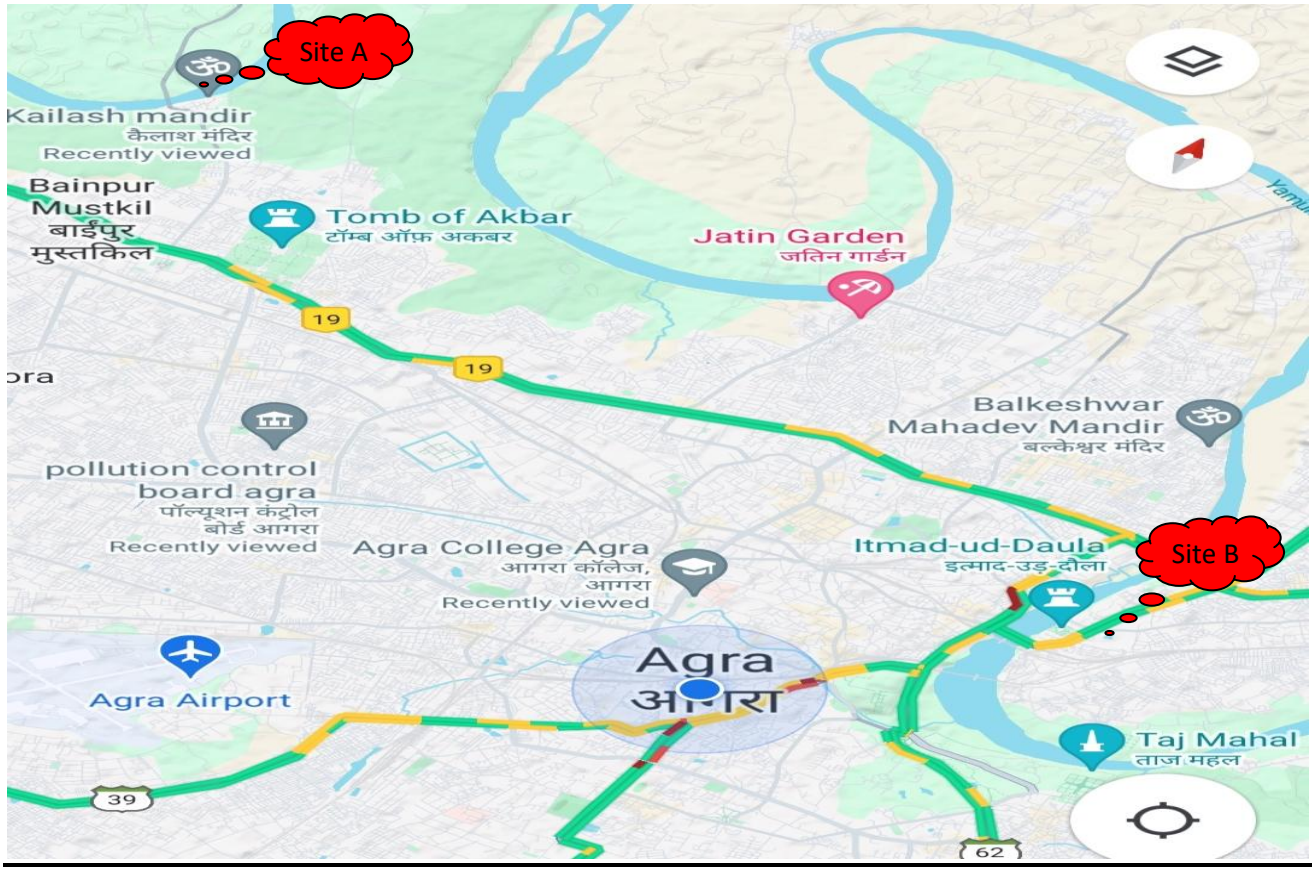
Total Dissolved Solids (TDS) Measurement: If required, filter a portion of the sample and measure TDS using a TDS meter.

Nutrient Analysis: Collect additional samples for nutrient analysis if needed for your study.

