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Assessment of Water Quality Parameters of Surface and underground water of Kanker District, Chhattisgarh in Summer Season

ORIGINAL ARTICLE


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Abstract

Water is essential for all life on Earth and serves important roles in domestic and industrial uses. It is crucial for economic and social development, found in natural and man-made sources like ponds, rivers, and dams. However, overuse and pollution from industrial and domestic waste have degraded water quality, leading to health risks for both aquatic and terrestrial life. To address this, water samples were collected from various sources in Kanker district, Chhattisgarh, during summer and tested for quality parameters such as temperature, pH, and dissolved oxygen. These results were compared against standards set by the Central Pollution Control Board and the Bureau of Indian Standards. The study aims to show how chemical contamination affects water quality and health risks.

Key Words

Water quality parameters, Temperature, Hardness, Alkalinity, Conductivity, Chloride ion.

Introduction

Water is essential for all life on Earth and is known as a universal solvent because it can dissolve many substances. It plays a vital role in various areas, including health, agriculture, and industry. However, freshwater, which is crucial for drinking and other purposes, is limited, only about 2. 7% of Earth's water is freshwater, with just 1% accessible for human use. Access to clean drinking water is a basic human right, yet in 2020-21, only 36. 6% of Indian households had piped potable water, with significant differences between urban (61. 4%) and rural areas (25%).[1]

Many drinking water sources are contaminated with harmful chemicals and pathogens, leading to severe waterborne illnesses. This contamination is caused by industrial activities, agriculture, climate change, and poor waste management. The study aims to evaluate water quality by measuring certain physicochemical parameters of natural water sources and comparing them with standards set by the CPCB and BIS to address freshwater scarcity[2].Seventy-one percent of the Earth's surface is water, with 97% being salty sea water and only 3% being fresh water. Out of the fresh water, only 0. 06% can be consumed by humans, while the remaining 2. 94% is found in ice caps, glaciers, groundwater, and swamps. This limited supply of fresh water is insufficient to meet the needs of people for both home as well as industry.

Following are the sources of water:

1. Surface Water: Stream, Lakes, river, ponds, reservoirs, Oceans
2. Underground water: water in wells and Springs
3. Rain water
4. Sea water

Ancient civilizations developed near river banks, using river water for agriculture, bathing, drinking, and transportation. Initially, people didn't understand hygiene or the impact of pollution. Natural processes helped in cleaning river water, but as science and technology progressed, human activities increased and polluted the rivers with harmful substances. This pollution led to a decline in water quality and an increase in water-borne diseases, which account for around 80% of human illnesses, according to the WHO[3]. Water contaminants fall into two categories: organic and inorganic pollutants. Organic pollutants come from natural sources like decaying vegetation and animal wastes, while inorganic pollutants mostly result from human activities, such as domestic sewage and industrial waste from various sectors like food, pharmaceuticals, and mining. Additionally, chemicals used in agriculture can also contaminate waterways and potentially harm drinking water systems. This work focuses on analyzing surface and groundwater samples for impurities, which can be categorized into three types: physical, chemical, and biological. Physical impurities include color (affected by metals and organic matter), turbidity (caused by fine particles), taste (influenced by dissolved substances), and odor (often from sewage and industrial discharge). Chemical impurities come from industrial processes, including acidity from mine drainage and gases like dissolved CO_2 and O_2. These gases affect water quality and support aquatic life. Mineral matter also contributes to chemical impurities. Biological impurities consist of various organisms such as algae and pathogens, which arise from sewage and other organic wastes and can proliferate in surface water but are often absent in deeper well water.

Study Area

Water is essential for all life and serves both domestic and industrial needs. The rapid growth of the human population has increased the demand for water. Activities like agriculture, mining, urbanization, and industrialization have harmed water quality by introducing sewage and industrial waste into freshwater sources. This pollution makes water unsafe for drinking and other uses, leading to serious diseases such as cholera and typhoid. Polluted water can also harm livestock and damage soil, impacting crop growth. To address these issues, it is important to regularly test water quality. Six water samples were collected from various sites in Kanker District, C. G.

