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Comprehensive Assessment of Physico-Chemical and Biological Parameters in Water Quality Monitoring: A Review of Contaminants, Indicators, and Health Impacts

Shubham Verma, Sneha Verma*, Ramakant, Vaibhav Pandey, Adarsh Verma

Department of Science, Maharishi School of Science and Humanities, Maharishi University of Information Technology, Lucknow, U.P., India[1]
*Corresponding author email: drsnehaverma@yahoo.com

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Abstract— *The degradation of water quality due to anthropogenic activities and natural processes poses a significant threat to public health and ecological integrity. This review highlights the biological, chemical, and physical parameters used in water quality monitoring and emphasizes their relevance in identifying pollution sources and associated health risks. We synthesized recent literature examining the roles of key parameters such as pH, BOD, COD, DO, TDS, heavy metals, and microbial indicators (e.g., E. coli, total coliforms). Findings underscore the elevated presence of heavy metals, nutrients, and pathogenic microorganisms in many freshwater systems, especially in densely populated or industrial regions. Agricultural runoff, industrial effluents, and poor waste management practices are primary contributors to contamination. Systematic monitoring of physico-chemical and biological parameters is critical for ensuring safe water use. Implementing comprehensive water testing protocols and enforcing environmental regulations are imperative for sustainable water resource management.*

Keywords— ***Water quality; Physico-chemical parameters; Microbial contamination; Heavy metals; BOD; MPN; Groundwater pollution***

I. INTRODUCTION

One of the most important natural resources that meets human needs is water.To protect and use every drop of water, we must take action.Surface and subsurface water bodies can be used to evaluate water resources.Impact of Climate Change on Ground Water: Compared to surface waterways, the effects of climate change on ground water have received far less research attention. In reaction to rising mean temperatures, precipitation, variability, and sea level, as well as changes in ground water recharge, ground water responds to climate change primarily through changes in river levels. Depletion of ground water resources and mining of ground water resources, as well as deterioration of water quality, are caused by changes in land use patterns brought on by growing urbanization, industry, and agricultural activities.As a result of severe deforestation, global warming, and other factors, rainfall is becoming less consistent and unpredictable every year.Ecosystem and biodiversity change has an impact on human health. Drinking water quality, freshwater availability, and public health will all be impacted by climate change. Water makes up around 70% of the Earth's surface, with 97.5% of it being salty and 2.5% being fresh. Of this 2.5%, less than 1% is accessible [1].

Approximately 97% of the earth's water is salty contained in lakes or seas; only 3% is fresh water. However, 68 per cent of Earth's fresh water is enclosed in the Antarctic and Greenland ice caps (30%) while just 0.3 per cent is enclosed in surface waters, including lakes, rivers, reservoirs, springs and streams. Quality of the water can be defined by its physical, chemical, biological and esthetic characteristics (appearance and smell) as well as by its fitness for the beneficial uses it has in the past provided for human and animal drinking, for the promotion of a healthy aquatic life, for irrigation of the land and for recreation. A safe water ecosystem is when it meets the standard in term of water maintains a rich, diverse population of species and is conducive for the consumption of public health. A safe water environment is when it fulfills the requirement in term of water preserves a rich, diversified population of species and is favorable for the consumption of public health [2].

The availability of high-quality water is necessary for enhancing living quality and reducing illness. Different kinds of impurities are present in natural water and are brought into aquatic systems by a variety of actions of humans, such as mining, processing, and using of metal-based materials, as well as by rock weathering and soils and the breakdown of atmospheric aerosol particles. Due to water runoff, the government's higher usage of metal-based fertilizers in agricultural revolution may cause concentrations of metal pollutants in fresh water reservoirs to continue rising. Additionally, drinking water pollution has been linked to water-borne diseases that have killed millions of people. Millions of people have died due to water-borne illnesses brought on by genuine drinking water pollution. Increases in biological and chemical oxygen demands, as well as total dissolved solids and total suspended solids, are caused by high levels of contaminants, primarily organic matter, in water. Water becomes unfit for drinking, irrigation, or any other objective as a result. Groundwater quality is established by a number of chemical components and their concentrations, which are primarily determined by the local geology.

Municipal solid waste and industrial waste have become two of the main sources of ground and surface's water contamination. Cholera, dysentery, salmonellosis, and typhoid are among the illnesses that are brought on by a lack of clean drinking water and proper sanitation practices. Leachates from waste dumps, partially treated or untreated wastewater, pollution from human settlements without proper sanitary infrastructure, and pollution from land use activities like agriculture are the key sources of ground water pollution in less industrialized areas [3].

The excessive and inappropriate use of water, animal feeds, agrochemicals, and drugs meant to increase productivity creates higher pollution burdens in the environment, encompassing rivers, lakes, aquifers, and water ways. Agricultural pollution also affects aquatic ecosystems; for instance, fisheries and biodiversity are impacted by eutrophication, which is brought on by the buildup of nutrients in lakes and rivers along the coast. The growing demand for food has led to the expansion and intensification of agricultural systems. Large amounts of organic matter, agrochemicals, sediments, drug residues, and salty drainage are released into water bodies by farms. There is evidence that the resulting water contamination endangers human health, aquatic ecosystems, and productive endeavors. Agricultural waste that is discharged into aquatic environments has a number of detrimental effects on fish and other aquatic life. It also concentrates toxins from contaminated water and travels further up the food chain.