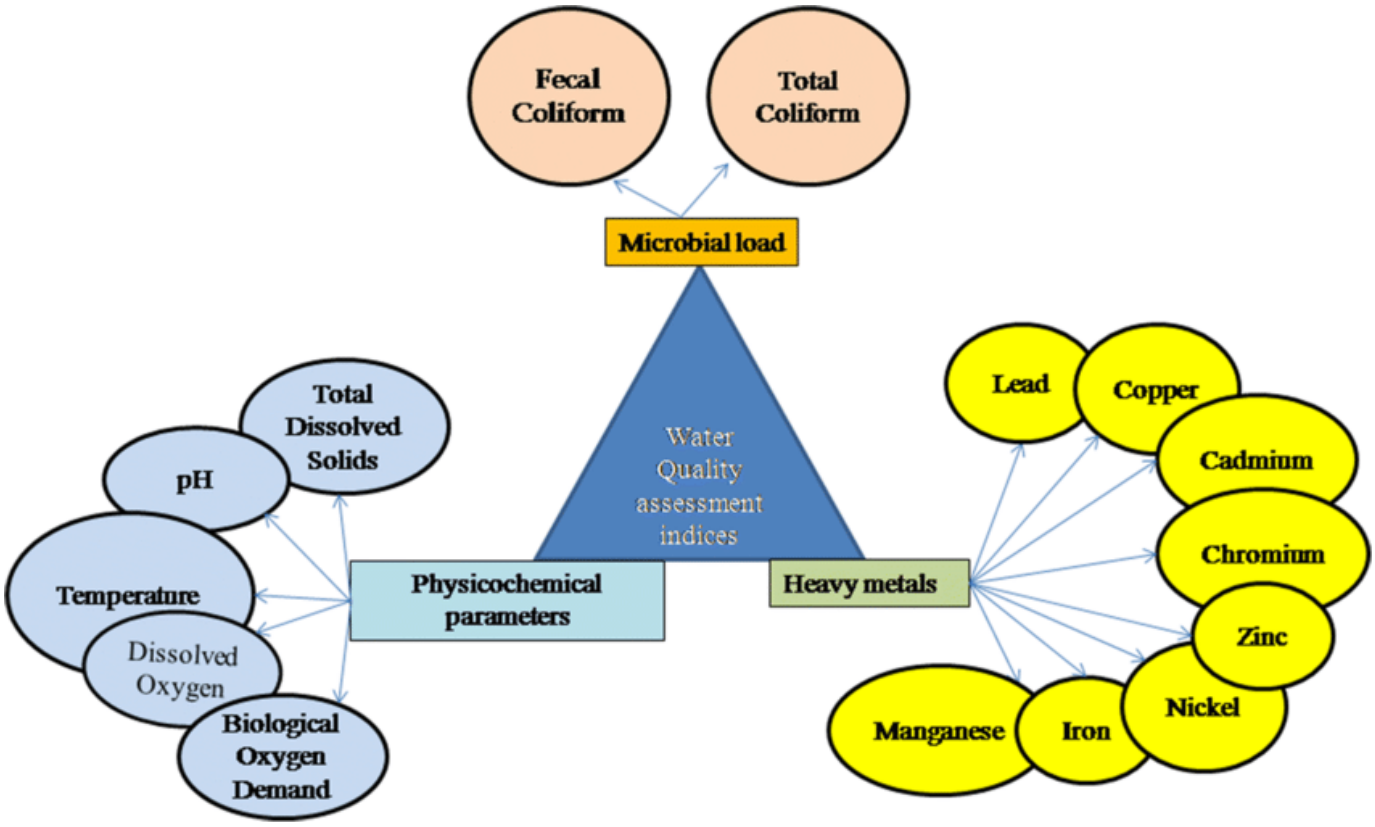
Transportation: Keeps samples cool and in the dark during transportation to the laboratory to prevent alternation in water quality.

Documentation: Maintain a detail record of the entire sampling process, from collection to transportation.

Sample Collection site as follows on Google Maps:-



PHYSICO-CHEMICAL PARAMETER - It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physico-chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and purity. Water does content different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance such as temperature, color, odour, pH, turbidity, TDS etc, while chemical tests should be perform for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters. For obtaining more and more quality and purity water, it should be tested for its trace metal, heavy metal contents and organic i.e. pesticide residue. It is obvious that drinking water should pass these entire tests and it should content required amount of mineral level. Only in the developed countries all these criteria's are strictly monitored. Due to very low concentration of heavy metal and organic pesticide impurities present in water it need highly sophisticated analytical instruments and well trained manpower.



Following different physico-chemical parameters are tested regularly for monitoring quality of water.

1. <u>Temperature -</u> In an established system the water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. Drastic temperature changes can be fatal to fish.

2.<u>pH-</u> Gupta et. al.[19] studied that pH is most important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity. The reduced rate of photosynthetic activity the assimilation of carbon dioxide and bicarbonates which are ultimately responsible for increase in pH, the low oxygen values coincided with high temperature during the summer month. Various factors bring about changes the pH of water. Karanth[20] conducted that the higher pH values observed suggests that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due to change in physico-chemical condition

<u>3.EC (Electrical Conductivity)-</u> Conductivity shows significant correlation with ten parameters such as temperature , pH value , alkalinity , total hardness , calcium , total solids, total dissolved solids , chemical oxygen demand , chloride and iron concentration of water. The underground drinking water quality of study area can be checked effectively by controlling conductivity of water and this may also be applied to water quality management of other study areas. It is measured with the help of EC meter which measures the resistance offered by the water between two Platonized electrodes. The

instrument is standardized with known values of conductance observed with standard KCl solution.

4.Carbon dioxide- Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism. Therefore, in aquatic biogeochemical studies, it is desirable to measure parameters that define the carbon dioxide system. CO_2 is also the most important green house gas on Earth. Its fluxes across the air-water or sediment-water interface are among the most important concerns in global change studies and are often a measure of the net ecosystem production/metabolism of the aquatic system. There are various readily measurable parameters of aquatic carbon dioxide system: such as pH (pCO_2), total dissolved inorganic carbon (DIC) and total alkalinity (TA). Surface water pCO_2 can be measured by photometric method and DIC CO_2 is measured by coulometer or by an infrared CO_2 analyzer. Total Alkalinity CO_2 is determined by HCl titration of the water sample to the CO_2 equivalence point.

5.Alkalinity- It is Composed primarily of carbonate $(CO_3O_2)^-$ and bicarbonate $(HCO_3)^-$, alkalinity acts as a stabilizer for pH. Alkalinity, pH and hardness affect the toxicity of many substances in the water. It is determined by simple dil. HCl titration in presence of phenolphthalein and methyl orange indicators. Alkalinity in boiler water essentially results from the presence of hydroxyl and carbonate ions. Hydroxyl alkalinity (causticity) in boiler water is necessary to protect the boiler against corrosion. Too high a causticity causes other operating problems, such as foaming. Excessively high causticity levels can result in a type of caustic attack of the boiler called "embrittlement".