Six water samples were collected from following sources located in Kanker District, C.G. :-

1. Doodh Nadi
2. Deewan Talaab
3. Dandia Talaab
4. Raja Talaab
5. Kishaan Talaab
6. Borewell water

Fig 1: Doodh Nadi, Kanker District

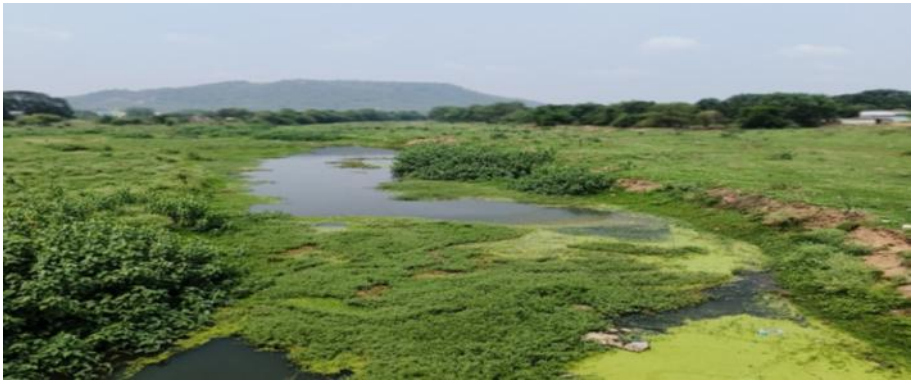