In many nations, fungicides, insecticides, and herbicides are heavily used in agriculture.

They can contaminate water supplies with carcinogens and other harmful compounds that can harm people if they are not chosen and managed properly [4].

Water for human consumption must be safe, healthy, easily accessible, sufficient in quantity, and free of contaminants. Access to water is a crucial human right, but it has also been linked to a variety of ailments. Water quality is based on physical, chemical, and bacteriological qualities. Microbiological testing of river waters is required for use purposes such drinking water production, irrigation, and recreational activities. Water quality is a global concern, particularly in relation to the spread of water-borne diseases. Pollution and contamination of ground and surface waters have negatively impacted ecosystem equilibrium. Water quality encompasses interconnected characteristics such as pH, oxygen content, and temperature that impact aquatic biota [5].

II. TYPES OF WASTE WATER

As seen in Figure 1, the components of wastewater can be divided into many broad groups. The range of their contributions is considerable.

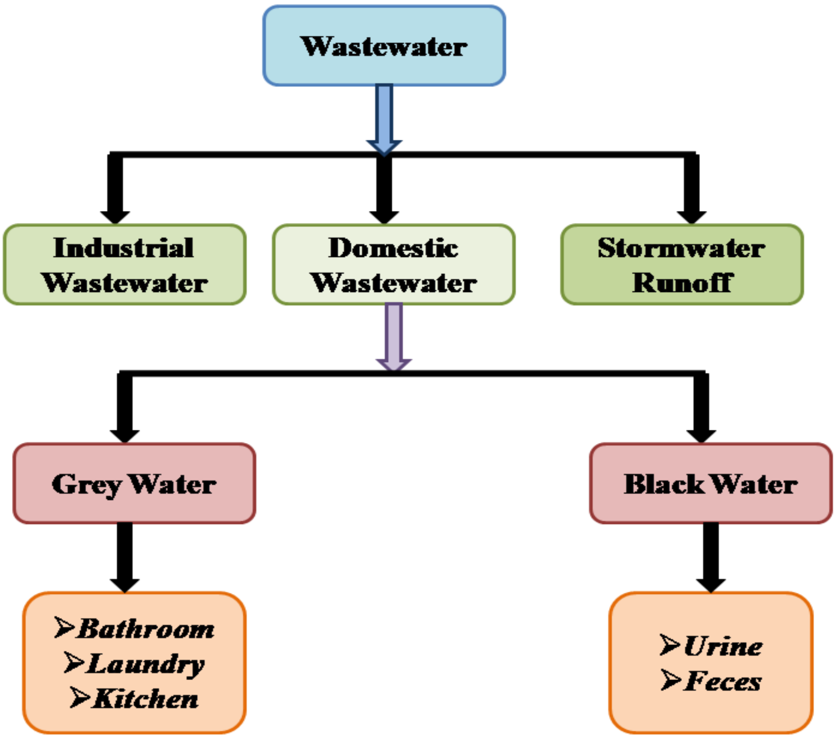

Fig.1: Classification of Wastewater

III. WASTEWATER CONTAMINANTS

Water pollutants can be broadly categorized based on their origin and environmental impact. The major classes include:

1. Environmental contaminants,
2. Pathogenic microorganisms,
3. Agricultural runoff and nutrient loading,
4. Sediments and suspended solids,
5. Inorganic pollutants (metals and salts),
6. Thermal pollution, and
7. Radioactive substances.

3.1 Environmental Contaminants

Oxygen-Demanding Wastes

Wastewater from domestic, industrial, and municipal sources—such as food processing plants, tanneries, and distilleries—contains significant quantities of biodegradable organic matter. Microbial decomposition of these substances results in the depletion of dissolved oxygen (DO). A DO concentration below 4.0 mg/L is considered critical for aquatic organisms and is a widely used indicator of water pollution severity [6].

Synthetic Organic Compounds

These anthropogenic pollutants are introduced into aquatic environments through industrial discharge, chemical spills, agricultural runoff, and improper waste disposal. They include pesticides, pharmaceuticals, food additives, detergents, solvents, plastics, and volatile organic compounds (VOCs). Many of these compounds are resistant to microbial degradation and persist in the environment. Even trace concentrations can render water unsuitable for consumption. Detergents contribute to surface foaming, while certain VOCs can create hazardous conditions such as sewer explosions. Polychlorinated biphenyls (PCBs), notable for their environmental persistence and lipophilicity, bioaccumulate in the tissues of aquatic organisms and pose long-term ecological and human health risks [7].