6. Dissolved Oxygen- DO is one of the most important parameter. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc. In the progress of summer, dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity. The high DO in summer is due to increase in temperature and duration of bright sunlight has influence on the % of soluble gases (O_2 & CO_2). During summer the long days and intense sunlight seem to accelerate photosynthesis by phytoplankton, utilizing CO_2 and giving off oxygen. This possibly accounts for the greater qualities of O2 recorded during summer (Krishnamurthy R). DO in sample is measured titrimetrically by Winkler's method after 5 days incubation at 293 K. The difference in initial and final DO gives the amount of oxygen consumed by the bacteria during this period. This procedure needs special BOD bottles which seal the inside environment from atmospheric oxygen.

7.Carbonate- Whenever the pH touches 8.3, the presence of carbonates is indicated. It is measured by titration with standardized hydrochloric acid using phenolphthalein as indicator. Below pH 8.3, the carbonates are converted into equivalent amount of bicarbonates. The titration can also be done pH metrically or potentiometrically.

8. Bicarbonate- It is also measured by titration with standardized hydrochloric acid using methyl orange as indicator. Methyl orange turns yellow below pH 4.0. At this pH, the carbonic acid decomposes to give carbon dioxide and water.

9. Biochemical Oxygen Demand (BOD)- BOD is a measure of organic material contamination in water, specified in mg/L. BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic materials (e.g., iron, sulfites). Typically the test for BOD is conducted over a five-day period.

10. Chemical Oxygen Demand (COD)- COD is another measure of organic material contamination in water specified in mg/L. COD is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. Both BOD and COD are key indicators of the environmental health of a surface water supply. They are commonly used in waste water treatment but rarely in general water treatment.

11. Sulphate- It is measured by nephelometric method in which the concentration of turbidity is measured against the known concentration of synthetically prepared sulphate solution. Barium chloride is used for producing turbidity due to barium sulphate and a mixture of organic substance (Glycerol or Gum acetia) and sodium chloride is used to prevent the settling of turbidity.

12. Ammonia (Nitrogen)- It is measured spectroscopically at 425 nm radiation by making a colour complex with Nessler's reagent. The conditions of reaction are alkaline and cause severe interference from hardness in water.

13. Calcium- It is measured by complex metric titration with standard solution of ETDA using Patton's and Reeder's indicator under the pH conditions of more than 12.0. These conditions are achieved by adding a fixed volume of 4N Sodium Hydroxide. The volume of titer (EDTA solution) against the known volume of sample gives the concentration of calcium in the sample.

14. Magnesium- It is also measured by complex metric titration with standard solution of EDTA using Eriochrome black T as indicator under the buffer conditions of pH 10.0. The buffer solution is made from Ammonium Chloride and Ammonium Hydroxide. The solution resists the pH variations during titration.

15. Sodium- It is measured with the help of flame photometer. The instrument is standardized with the known concentration of sodium ion (1 to 100 mg/litre). The samples having higher concentration are suitably diluted with distilled water and the dilution factor is applied to the observed values.

16. Potassium- It is also measured with the help of flame photometer. The instrument is standardized with known concentration of potassium solution, in the range of 1 mg to 5 mg/litre. The sample having higher concentration is suitably diluted with distilled water and the dilution factor is applied to the observed values.

17. Chloride- Raviprakash, Rao et. al.[21] measured by titrating a known volume of sample with standardized silver nitrate solution using potassium chromate solution in water or eosin/fluorescein solution in alcohol as indicator. The latter indicator is an adsorption indicator while the former makes a red colored compound with silver as soon as the chlorides are precipitated from solution.

18. Silicates & Phosphate- These are also measured spectroscopically. Yellow colour is developed from the action of phosphates and silicates on molybdate ion under strong acidic conditions. The intensity of colour is directly proportional to the concentration of phosphate and silicates in the sample. Phosphate complexes are reduced by weak reducing agents such as ascorbic acid or tartaric acid (potassium antimonyl tartarate) where as silica complexes require strong reducing conditions of hydrazine or bisulphite. The colour of reduced complex is sky blue.

ANALYTIC INSTRUMENT- Highly impure water has various effects on human being, domestic purpose as well as industrial use. Such as human beings get affected/ infected due to presence of different bacteria and heavy metals present in water. It may affect the different body organ and physiological disorder. Hard water is not suitable for domestic use such as washing, bathing, cooking as well as other purpose. Hard water is also not suitable for industrial and agricultural use. It damages the delicate machineries and affects the quality, stability and glossiness of the final product.

Central water commission is maintaining a three tier Laboratory system for analysis of the parameters.

The Level-I Laboratories are located at 258 field water quality monitoring stations on various rivers of India where physical parameters such as temperature, colour, odour, specific conductivity, total dissolved solids, pH and Dissolved Oxygen of river water are observed .

There are 24 Level-II Laboratories located at selected Division Offices to analyze 25 different physico-chemical characteristics and bacteriological parameters of river water.

Table 1: Different analytical water quality parameters with their analytical technique and guideline values as per who and Indian standard

Sr No	Parameters	Technique Used	WHO Standard	Indian Standard	EPA Guidelines
1.	Temperature	Thermometer	-	-	-
2.	Color	Visual/ Color Kit	-	5 Hazen units	-
3.	Odour	Physiological sense	Acceptable	Acceptable	-
4.	Electrical Conductivity	Conductivity meter / Water analysis kit	-	-	2500 us/cm
5.	pH	pH meter	6.5-9.5	6.5-9.5	6.5-9.5
6.	Dissolved Oxygen	Redox titration	-	-	-
7.	Total	Complexometric	200 ppm	300 ppm	<200 ppm