Fig. 2: Deewan Talaab, Kanker District

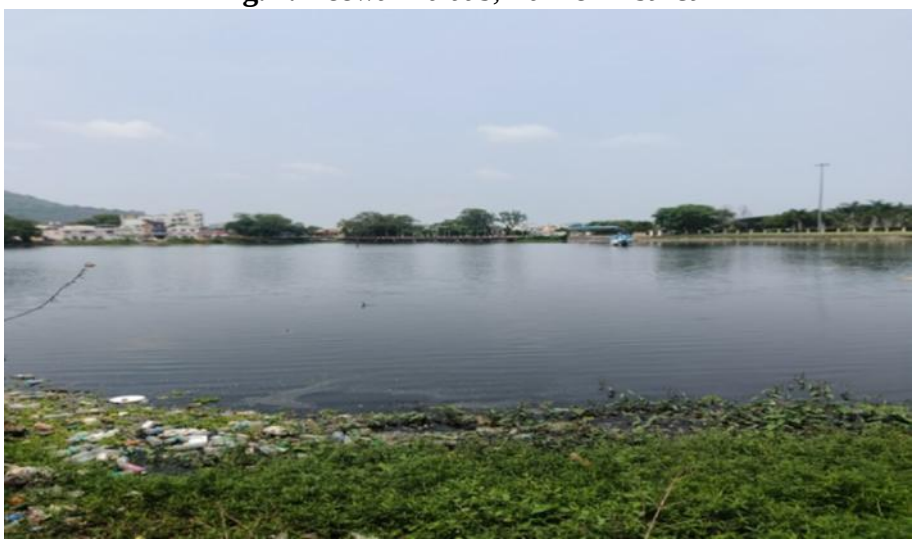


Fig 3: Dandia Talaab, Kanker District

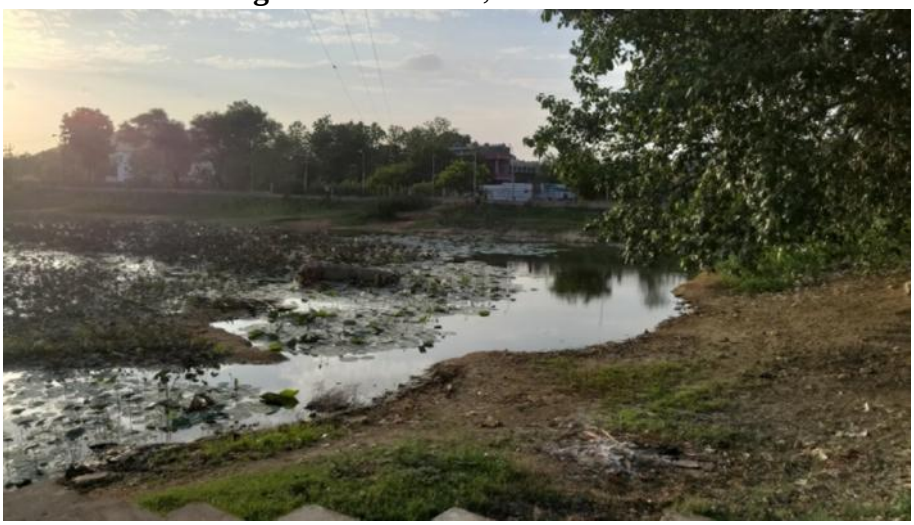


Fig 4: Raja Talaab, Kanker District

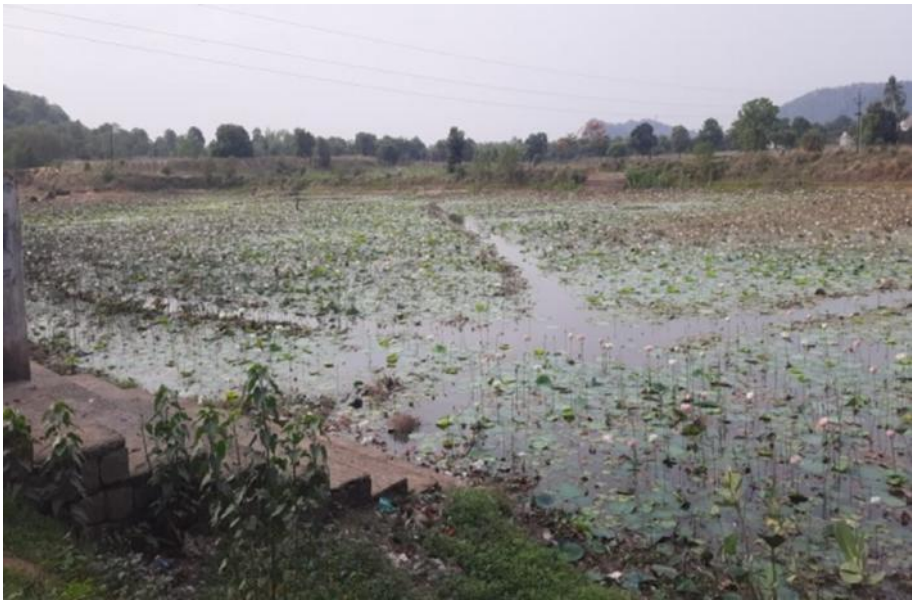
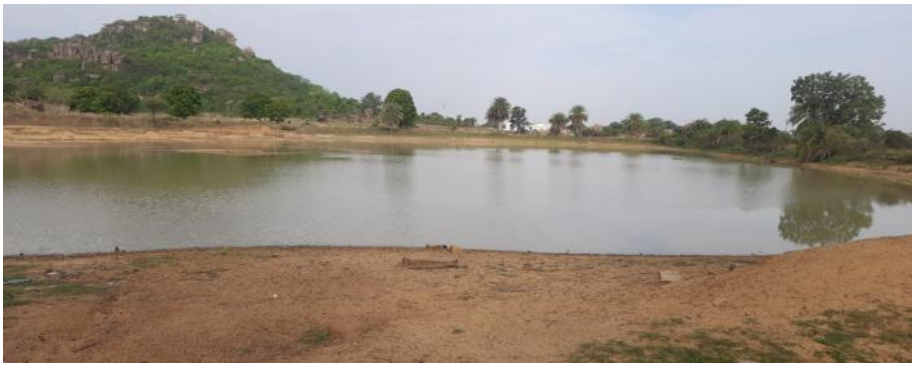