Petroleum-Based Pollutants (Oil)

Crude oil and refined petroleum products enter aquatic systems through accidental spills, leaking pipelines, and discharge of industrial effluents. Being less dense than water, oil spreads across the surface, impairing gas exchange and reducing light penetration, which negatively affects photosynthesis. Oil pollution also coats aquatic flora and fauna—particularly waterbirds—disrupting their thermoregulation and reproductive behaviors. Furthermore, petroleum hydrocarbons contain polycyclic aromatic hydrocarbons (PAHs), which are known carcinogens [8].

3.2 Pathogenic Microorganisms

Pathogens—including bacteria, viruses, and protozoa—commonly enter water bodies via untreated sewage, effluents from slaughterhouses, and contaminated surface runoff. These microorganisms are responsible for a range of waterborne diseases in humans, such as cholera, typhoid fever, dysentery, polio, and viral hepatitis. Their presence poses a serious threat to public health, especially in regions with inadequate sanitation infrastructure.

3.3 Nutrient Pollution

Effluents from sewage treatment plants, fertilizer industries, and agricultural fields contain high concentrations of nitrogen and phosphorus compounds. When discharged into water bodies, these nutrients stimulate excessive growth of algae and aquatic plants—a process known as eutrophication. This leads to oxygen depletion (hypoxia), disruption of aquatic ecosystems, and loss of biodiversity. Cyanobacterial blooms in eutrophic waters may release toxins that cause gastrointestinal, dermatological, and neurological disorders in humans. Furthermore, elevated nitrate levels (>10 mg/L) are particularly hazardous to infants, potentially causing methemoglobinemia, or "blue baby syndrome," due to impaired oxygen transport in blood.

3.4 Inorganic Pollutants

Inorganic contaminants, including heavy metals and mineral salts, are introduced into water systems via industrial discharge, mining operations, and atmospheric deposition. These substances are chemically stable, non-biodegradable, and bioaccumulative.

- Common inorganic pollutants include cyanides, sulfates, mineral acids, metal salts, and complexes.
- Heavy metals such as mercury (Hg), copper (Cu), cadmium (Cd), lead (Pb), arsenic (As), and selenium (Se) are toxic even at low concentrations and adversely affect aquatic life and human health. For instance, Cu concentrations exceeding 0.1 mg/L are harmful to microbial populations.
- Ingestion of contaminated aquatic organisms results in biomagnification of toxic metals in the food chain.
- Eutrophic conditions further exacerbate metal mobilization and uptake by aquatic organisms.

3.5 Radioactive Contaminants

Radioactive pollution arises from both natural and anthropogenic sources. Key contributors include:

- Mining and processing of radioactive ores
- Medical, agricultural, and industrial use of radioisotopes (e.g., I-131, P-32, Co-60, Ca-45, S-35, C-14)
- Effluent discharge from nuclear power plants and reactors, involving isotopes such as Sr-90, Cs-137, Pu-238, U-235, and U-238
- Atmospheric fallout from nuclear weapons testing and usage

IV. PHYSICO- CHEMICAL PARAMETERS

Water testing is crucial before usage in drinking, residential, agricultural, or industrial applications. Water must be examined for several physicochemical properties. The water testing parameters are chosen based on the intended usage and the level of quality and purity required. Water contains a variety of floating, dissolving, suspended, and microbiological/bacteriological contaminants. Physical tests for temperature, color, odor, pH, turbidity, and TDS are recommended, while chemical tests for BOD, COD, hardness, Dissolved oxygen, alkalinity and other characteristics should be conducted. To improve the quality and purity of water, it ought be examined for trace metals, heavy metals, and pesticide residues. Drinking water must pass all tests and have the necessary amount of minerals. These parameters are properly monitored only in industrialized countries. Water analysis requires advanced technology and skilled personnel due to low concentrations of heavy metals and organic pesticides. Water quality is monitored on a regular basis using several physic and chemical criteria.

4.1 Temperature

In a well-established system, water temperature regulates the speed at which all chemical reactions occur and effects fish development, reproduction, and immunity; extreme temperature variations can be lethal to fish.

4.2 Colour

Water colour refers to the natural hues created by colloidal particles in solution. Natural water color can be caused by humic acids, fulvic acids, metallic ions, suspended debris, phytoplankton, and industrial effluents. Algal vegetation adds green color to water, but water with too many slits appears brown. The presence of organic debris and iron causes the water to turn yellow [9].

4.3 pH value

pH is a simple parameter yet very much an important factor. A crucial factor is the pH of water, which can affect the solubility and biological availability of nutrients, particularly metals like iron. The unbalance of pH effluent may disrupt the pH buffer systems and also disorder the ecological system. The changes in pH may have a strong effect on the toxicity of metals [10]. One of the most important and often used tests in water chemistry is pH measurement. Water supply and wastewater treatment processes that rely on pH include coagulation acid-base neutralization, precipitation, water softening, disinfection, and corrosion control [11].