	Hardness	titration			
8.	Alkalinity	Acid-Base titration	-	200 ppm	-
9.	Acidity	Acid-Base titration	-	-	-
10.	Ammonia	UV Visible Spectrophotometer	0.3 ppm	0.5 ppm	0.5 ppm
11.	Bi carbonate	Titration	-	-	-
12.	Biochemical Oxygen Demand (BOD)	Incubation followed by titration	6	30	5
13.	Carbonate	Titration	-	-	-
14.	Chemical Oxygen Deman (COD)	C.O.D digester	10	-	40
15.	Chloride	Argentometric titration	250 ppm	250 ppm	250 ppm
16.	Magnesium	Complexometric titration	150 ppm	30 ppm	-
17.	Nitrate	UV Visible Spectrophotometer	45 ppm	45 ppm	50 mg/I
18.	Nitrite	UV Visible Spectrophotometer	3 ppm	45 ppm	0.5 mg/I
19.	Potassium	Flame Photometer	-	-	-
20.	Sodium	Flame Photometer	200 ppm	180 ppm	200 ppm
21.	Sulphate	Nephelometer / Turbidimeter	250 ppm	200 ppm	250 ppm

Ref.:- [WHO, USEPA, Indian Standard, National Primary Drinking Water Regulations, Drinking Water Contaminants US EPA]

Table 2: Different analytical water quality parameters used for testing of quality of water and their sourse of occurance and potential health effects with USEPA guidelines.

Sr No	Parameter	Source of Occurrence	Potential Health effect
1.	Turbidity	Soil runoff	Higher level of turbidity are associated with disease causing bacteria's
2.	Color	Due to presence of dissolved salts	-
3.	Odor	Due to biological degradation	Bad odor unpleasant
4.	Electrical conductivity	Due to different dissolved solids.	Conductivity due to ionizable ions. High conductivity increases corrosive nature of water.
5.	pH	pH is changed due to different dissolved gases and solids.	Ffects mucous membrane; bitter taste; corrosion

6.	Dissolved oxygen	Presence due to dissolved oxygen	D.O corrode water lines, boilers and heat exchangers, at low level marine animals cannot survive.
7.	Total Hardness	Presence of calcium (Ca^{2+}) and magnesium (Mg^{2+})ions in a water supply. It is expressed Hardness minerals exist to some degree in every water supply.	Poor lathering with soap; deterioration of the quality of clothes; scale forming
8.	Total Alkalinity	Due to dissolved gases (CO_2)	Embrittlement of boiler steel, Boiled rice turns yellowish
9.	TDS	Presence all dissolved salts	Undesirable taste; gastro-intestinal irritation, corrosion or incrustation.
10.	Calcium	Precipitate soaps; anionic	Interference in dyeing, textile.
11.	Magnesium	Surfactants, anionic emulsifiers,	Paper industry etc.
12.	Ammonia	Due to dissolved gases and degradation of organics	Corrosion of Cu and Zn alloys by formation of complex ions.
13.	Barium	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	Increase in blood pressure.
14.	Biochemical Oxygen Demand (B.O.D)	Organic material contamination in water	High BOD decreases level of dissolved oxygen.
15.	Carbonate	Due to dissolution of CO_2	Product imbalance Unsatisfactory production short product life
16.	Chloride	Water additive used to control microbes, disinfect.	Eye/Nose irritation; stomach discomfort. Increase corrosive character of water.
17.	Nitrate	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits	Effect on Infants below the age of six months symptoms include shortness of breath and blue-baby syndrome.
18.	Phosphate	-	Stimulate microbial growth Rancidity Mold growth
19.	Sodium	Natural component of water	-
20.	Sulphate	Due to dissolved Ca/Mg/Fe sulphates	Taste affected; gastro-instenstinal irritation, Calcium sulphate scale.

ROLE OF CHEMISTRY IN WATER POLLUTION ANALYSIS

Water quality analysis involves assessing various physico-chemical parameters to ensure the safety and suitability of water for different purposes. Chemistry plays a crucial role in this process by providing methods to measure and interpret these parameters.

1. **pH Level**: Chemistry helps determine the acidity or alkalinity of water using the pH scale. It influences chemical reactions and the solubility of minerals, impacting water quality for aquatic life and human consumption.

2. **Dissolved Oxygen (DO)**: Chemistry is essential for measuring DO, crucial for aquatic organisms. Low DO levels can indicate pollution and other factor affecting oxygen solubility.

3. **Conductivity**: Chemistry aids in understanding the ability of water to conduct electricity, linked to dissolved ion concentration. Conductivity provides insights into salinity and pollution levels.

4. **Turbidity**: Chemistry contributes to methods for measuring suspended particles in water. Turbidity affects light penetration influencing aquatic ecosystems and water treatment processes.

5. **Total Dissolved Solids (TDS)**: Chemistry is fundamental in determining the concentration of dissolved ions in water. High TDS level may affect taste, safety, and suitability for various uses.