Fig 5: Kishaan Talaab, Kanker District



Experimental Method

1. **Collection and sampling:** Water samples to be tested were collected from underground and surface water sources in the month of April 2025. Six water samples were collected for testing water quality parameters, out of six samples five samples were collected from surface water resources and one from underground source. These samples were collected in 1.5 liters bottles. Bottles were washed with HNO_3 to remove any contamination if present. Then these bottles were rinsed with distilled water for three to four times and dried. Leakage of bottles were checked. Labels were pasted on bottles with name of source and dates of sample collection.
2. **Analysing Procedures:** The objective of this study was to determine the physicochemical parameters of natural sources such as underground and Surface water sources and to assess the quality of water. This analysis is done to ensure the safety and also to ascertain that the physical, chemical and biological parameters are within the limits. Qualitative and quantitative aspect of water sources can be analyzed and remedies can be suggested in order to terminate fresh water scarcity.

Following water parameters were analyzed for assessment of water quality of River. lakes and borewell water:

1. **pH:** It is a measure of the acidic or basic nature of the solution. The concentration of the hydrogen ion[H^+] activity in a solution determines pH. Mathematically it is expressed as

$$pH = -\log[H+] \quad (1)$$

The pH value is the negative power, to which 10 must be raised to equal the hydrogen ion Concentration. 7-14 pH values indicate that solution is basic and 0-7 is acidic. pH=7 indicates that the solution is neutral.

pH was determined using Digital pH meter, Model-112, Electronics India. pH meter was allowed to warm up. Then it was calibrated with buffer of pH 4 and pH 7. Then pH of six water samples were taken.

2. **Temperature:** Temperature of water was taken by directly inserting Thermometer in water source for few minutes till the reading becomes constant and noted.
3. **Electrical Conductivity:** Just like metals some electrolytic solutions like acids, bases and salt solutions also conduct electricity. Natural water has salts dissolved in it. They allow electric current to pass through them just like electrolytic solutions. Electrolytic conductor too obeys Ohm's law;

$$I = E/R \quad (2)$$

Where, E is potential difference in Volts between the ends of the conductor of R is resistance in Conductance and measured in reciprocal of ohms (ohm $^{-1}$), but its official designation is now Siemens (Symbol; S, S =1). The instrument was set at cell constant 1 and unit of electrical Conductivity as milli Siemens.

Electrical Conductivity of water samples was measured by Digital Conductivity meter, model no. Alpha-06, Electronics India. Electrical conductivity of all six samples were measure and readings were noted.

4. **Turbidity:** The degree of cloudiness is measured by turbidity. The amount of water cloudiness, as determined by passing a beam of light through it. Photometric measurement and light transmission through the water was done. Material that is floating in water causes cloudiness. Plankton, clay, silt, organic material, and more. In natural water, turbidity is caused by microscopic life forms. This has been identified as a significant constraint.in the aquatic biological productivity. In the current investigation, the turbidity of the samples was documented.
5. **Total Dissolved Solids (TDS):** In natural water, the majority of dissolved solids are made up of carbonates, nitrates, phosphates, sulphates, chlorides, bicarbonates, calcium, iron, magnesium, sodium, potassium, and manganese, and other elements They are caused by dissolution or Weathering of the soil and stones, including disintegration of gypsum, lime, and other slowly dissolving soil minerals. The information is presented in table 1[4]
6. **Alkalinity:** The alkalinity is measured by the acidimetric titration method, which employs various indicators such as phenolphthalein and methyl orange.
7. **Total Hardness:** The Eriochrome black-T was used as an indicator in a complexometric titration with EDTA to determine the water sample's total hardness (TH).
8. **Biochemical Oxygen Demand (BOD):** Biochemical Oxygen Demand (BOD): The Biochemical Oxygen Demand, often known as BOD, is a test used to determine the quantity of biodegradable organic matter in a water sample. The results are stated in terms of the amount of BOD in mg/L that microorganisms, mainly bacteria, will consume as they break down these substances.[5]
9. **Chemical Oxygen Demand (COD):** Chemical oxygen demand (COD): The oxygen needed to oxidize every compound found in water, including those that are not biodegradable, is measured by the quick chemical oxygen demand (COD) test. The amount of pollution in water may be accurately assessed using COD. The COD of water rises as the amount of organic matter in it increases.