4.4 Electric Conductivity:

Electrical conductivity is the ability of a substance to conduct electric current. In water, it is the property caused by the presence of dissolved mineral matter. The conductivity is the reciprocal of the resistance measured between two electrodes kept one cm apart and having a surface area of 1 cm^2. The conductivity of distilled water ranges between 1 to 5 µmho but the presence of salts and contamination with waste waters increases the conductivity of the water. Conductivity is highly dependent upon temperature and therefore is reported normally at 25°C to maintain the comparability of data from various sources. The maximum permissible limit of electrical conductivity in drinking waters recommended by WHO is 500 µmho/cm [12]. Electrical conductivity in natural waters is the normalized measure of the water's ability to conduct electric current. Dissolved salts like potassium and sodium chloride have the biggest impact on this.. Untreated water sources had the highest electrical conductivity (EC) (70 µs/cm), whereas water samples taken from disinfection (46 µs/cm) and reservoir (45 µs/cm) points had the lowest EC. The EC data of water sources from other cities around the country are substantially higher than those from the current study. These variations could be caused by the soil types, farming methods, and geological factors in the study location [13].

4.5. Total Suspended Solids (TSS)

Total suspended solids (TSS)-the portion of total solids in an aqueous sample retained on the filter that exceed 2 microns in size [14]. Sand, mineral precipitates,silt, clay and biological materials like algae can all be found in TSS. TSS development is mostly dependent on hydrology-driven physical processes. TSS includes the chemical precipitation of inorganic solids or the accumulation of dissolved organic materials in the water column. TSS makes a body of water more turbid, which reduces light penetration and hinders aquatic plants' ability to photosynthesize, potentially resulting in oxygen deficiency [15].

4.6 Total Dissolved Solids (TDS)

TDS indicates that there are other materials present in the water, making it less pure and solid on its own. The pH reading is typically correlated with TDS. The flavor of the water is influenced by the presence of dissolved particles in it. As a result, there cannot be a substantial variation in TDS levels from the typical water value. Customers do not find it acceptable due to flavor alone, but also to additional consequences. This situation can indicate that lower TDS waters may be contaminated by germs, and it is also extremely detrimental to human health [16]. Water with a high concentration of dissolved solids has a higher density, which affects the osmoregulation of freshwater species, decreases the solubility of gases like oxygen, and makes water less useful for drinking, irrigation, and industrial uses. TDS concentrations above 500 mg/L reduce palatability and may irritate the digestive tract.

4.7 Biochemical Oxygen Demand (BOD)

BOD represents the level of oxygen used by bacteria to partially decompose or completely oxidize biochemical materials in water and which constitute their carbon source (fats, carbohydrates, surfactants, etc.). The presence of a high amount of BOD_5 in water clearly indicated pollution which may be due to domestic sewage in the water [17]. The term "biochemical oxygen demand" (BOD) refers to how much oxygen is needed by bacteria to break down organic matter in a sample under anaerobic conditions at 20°C for five days. The proportional oxygen needs of effluents, wastewaters, and contaminated waterways are determined via BOD testing.

$$C_6H_{12}O_6 + 6O_2 \rightarrow CO_2 + H_2O + \text{new microbes}$$

4.8 Chemical Oxygen Demand (COD)

The Chemical Oxygen Demand (COD) test is one of the quickest ways to check the quality of water while it is being treated.COD is a measure of the level of organic matter contamination in water bodies. It's the oxygen content of a sample that is equal to the amount of organic matter that strong chemical oxidants like potassium dichromate or potassium permanganate may oxidize [18].

4.9 Dissolved oxygen

The dissolved gaseous form of oxygen is called DO. Fish and other aquatic life depend on it for respiration. Diffusion from the atmosphere and as a consequence of plants' and algae's photosynthesis allow DO to reach the water. To sustain 100% DO saturation, the DO concentration in epilimnetic fluids continuously equilibrates with the atmospheric oxygen concentration. DO concentrations between 5 and 15 mg/l are ideal. When the rate of photosynthesis exceeds the rate of oxygen diffusion to the atmosphere, excessive algal growth can cause the water to become over-saturated (more than 100% saturated) with DO. Since there is no way to replenish the oxygen used up by respiration and decomposition, hypolimnetic DO concentrations are usually low. Fish require 3-5 mg/L of DO at minimum. When the rate of photosynthesis exceeds the rate at which oxygen diffuses into the atmosphere, excessive algal growth can cause the water to become over-saturated (more than 100% saturated) with DO.

Because there is no way to replenish the oxygen used up by respiration and decomposition, hypolimnetic DO concentrations are usually low. For survival, fish require 3-5 mg/L of DO. Direct and indirect information, such as bacterial activity, photosynthesis, nutrient availability, stratification, etc., are provided by its association with water bodies [19].

4.9 Alkalinity

Alkalinity, which is mostly made up of bicarbonate (HCO3-) and carbonate (CO3 2-), stabilizes pH. Hardness, pH, and alkalinity all have an impact on how poisonous various compounds are in water. It is ascertained using a straightforward dil HCl titration with phenolphthalein and methyl orange markers present. Boiler water becomes alkaline mostly due to the presence of carbonate and hydroxyl ions. Boiler water must have hydroxyl alkalinity, or causticity, to prevent corrosion in the boiler. Foaming and other operational issues are brought on by excessive causticity. An "embrittlement" caustic assault on the boiler can be caused by too high causticity levels"[20].