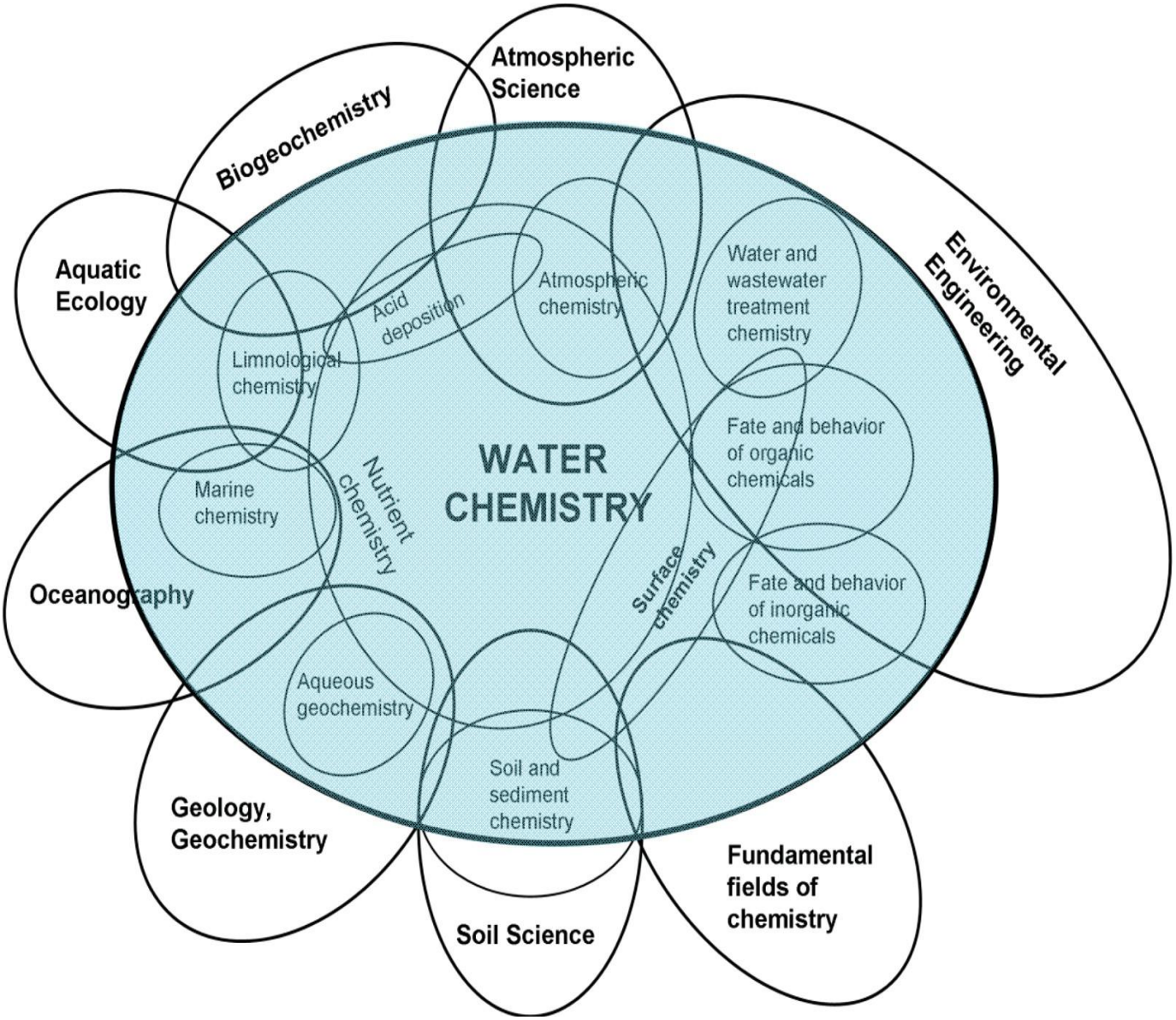
6. **Nutrient Levels (Nitrogen, Phosphorus):** Chemistry helps analyze nutrient content, influencing water fertility. Elevated nutrient levels can lead to eutrophication , impacting ecosystems.
7. **Heavy Metals:** Chemistry plays a key role in detecting and quantifying heavy metal concentrations. Heavy metals pose health risk and can accumulate in aquatic environments.

8. **Chlorine Residual:** Chemistry is involved in measuring chlorine levels use for disinfection. Monitoring residual chlorine ensures water safety for consumption.

9. **Bacterial Contamination:** Chemistry contributes to methods for detecting indicators microbial contamination. Presence of bacterial can indicate potential health hazards.

10. **Organic Matter:** Chemistry helps assess levels of organic compounds in water . High organic matter may impact taste, odor, and promote microbial growth.

In summary, chemistry provides the analytical tools and methodologies to evaluate physico-chemical parameters, ensuring comprehensive water quality analysis for environmental and human health consideration.


Biogeochemistry
Atmospheric Science
Aquatic Ecology
Environmental Engineering
Oceanography
Geology, Geochemistry
Soil Science
Fundamental fields of chemistry
WATER CHEMISTRY
Limnological chemistry
Acid deposition
Atmospheric chemistry
Water and wastewater treatment chemistry
Fate and behavior of organic chemicals
Marine chemistry
Nutrient chemistry
Surface chemistry
Fate and behavior of inorganic chemicals
Aqueous geochemistry
Soil and sediment chemistry

DATA ANALYSIS

Primary water quality criteria for designated best use classes as per Uttar Pradesh pollution control board as follows:-

Classification	Category	Tolerance Limit
Drinking Water Source without conventional treatment but after disinfections	A	1. Total Coliform Organism MPN/100 ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical oxygen demand 5 days 20^{0}C 2mg/l or less
Outdoor Bathing (Organized)	B	1. Total Coliform Organism MPN/100 ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5mg/l or more 4. Biochemical oxygen demand 5 days 20^{0}C 3mg/l or less
Drinking Water Source after conventional treatment and disinfections	C	1. Total Coliform Organism MPN/100 ml shall be 5000 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 4mg/l or more 4. Biochemical oxygen demand 5 days 20^{0}C 3mg/l or less
Progagation of Wild Life and Fisheries	D	1. pH between 6.5 and 8.5 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
Irrigation Industrial Cooling, Controlled waste disposal	E	1. pH between 6.0 and 8.5 2. Electrical Conductivity at 25^{0}C micro mhos/cm Max.2250 3. Sodium absorption ration Max.26 4. Boron Max. 2mg/l