Results and Discussion

It is of utmost importance to have an idea about water quality parameters of any water source so that anyone can decide its usability for drinking, washing, cooking etc. As far as for industrial and agricultural purposes are concerned, specification of water are fixed which is based on various physicochemical characteristics of water. Water from any source should be tested and the results indicate the pollutant loads in water. Polluted water be can be treated by the methods suitable for removal of specific pollutants in surface or underground water source. In this study we estimated water quality parameters of six samples collected from different natural sources of Kanker District during Summer season. First physical examination was done followed by chemical parameters determination.

Physical Parameters

Colour, Odour and Taste: Following table no. 1 contains physical parameters of six water samples.

Table no. 1: Physical Parameters

Source of water Sample	Physical Parameters	Observations
Sample no.1 Doodh Nadi	Colour	Transparent
	Odour	Odourless
	Taste	Tasteless
Sample no.2 Deewan Talaab	Colour	Non Transparent
	Odour	Odourless
	Taste	Tasteless
Sample no. 3 Dandia Talaab	Colour	Non Transparent
	Odour	Odourless
	Taste	Tasteless
Sample no.4 Raja Talaab	Colour	Non Transparent
	Odour	Odourless
	Taste	Tasteless
Sample no.5 Kishaan Talaab	Colour	Non Transparent
	Odour	Odourless
	Taste	Tasteless
Sample no.6 Borewell	Colour	Transparent
	Odour	Odourless
	Taste	Tasteless

Colour, odour and taste of river and pond water is normal as per Water quality Standards given by CPCB(Table no. 1)

2. Parameters for water quality Assessment

i) pH: Table no 2 shows pH values of water samples which was determined using pH meter.

Table no. 2: pH values

Water sample	pH values
Sample no.1, Doodh Nadi	7.8
Sample no.2, Deewan Talaab	7.7
Sample no. 3, Dandia Talaab	7.3
Sample no.4, Raja Talaab	7.1
Sample no.5, Kishaan Talaab	7.2
Sample no.6, Borewell	7.3

pH values are in the range of 7.1-7.8. were compared with the pH values in Table no.1(CPCB). pH values of sample fall within the permissible limits 6.5-8.5 which indicates that all water samples are safe and fit for drinking. If pH values are below 7 means water is acidic in nature and if values are near 14 means water is highly alkaline. pH value 7 indicates neutrality of water at 25^0C [7].

ii) Temperature: Table no. 3. Shows temperature of water samples during onset of summer season**.**

Table no. 3: Temperature

Water sample	Temperature in ^{0}C
Sample no.1 ,Doodh Nadi	34
Sample no.2, Deewan Talaab	34
Sample no. 3, Dandia Talaab	34
Sample no.4, Raja Talaab	34
Sample no.5, Kishaan Talaab	34
Sample no.6, Borewell	34

Water samples were collected in the April month. Temperature range is 34-35^{0}C which is permissible as per IS :10500.

iii) Electrical conductivity:- Table no. 4 shows electrical conductivity of all six water samples. Electrical conductivity was determined by Conductivity meter.

Table no. 4: Electrical Conductivity

Water sample	Electrical Conductivity (µS/cm)
Sample no.1, Doodh Nadi	320
Sample no.2, Deewan Talaab	420
Sample no. 3, Dandia Talaab	250
Sample no.4, Raja Talaab	230
Sample no.5, Kishaan Talaab	520
Sample no.6, Borewell	560

Values of Electrical Conductivity determined are in range of 230-560 µS/cm. Electrical conductivity tells us about the presence of ions causing hardness, alkalinity and dissolved solids in water. By determining conductivity, we can have the idea about impurities present in water.

iv) Total dissolved Solids: TDS Values of all six samples range from 190-270 shown in Table no.5.

Table no. 5: Total dissolved solids

Water sample	Total Dissolved Solids(mg/L)
Sample no.1, Doodh Nadi	215
Sample no.2, Deewan Talaab	220
Sample no. 3, Dandia Talaab	235
Sample no.4, Raja Talaab	190
Sample no.5, Kishaan Talaab	325
Sample no.6, Borewell	370

According to BIS 1500-2012, acceptable and permissible limit is 500 and 2000. TDS values were compared with the BIS values given in Table no.2. TDS values are less than 500 which shows water is safe for drinking and other purposes.

v) Total Hardness and Permanent Hardness: Total and permanent hardness were determined by complexometric titration using EDTA. Both the values are recorded in Table no. 6.