4.10. Sulphate

Sulfate is found in nature in large quantities, and it may be found in natural streams at a few to several thousand milligrams per liter in concentration. Pyrite oxidation from mine drainage wastes may produce significant volumes of SO4. Sodium magnesium sulphate exert a cathartic action and hence its concentration above 250 mg/L in potable water is objectionable. Sulphate causes a problem of scaling in industrial water supplies, and problem of odour and corrosion in waste water treatment due to its reduction to hydrogen sulphide.

4.11 Nitrate

Although it can reach high levels in some aquifers, nitrate (NO), the most oxidizable type of nitrogen, is found in trace amounts in surface waters. Receiving water bodies become eutrophic due to nitrate, a crucial plant nutrient.

4.12 Phosphate

Phosphorus occurs in water and waste water almost solely as phosphates. These forms are commonly classified as orthophosphate, condensed phosphate and organically bound phosphates. These may occur in the soluble from, in particles of detritus or in the bodies of aquatic organisms. Water supplies may be polluted by fertiliser use, sewage, and industrial waste, or they may naturally contain phosphate from mineral contact. Therefore, it is more likely that groundwater will contain higher phosphate concentrations.

4.13 Indicators of Water Quality

Water pollution by pathogenic microorganisms from human and animal waste causes public and ecosystem health risks. Understanding the causes of the fecal matter and recognizing the appropriate signs are essential to managing this issue. In water and soil samples, *Escherichia col*i *(EC), Enterococci(IEC)* and *Clostridium perfringens (CP)*, are employed as stand-ins to identify pathogenic bacteria. They are also used as faecal pollution indicators for the evaluation of faecal contamination and conceivable water quality decay in different freshwater sources. *Coliforms* have been used like a standard indicator of recent faecal pollution [21].Bacteria, particularly *streptococci or E. coli*, are well-known markers of sewage contamination in drinking and bathing water. Certain bacterial groupings of organisms have been routinely employed as indicators of water pollution in sanitary microbiology. The total *coliform* count is one of the best markers of water pollution. The family *Enterobacteriaceae* contains a variety of organisms that belong to the *coliform* group. The *coliform* group includes the well-known bacteria E. coli and E. aerogenes, which are frequently found in contaminated water. *Escherichia coli*, a common bacteria in human excrement, is a great way to detect fecal contamination in water[22]. A popular technique for determining the water's safety is the total *coliform* count approach. The WHO states that drinking water should have a *coliform* and E. coli level of 0/100 ml and residential and recreational water should have a limit of 126 CFU/100 ml. According to Bureau of Indian Standards guidelines, drinking water should have a total and fecal *coliform* concentration of 0/100 ml [23].

Total *Coliforms*:

The group of Coliform bacteria comprises more than twenty bacterial species, divided into two subgroups: total *coliforms* and thermotolerant *coliforms*. The subset of total *coliforms* is composed of *Enterobacteria* that are capable of fermenting lactose, with the production of gases at 35°C, a capacity that, with the formation of gas in culture media, serves as the basis for traditional methods of detection of total *coliforms*. They are common in food manufacturing environments and can become part of the resistant microbiota[24]. The two most common microbiological indicators used to identify pathogens and fecal contamination are total *coliform* and E. coli. Methods of most probable number (MPN) are employed to quantify total *coliform* [25].

Fecal *Coliforms*:

Fecal *coliform*, also known as thermotolerant *coliforms*, are restricted to bacteria capable of fermenting lactose at 44.5 –45.5°C with the production of gases. Some originate from the digestive system of animals with warm blood, such as *Escherichia coli*, *Klebsiella*, and *Enterobacter*. As indicators of water quality, *coliform* bacteria have been used to monitor potability since 1920 due to their economic viability and ease of detection [24]. Coliform is naturally present in the environment, but Fecal *coliform* and E. coli are derived from human and animal waste. Thus, the presence of Fecal *coliform* and *E. coli* on a material or water indicates that the water is contaminated by human or animal waste. *E. coli* causes disease (pathogens) in this waste can cause diarrhea, cramps, nausea, headaches. This pathogen may pose a special health risk for infants, young children, and people with impaired immune system [26].

4.14 Most Probable Number (MPN) test for coliforms:

The MPN is a procedure to estimate the population density of viable microorganisms in the test sample. The preferred and most cost-effective method for detecting *coliforms* is the Most Probable Number (MPN). This technique allows statistical evaluation of the number of microorganisms present in a sample and measures the metabolically active viable proportion, which can be used to estimate the total population or a specific group of microorganisms.A series of inverted Durham tubes containing double and single robust lactose broth is infected and tested in measured amounts of water. The *coliforms* create acids and gases by fermenting the lactose in the soup. The number of positive tubes in relation to the MPN table is used to estimate the MPN of *coliforms* present in 100 milliliters of water.