All the samples were analyzed in the regional laboratory of Uttar Pradesh Pollution Control Board, Agra. All the water quality parameters were analyzed according to the Indian standard[22] . The monitoring was made over a period of 3 months for two different site given below. A comparison of analyzed physic-chemical parameters of river Yamuna as observed with drinking quality standard as follows

SITE A (KAILASH GHAT)

Physico-chemical Parameters	Sep 23	Oct 23	Nov 23
DO (mg/L)	7.6	7.5	7.2
B.O.D (mg/L)	6.8	7.2	7.6
Total Coliform (MPN / 100 ml)	7800	11000	7800
Fecal Coliform (MPN / 100 ml)	4500	4000	4500
Category	D	D	D

SITE B (TAJMAHAL)

Physico-chemical Parameters	Sep 23	Oct 23	Nov 23
DO (mg/L)	7.0	6.9	6.8
B.O.D (mg/L)	8.8	8.4	8.4
Total Coliform (MPN / 100 ml)	11000	14000	11000
Fecal Coliform (MPN / 100 ml)	6800	6800	6800
Category	D	D	D

RESULT AND DISCUSSION

The Yamuna River is one of the worst polluted rivers in North India. A large number of population and industrial units are situated near the bank of the river. A domestic and industrial effluent contaminates the river water to a greater extent. According to the Uttar Pradesh Pollution Control Board, the main reason behind this is the major drains of the city emptying their filthy content into the Yamuna River. Although the government is spending about 48 Crores per year on sewer networks and treatment plants, yet the untreated & unchecked industrial and sewage waste continues to flow in the Yamuna and pollute the water. Presently the river water is not only potable rather it is also unfit for irrigation and bathing.

Several Physico-chemical parameters were analyzed by standard methods and a comparison has been made according to BIS[23]. The temperature ranges vary between 17°C to 23°C in the study period. The pH of river water varies from 6.9 to 8.1 which are in permissible limit. The dissolved oxygen value varies from 6.8 mg/L to 7.6 mg/L. The TDS value varies between 740 to 1391 mg/L. The high value of TDS indicates the presence of organic matter in the Yamuna water. The salinity value varies from 0.28 to 0.38 ppt. The total hardness values ranged between 285 mg/L to 480 mg/L, which indicates the presence of Calcium and Magnesium salt in the water samples. The Chloride value varies from 251 mg/L to 390 mg/L, which is above the permissible limit. It indicates the presence of excess salt in water. The BOD value varies between 6.8mg/L to 8.8 mg/L, which is not within the permissible limit. It indicates the presence of organic matter in the sample river water. The COD value ranged between 49 mg/L to 97 mg/L, which is beyond the permissible limit and indicating oxidation of water borne organic and inorganic matter present in the Yamuna River water sample.

It is clear that except dissolved oxygen all parameters such as temperature, turbidity, conductivity, calcium, chloride, nitrate, sulphate, phosphate, suspended solids, BOD, COD, Coli form and faucal coli form bacteria increases gradually from upstream site A to downstream sites B sites of Yamuna river. The result clearly indicates that these changes in the level of such parameters were due to urbanization and small scale iron foundries, leather and silver plating industries are responsible for pollution in the Yamuna River, which is going to increase regularly due to direct throwing of wastes in the Yamuna.

As the level of pollution increases, the number of fecal coli form per 100 ml will also increase rapidly. This will be an alarming situation as various contaminant diseases may be caused due to these microbes. Authors also found that polluted materials are continuously

mixing in the Yamuna River by various small and large industries situated on the bank of Yamuna River in Agra. All these parameters are alarming for people of Agra because pollution level has increased from upstream to downstream site. The fecal coli form and coli form are increasing rapidly which are responsible for various contaminants diseases for human beings as well as cattle, related with this water.

It is clear that industrialization urbanization, population explosions are causes to deteriorate the various sources of water. The industrial effluent, sewage and polluted water from other sources are continuously discharging into the Yamuna River.

The study aims to examine the alteration in the quality of water of the Yamuna River at Agra in the year 2023.Water. The conventional method by which inspection can be done for the water quality has 12 physico-chemical parameters (TDS, Chlorides, Alkalinity, DO, Temperature, COD, BOD, pH, Magnesium, Hardness, Total Coli form, and Calcium). These parameters will be measured carefully, and their respective value will be found. So, the standard value and observed value will be compared with each other, and the variation is going to be measured between them. By this variation, identification of the quality of water can be done.

IMPLICATION- Water is a key component of the environment which its quality must be maintained and free from pollution. From Table 1, all the topics reviewed are relevant to environmental effects of surface water pollution. The use of standard method including questionnaire, review of related literature, sampling and laboratory analysis for obtaining data and information from the field. Previous studies by authors showed that surface water pollution arises from anthropogenic activities by transporting sediments from different land uses into nearby surface water bodies. Various authors were of convergent view that surface water parameters such as pH, BOD, COD, TDS and turbidity varies with season of the year (i.e.) dry and rainy season. BOD and COD of surface water has reduce because of the quantum on organic and inorganic wastes deposited inside rivers. Authors such as sensitizing people on the dangers of dumping refuse inside the river should be adopted for to reduce the level of pollution and contamination in surface water bodies while other task forces should be employed to ensure strict compliance by the natives to maintain water quality standard.

Generally, it is of common knowledge that regions with high human population and high rate of urbanization tends to suffer more of surface water pollution because individuals and industries has a mindset that surface water bodies are dumpsite for disposing off their waste. This is because, in global context, many people see water body as industrial dustbin since they channel out their industrial effluents in them for easier waste discharge which is of great environmental cost.

Water quality analysis using various physico-chemical parameters provides crucial information about the condition of water. Here are some implications:

1. **Health Impact:** High levels of contaminants like heavy metals or pathogens can pose risks to human health if present in drinking water, leading to waterborne diseases.