Table no. 6: Total and permanent Hardness

Water sample	Total Hardness(mg/L)	Permanent Hardness(mg/L)
Sample no.1, Doodh Nadi	200	50
Sample no.2, Deewan Talaab	191	79
Sample no. 3, Dandia Talaab	186	60
Sample no.4, Raja Talaab	180	60
Sample no.5, Kishaan Talaab	240	50
Sample no.6, Borewell	263	53

Total Hardness in the above table is the sum of Permanent hardness and Alkalinity. According to Indian standard for drinking water as per BIS specification 10500-2012, maximum allowable limit for hardness is 600 mg/L. Values of Hardness of all water samples are less than 600ppm, which shows water is of good quality.

vi) Alkalinity: Alkalinity was determined by titration method and values are recorded on the Table no. 7 below.

Table no. 7: Alkalinity

Water sample	Alkalinity (mg/L)
Sample no.1, Doodh Nadi	150
Sample no.2, Deewan Talaab	112
Sample no. 3, Dandia Talaab	126
Sample no.4, Raja Talaab	120
Sample no.5, Kishaan Talaab	190
Sample no.6, Borewell	210

According to Indian standard for drinking water as per BIS specification 10500-2012, maximum allowable limit for Alkalinity is 600 mg/L. Values of Alkalinity are in between 100-220mg/L of all water samples and are less than 600ppm, which shows water is of good quality and safe for drinking purposes. For industrial purposes where alkaline water in not at all required such as in beverage industry, water should be treated to remove alkalinity beforehand.

vii) Dissolved Oxygen(DO): Winkler's method was used to determine dissolved oxygen present in all six samples and values obtained were recorded in the Table no. 8 below.

Table no. 8: Dissolved Oxygen

Water sample	Dissolved Oxygen (mg/L)
Sample no.1, Doodh Nadi	16.0
Sample no.2, Deewan Talaab	18.0
Sample no. 3, Dandia Talaab	19.6
Sample no.4, Raja Talaab	15.2
Sample no.5, Kishaan Talaab	17.6
Sample no.6, Borewell	15.6

According to BIS (updated module IS 10500-2012), ideally DO values should lie in the range of 3-6mg/L. DO values of Doodh river is lowest and Dandia Talaab has highest value which shows that water has abundant aquatic flora and fauna and has no microbial contamination.

viii) Biological Oxygen Demand: BOD values determination takes five days. BOD values are shown in Table no. 9.

Table no. 9: Biological Oxygen Demand

Water sample	Biological Oxygen Demand (mg/L)
Sample no.1, Doodh Nadi	4.00
Sample no.2, Deewan Talaab	2.70
Sample no. 3, Dandia Talaab	2.24
Sample no.4, Raja Talaab	8.10
Sample no.5, Kishaan Talaab	3.23
Sample no.6, Borewell	4.56

Above table shows BOD values of all six samples. BOD values should be between 2-3 mg/L. Raja Talaab showed Highest BOD value whereas Dandia Talaab have lowest BOD value. If BOD values are at higher side, it indicates that may be due to organic waste, municipal sewage waste and biological waste disposal. Generally, BOD values are high in summer season due to increase in microbial activity.

Conclusion

Nature has provided us with abundant natural sources of water. Fresh water sources have very less water in comparison to saline water. For survival of Human beings' fresh water is needed for drinking and day to day activities. Nowadays natural sources of water has been contaminated by unwanted wastes which are deteriorating it. So, water testing is the only option to keep a check on quality of water for avoiding Health risks. During this study we have determined and tabulated values of pH, EC, Temperature, TDS, Hardness, Alkalinity, DO, BOD. All the values were compared with the Values given by CPCB and Bureau of Indian standards are were found to be in the limits.

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