V. SOME PHYSICO-CHEMICAL AND BIOLOGICAL ANALYSIS STUDY OF POLLUTED WATER SAMPLE IN INDIA

Physicochemical parameter analysis is critical for determining the quality of water and comparing the results of various physicochemical parameter values to standard values.

Panda et al. (2018) investigated and analyzed numerous physicochemical properties of river water. His findings revealed that pH and DO levels are low, while BOD and heavy metal levels are higher than legal limits during the summer than in the winter. While researching the bacterial pollution of the river Salandi detected germs in all monitoring locations, regardless of season. However, the specific nature and quantity of bacteria were not determined [27].

Mishra et.al.(2007) discovered the following bacteria when examining the bacteriological contamination of the Ganga River in Varanasi, and the amount of bacteria is more in the rainy season than in the summer and winter seasons. According to the scientists, the larger amount of bacteria during the rainy season may be related to the presence of organic substances, which enhance the bacterial development and multiplication [28].

Kerketta et.al.(2013) analyzed the physicochemical parameters of drinking water samples obtained from various sources in Ranchi, Jharkhand, India. His findings found that the physical look, odor, and taste were all pleasant, with the exception of pond and river water, which had excessive turbidity and a foul-smelling odor. Temperature, pH, DO, BOD, alkalinity, conductivity, total dissolved solids, and salinity were all within the WHO permitted levels. The lead and cadmium levels in all water samples were slightly higher than the WHO allowed limits, which could be significant in terms of public health. The study's physicochemical properties indicated that river and pond water were unsuitable for drinking. Regular measurement of the above metrics can improve water quality [29].

Satya et al. (2018) investigated the physicochemical, and bacteriological characteristics of Ganga water in Patna, India. His findings revealed that untreated sewage is having a growing impact on the Ganga. The increased bacterial population renders surface water unfit for ingestion, potentially leading to a loss of dissolved oxygen. Pollution in Patna is primarily caused by excessive sewage discharge from the municipality. Surface water requires treatment before consumption. Processes such as water softening, ion exchange, and demineralization can reduce pollutants. Finally, these finding showed the importance of understanding the water characterization for effective utilization and prediction of change to minimize the effect of urbanization. It is essential to safeguard the utilization and monitoring after three months of water resources for future generations [30].

In the Indian state of Rajasthan, Mahesh Kumar and G. V. Mishra et al. (2024) investigated the causes and effects of water pollution on a variety of water bodies. His result revealed that the surface water of Rajasthan's numerous bodies of water is contaminated by silt, various agrochemicals, industrial effluent waste, residential and sewage trash, and thermal pollution. The majority of companies release harmful materials into waterways. Some sources induced illnesses by dispersing microorganisms. Overuse of fertilizer in agriculture polluted water by providing nutrients to unanticipated plants, which ultimately led to eutrophication and DO depletion. The majority of urea nitrates enter ground water through the soil. Sedimentation and silt prevent sunlight from reaching aquatic plants through the water. This prevents photosynthesis from occurring. For aquatic creatures, dissolved oxygen is absolutely essential. Increases in Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) indicate that more substances are using oxygen from water bodies. As a result, increased BOD and COD indicate decreased DO and greater risk to aquatic life. Pesticide ingredients, particularly chlorinated pesticides, are dangerous water contaminants. They may have an impact on the human nervous system and build up through the food chain [31]. Abhineet, N. and Dohare et al. (2014) investigated the Khan River's water quality in Indore, India, and According to the report, the discharge of industrial and household trash has contaminated the Khan River. The deposition of these hazardous organic and inorganic materials from the surrounding areas and industry contaminates the river water, making it full of dangerous toxins [32]. Gupta, K.K., and Yadav et al. (2013), Agra City water samples were gathered from different locations, and analysis showed that none of them met Indian Standards 10500-91 or WHO standards. It is important to take precautions before consuming groundwater in the Agra region to avoid harmful health impacts [33].

A study on the physical and chemical characteristics of wastewater effluents from industrial regions in Jaipur, Rajasthan, India, was conducted by Dhingra, P. Singh, et al. in 2015. and his findings showed that, if waste water from industrial areas is dumped directly into the ground, its temperature may have an impact on the texture of the soil. Additionally, it may diminish soil fertility and increase microbial activity.Furthermore, aquatic life may suffer if waste water effluents are released into the water directly [34].

The Ambattur industrial sector in Chennai City's groundwater quality is the subject of a 2011 paper by Saravanakumar and Ranjith Kumar. Among the metrics they examined were conductivity, TDS, pH, total alkalinity, total hardness, fluoride, turbidity, sulfate, and chloride. A minor variation in the physical and chemical characteristics of the water samples under investigation was noted. A comparison of the water sample's physico-chemical characteristics with ICMR and WHO limits revealed that the groundwater is extremely contaminated and poses health risks to human consumption [35].