2. **Ecosystem Health:** Water quality affects aquatic ecosystems. Unfavorable conditions may harm aquatic life, disrupt food chains, and impact biodiversity.

3. **Drinking Water Treatment:** Understanding water parameters helps in designing effective treatment processes, ensuring safe and clean drinking water for communities.

4. **Agricultural Use:** Water quality influences irrigation suitability. High salinity or toxic elements can affect crop growth and soil quality.

5. **Industrial Processes:** Industries often require specific water quality for processes. Inaccurate water analysis can impact industrial operations and product quality.

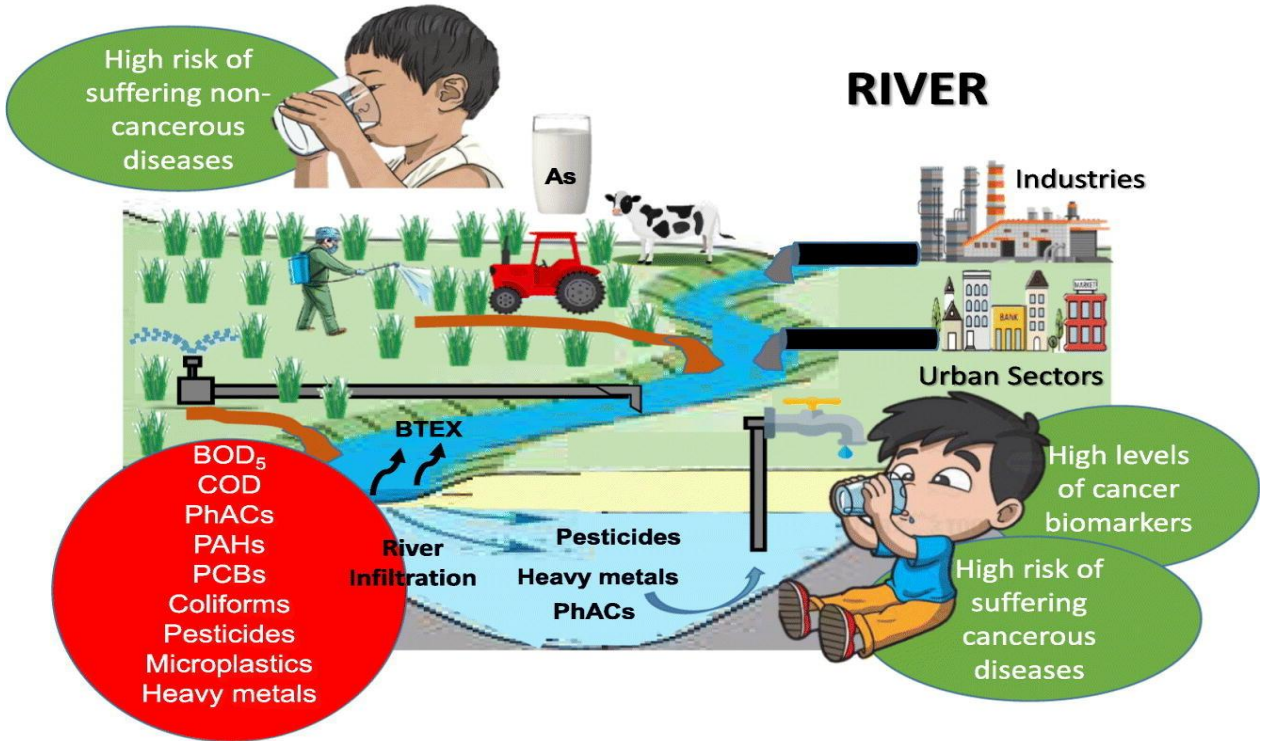
6. **Environment Monitoring:** Monitoring changes in water quality over time helps identify pollution sources, enabling better environmental management and policy decisions.
7. **Regulatory Compliance:** Governments use water quality data to set standards and regulations, ensuring compliance by industries and safeguarding public health and the environment.

8. **Groundwater Protection:** Monitoring physico-chemical parameters in groundwater helps prevent contamination, preserving this vital water source.

9. **Aquaculture:** Water quality is critical for aquaculture. Fish and shellfish health depends on parameters like dissolved oxygen, pH and nutrient levels.

10. **Climate Change Impact:** Water quality analysis contributes to understanding the impact of climate change on aquatic systems, aiding in adaptation and mitigation strategies.

In summary, comprehensive water quality analysis plays a pivotal role in safeguarding human health, protecting ecosystems, supporting various industries, and maintaining overall environmental sustainability.



CHALLENGES AND LIMITATIONS

- The study was limited to Agra city.
- This research relied on voluntarily disclosed information and the level of access granted. Useful information which could have enhanced the outcomes might have been withheld.
- The data was interpreted by one person leaving out room for other possible interpretations.
- All the utilities studied here are government owned

Studying water quality analysis through various physico-chemical parameters poses challenges such as:

1. **Data Variability:** Water quality can vary spatially and temporally, making it challenging to capture representative samples and ensure accurate analysis.

2. **Complex Interactions:** The interplay of different physico-chemical parameters is intricate, and understanding their combined effects on water quality requires a comprehensive approach.

3. **Instrumentation Accuracy:** The precision of measuring instruments can influence data reliability, and maintaining and calibrating equipment is crucial for accurate results.

4. **Sample Contamination:** Contamination during sample collection, handling, or analysis can lead to inaccurate results, emphasizing the need for strict protocols and quality control measures.

5. **Resource Intensity:** Comprehensive water quality analysis demands resources, both in terms of time and finances, which may pose constraints, particularly in resource-limited settings.