VI. CONCLUSION

Water that is extremely polluted has a variety of affects on people, both domestically and industrially. For instance, the presence of certain germs and heavy metals in water can effect or infect humans. It may have an impact on several body organs and physiological disorders. Hard water cannot be used for cooking, bathing, washing, or any other household task. Additionally, hard water is unsuitable for agricultural and industrial applications. It compromises the quality, stability, and glossiness of the finished product and harms the fragile machinery.Testing the water before using it for drinking, household, agricultural, or industrial purposes is crucial. It is necessary to examine water using many physicochemical parameters. The parameters chosen for water testing are entirely dependent on the intended use of the water and the degree of purity and quality required. A variety of floating, dissolving, suspended, microbiological, and bacteriological contaminants can be found in water. The most crucial source of water for industrial, agricultural, and drinking uses is groundwater. Surface and subsurface water quality have declined as a result of population growth and related demands. Urbanization and modern civilization regularly release solid waste dumps, home sewage, and industrial effluent. The reason behind groundwater. Monitoring groundwater quality on a regular basis and devising strategies to safeguard it are crucial since once contaminated, the quality cannot be restored by removing the contaminants from the source. We should therefore look into qualitative study of a few groundwater physicochemical properties prior to using water. One may use this as a guide to help society become more aware of the imminent decline in their environment and health.

REFERENCES

[1] Mishra, R.K., 2023. Fresh water availability and its global challenge. *British Journal of Multidisciplinary and Advanced Studies*, *4*(3), pp.1-78.

[2] Adekanmi, A.T., 2021. Health hazards of toxic and essential heavy metals from the poultry waste on human and aquatic organisms. In *Animal feed science and nutrition-production, health and environment*. IntechOpen.

[3] Sale, J.F., Yahaya, A., Ejim, C.C. and Okpe, I.W., 2019. Physicochemical assessment of water quality in selected borehole in Anyigba Town, Kogi State, Nigeria. *Journal of Applied Sciences and Environmental Management*, *23*(4), pp.711-714.

[4] Sonone, S.S., Jadhav, S., Sankhla, M.S. and Kumar, R., 2020. Water contamination by heavy metals and their toxic effect on aquaculture and human health through food Chain. *Lett. Appl. NanoBioScience*, *10*(2), pp.2148-2166.

[5] Titilawo, Y., Akintokun, A., Shittu, O., Adeniyi, M., Olaitan, J. and Okoh, A., 2019. Physicochemical properties

and total coliform distribution of selected rivers in Osun State, Southwestern Nigeria. *Polish Journal of Environmental Studies*, *28*(6), pp.4417-4428.

[6] Singh, D., Goswami, R.K., Agrawal, K., Chaturvedi, V. and Verma, P., 2022. Bio-inspired remediation of wastewater: A contemporary approach for environmental clean-up. Current Research in Green and Sustainable Chemistry, 5, p.100261

[7] Montano, L., Pironti, C., Pinto, G., Ricciardi, M., Buono, A., Brogna, C., Venier, M., Piscopo, M., Amoresano, A. and Motta, O., 2022. Polychlorinated biphenyls (PCBs) in the environment: occupational and exposure events, effects on human health and fertility. Toxics, 10(7), p.365.

[8] Bayu, A., Budiyanto, F., Farobie, O., Amrullah, A., Syaftika, N., Rahmawati, S.I. and Karnjanakom, S., 2024. Towards a Macroalgal Biorefinery via Integrative Production of Bioactive Compounds, Caloric Gas and Carbon-based Porous Materials.

[9] Nayar, R., 2020. Assessment of water quality index and monitoring of pollutants by physico-chemical analysis in water bodies: a review. *International Journal of Engineering Research and Technology*, *9*(01).

[10] Bakar, N.A., Othman, N., Yunus, Z.M., Daud, Z., Norisman, N.S. and Hisham, M.H., 2020, May. Physico-chemical water quality parameters analysis on textile. In *IOP conference series: earth and environmental science* (Vol. 498, No. 1, p. 012077). IOP Publishing.

[11] APHA-4500-A;2023 by American Public Health Association, American Water Works Association, and Water Environment Federation

[12] Nayar, R., 2020. Assessment of water quality index and monitoring of pollutants by physico-chemical analysis in water bodies: a review. *International Journal of Engineering Research and Technology*, *9*(01).

[13] Duressa, G., Assefa, F. and Jida, M., 2019. Assessment of bacteriological and physicochemical quality of drinking water from source to household tap connection in Nekemte, Oromia, Ethiopia. Journal of environmental and public health, 2019(1), p.2129792.

[14] APHA-2540-A;2023 by American Public Health Association, American Water Works Association, and Water Environment Federation

[15] Butler, B.A. and Ford, R.G., 2018. Evaluating relationships between total dissolved solids (TDS) and total suspended solids (TSS) in a mining-influenced watershed. *Mine water and the environment*, *37*(1), p.18.