6. **Changing Environmental Conditions:** Natural variations in environmental conditions, such as weather patterns or seasonal changes, can impact water quality parameters, adding complexity to the analysis.

7. **Standardization Issues:** Lack of standardized methodologies across different laboratories or regions can hinder the comparability of results, emphasizing the importance of adhering to established protocols.

8. **Emerging Contaminants:** Rapid urbanization and industrialization introduce new contaminants that may not have well established testing methods, necessitating ongoing research and adaptation of methodologies.

Overcoming these challenges requires rigorous study design, adherence to quality assurance practices, continuous monitoring, and collaboration between researchers and regulatory bodies to improve methodologies and address emerging issues in water quality analysis.

From the reviewed literatures and based on the results the following points are to be be considered not only to enhance the water quality and the environment, but also to protect the health of the people who depend on these surface water bodies for their living:

1. Management plan to restrict the dumping of wastes into surface water bodies is needed in order to reduce the impact on water quality and pollution related health problems. This can be achieved through effective waste management strategy and provision of reliable public water supply.

2. Regular monitoring exercises should be carried out by enforcement agencies and the locals on the activities along the river bank in order to ensure those effluents standards and other sanitary conditions are complied with.

3. Regulators of environmental and public health standards should put in place functional measures to enforce the already established standards not just only by punishing offenders, but also by rewarding/acknowledging compliance.

4. Regular review of environmental effects of surface water pollution should be conducted by researchers to indicate the trend in pollutional loads of rivers, stream and lakes across the globe.

Suggestions to improve the quality of Yamuna water are as follows:-

● Industrial Wastewater must be properly treated before discharging into the river, as per guidelines prescribed by CPCB.

● Arrangements of fencing along the bank of the river to prevent direct disposal of domestic waste and other polluting materials.

● Launching awareness programs from time to time among the people residing near the bank of the river to take part in pollution prevention activities and minimize the pollution.

● Encouragement of plantation activity along the bank of the Yamuna River which prevents the agricultural run-off into the river containing pesticides and fertilizers residues.

CONCLUSION

Present study was conducted to observe the water quality of the Yamuna River in Agra during the monsoon season from September to November. This study reveals that a large number of water samples, collected from different Sampling points, goes beyond the highest level of water quality index and are severely polluted due to which it can't be used for drinking purpose. Except for pH, all water quality parameters like BOD, COD, TDS, Cl, and Hardness do not lie within the standard permissible limits prescribed by BIS. The Dissolved oxygen lies within the limit in some sites during the winter season. Evaluation of the water quality of the Yamuna River indicates that the water quality is worst; it is not useful for drinking and bathing.

In light of the above study we come to the conclusion that the level of water pollution have reached to the alarming stage. The quality of water in most part of the world has degraded, though the situation in India is more severe. Indian philosophers believe that "thought of a person depends on the type of food and water to which he is fed". The above contention is well scientific, because as we ingest contaminated food and water the normal physiology is disturbed. Our body consists of about more than 10000 hormones and enzymes which are very specific in their requirement and kinetics. If any undesired material enters into our body it affects the mechanism of the hormone or enzyme activity in question.

We are unaware of the fact that we are consuming considerable amount of DDT, BHC, Aldrin and many other pesticides in addition to a variety of heavy metals along with

our diet. The entry of these xenobiotics should be avoided. We must not use pre-seasonal fruits and vegetables as they require large amount of chemical fertilizers and pesticides to develop in the adverse situations.

We have conquered the nature to pollute it but still we have failed to understand the nature policy even less than 10%. Daily thousands of casualties are reported, most of them are told to be due to heart attack. It is a big question before the cardiologists that are only heart, the most sensitive organ in our body? Because accumulation of the xenobiotic compounds has been reported in different specific target organs which are important cause of deaths now-a-days but its actual cycle is unexplored. No compound in nature is medicine or poison, it is only those to which the subject is exposed. Thus, it becomes our responsibility to check the accumulation of higher dose of any compound in the ecosystem.

It is demand of the time to move towards sustainable development. We should think of even those generations which have still to appear on this earth. We must notice that ours is not the last generation to flourish on this earth, remember, they will be our sons or grand-sons.

The findings of this article reviewed that in India there is lack of clean drinking water and sanitation. The water quality problems and incidence of various water-related diseases had economic impact on weaker households in the society in India. In fact it can be said that weaker sections of the society is most vulnerable to the impact of water pollution and the diseases caused by it. The water-related diseases, which mainly affected children, were diarrhea, malaria, cholera, skin infections, etc.The number of days spent in illness, led to a loss of school days among children and loss of workdays and the consequent loss of income among adults. It put a big economic burden on the households due to the cost for treatment. These people spend the maximum share of their earning on the diseases. The low-income households spend a relatively higher proportion of their income to cope with water-related diseases, which further compounded their economic stress. This article unravel that the waste water treatment plants in India are either not adequate or they do not function well. Efforts are being made but not coping with the growing problem. Various measures taken to improve the agricultural yield and rapid industrialization is also graving the situation in India. Rapid development measures taken by the government is leading to the increasing water diseases. The unplanned household practices like use of excessive water in the household chores and careless drainage further engraves the situation and affects the sustainability of the water.

The article suggests that a number of central and state government institutions and departments are functioning to monitor the quality of water. However, these efforts and investments in water supply and sanitation sector and measures taken by various pollution control boards still have not helped to improve health outcomes. The article suggests that there is a dire need to focus on the sustainability of water resources in the near future and also on the quality of water, as poor water quality can further affect the already dwindling water resources. An effective water policy is the need of the hour.

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