[16] Jaffar, A., M Thamrin, N., Megat Ali, M.S.A., Misnan, M.F. and Mohd Yassin, A.I., 2020. The influence of physico-chemical parameters to determine water quality: a review. *Journal of Electrical And Electronic Systems Research (JEESR)*, *17*, pp.116-121.

[17] Boudeffa, K., Fekrache, F. and Bouchareb, N., 2020. Physicochemical and biological water quality assessment of the Guebli River, northeastern Algeria. *Rasayan J. Chem*, *13*(1), pp.168-176.

[18] Aguilar-Torrejón, J.A., Balderas-Hernández, P., Roa-Morales, G., Barrera-Díaz, C.E., Rodríguez-Torres, I. and Torres-Blancas, T., 2023. Relationship, importance, and development of analytical techniques: COD, BOD, and, TOC in water—An overview through time. *SN Applied Sciences*, *5*(4), p.118.

[19] Halim, A., Sharmin, S., Rahman, H., Haque, M., Rahman, S. and Islam, S., 2018. Assessment of water quality parameters in baor environment, Bangladesh: A review. *International Journal of Fisheries and Aquatic Studies*, *6*(2), pp.269-263.

[20] Patil, P.N., Sawant, D.V. and Deshmukh, R.N., 2012. Physico-chemical parameters for testing of water–A review. *International journal of environmental sciences*, *3*(3), pp.1194-1207.

[21] Goshu, G., Koelmans, A.A. and de Klein, J.J.M., 2021. Performance of faecal indicator bacteria, microbial source tracking, and pollution risk mapping in tropical water. *Environmental* Pollution, 276, p.116693

[22] Some, S., Mondal, R., Mitra, D., Jain, D., Verma, D. and Das, S., 2021. Microbial pollution of water with special reference to coliform bacteria and their nexus with environment. *Energy Nexus*, *1*, p.100008.

[23] Arghyam, Indian Standard for Drinking Water as per BIS specifications (IS 10500-2012), Second Revision, 2020 https://www.indiawaterportal. org/articles/indian-standard-drinking-water-bis-specifications-10500-1991 (accessed 02 April 2021).

[24] da Silva, F.O., Camargo, A.F. and Treichel, H., 2024. Thermotolerant coliform bacteria present in water bodies. *Brazilian Applied Science Review*, *8*(1), pp.42-67.

[25] Kumar, S., Singh, R.V. and Kumar, K., 2023. Microbial Indicator as a Performance Evaluation Tool for STP: Case Study. Journal of Survey in Fisheries Sciences, 10(1S), pp.5203-5215

[26] Rohmah, Y., Rinanti, A. and Hendrawan, D.I., 2018. The determination of ground water quality based on the presence of Escherichia coli on populated area (a case study: Pasar Minggu, South Jakarta). In IOP Conference Series: Earth and Environmental Science (Vol. 106, No. 1, p. 012079). IOP Publishing

[27] Panda, Pratap Kumar, Rahas Bihari Panda, and Prasant Kumar Dash. "The river water pollution in India and abroad: A critical review to study the relationship among different physico-chemical parameters." *American Journal of Water Resources* 6, no. 1 (2018): 25-38.

[28] Mishra, A & Tripathy. B.D. : Seasonal & temporal variation in physico-chemical & bacteriological characteristics of river Ganga in Varanasi, Current World Environment, 2(2), 149-154 (2007).

[29] Kerketta, P., Baxla, S.L., Gora, R.H. and Kumari, S., 2013. Analysis of physico-chemical properties and heavy metals in drinking water from different sources in and around Ranchi, Jharkhand, India. *Veterinary world*, *6*(7).

[30] Satya, Kumari, and Chanavir Narayan. "Study of physico-chemical and biological characteristics of the water of river Ganga at Patna, India." *Current World Environment* 13, no. 3 (2018): 374.

[31] Kumar, M. and Mishra, G.V., 2024. Causes and Impacts of Water Pollution on Various water bodies in the State of Rajasthan, India: A Review. *Environ. Ecol*, *42*, pp.645-654.

[32] Abhineet, N. and Dohare, E.R.D., 2014. Physico-chemical parameters for testing of present water quality of Khan River at Indore, India. *International Research Journal of Environment Sciences*, *3*(4), pp.74-81.

[33] Gupta, N., Yadav, K.K., Kumar, V. and Singh, D., 2013. Assessment of physicochemical properties of Yamuna River in Agra City. *International Journal of ChemTech Research*, *5*(1), pp.528-531.

[34] Dhingra, P., Singh, Y., Kumar, M., Nagar, H., Singh, K. and Meena, L.N., 2015. Study on Physico–Chemical Parameters of Waste Water Effluents from Industrial areas of Jaipur, Rajasthan, India. *Int. J. Innov. Sci. Eng. Technol*, *2*(5), pp.874-876.

[35] Saravanakumar, K. and R. Ranjith, Kumar, (2011), Analysis of water quality parameters of groundwater near Ambattur industrial area, Tamil Nadu, India, Indian Journal of Science and Technology, 4(5), pp 1732-1736.