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DETERMINATION OF GROUND WATER QUALITY IN LONG TERM IRRIGATION ZONE: A STUDY OF BHANDARDARA LEFT BANK CANAL COMMAND AREA

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Abstract

Groundwater is an essential resource for drinking and irrigation, particularly in rural areas where surface water is limited. Ensuring the quality of groundwater is crucial for both public health and agricultural productivity. This study assesses the chemical quality of groundwater in the long-term irrigated zone of the Bhandardara Dam Left Bank Canal command area, part of the Ahilyanagar District in Maharashtra, India. The research analyzes key water quality parameters to determine its suitability for drinking and irrigation. Parameters such as pH, calcium carbonate hardness, chemical oxygen demand (COD), alkalinity, nitrites, ammonia, dissolved oxygen (DO), fluoride, chloride, electrical conductivity (EC), and total dissolved solids (TDS) were evaluated for 22 water samples collected across various villages in the region. The findings show that the groundwater generally falls within acceptable limits for drinking water, with most parameters like pH, fluoride, chloride, and TDS meeting the required standards. However, some samples exhibited elevated levels of COD, EC, and hardness, indicating potential concerns for water quality. High levels of COD in certain samples suggest organic contamination, while elevated EC values point to a higher concentration of dissolved salts, which may affect both the taste and safety of the water. The study concludes that while the majority of the groundwater samples are suitable for drinking, certain areas require further attention and possible treatment to ensure safe and sustainable water use.

Keywords: Ground Water, Irrigation, Water Parameters, Bhandardara Dam.

Introduction: -

Groundwater is a natural water resource used for drinking and agriculture in rural area apart from surface water. Its quality should be assessed regularly, and the condition of water resources should be maintained accordingly. Clean and safe water is an absolute need for health and productive life over the years, the increasing use of groundwater for irrigation has raised concerns about its quality and the potential impacts on both soil fertility and crop health. Contaminants from agricultural activities, such as fertilizers, pesticides, irrigation and untreated wastewater, can leach into the groundwater, affecting its chemical composition and overall quality. In study area is oldest irrigated zone of Maharashtra the Canal area of Pravara left bank canal lenth 81.1 km constructed in 1893 from Prvara River. The present study intends to assess the chemical quality of drinking water from different natural sources,

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of ground water Bhandardara dam left bank canal camand area part of Ahilyanagar District. The primary goal of this research is to analyze the drinking water quality parameters to ensure that the water is safe for drinking. In this study sample are determine the phsico chemical property wear analyse. The quality of groundwater in irrigation zones is influenced by multiple factors, which can be assessed through the analysis pH: This parameter determines the acidity or alkalinity of water. Calcium Carbonate Hardness ($CaCO_3$_Hard_mg/L): The hardness of water is mainly due to the presence of calcium and magnesium ions. Chemical Oxygen Demand (COD_mg/L): COD is an indicator of the organic matter content in water. Phosphate (Phosphate_mg/L): Phosphates are essential nutrients for plant growth, but excessive concentrations in groundwater can lead to eutrophication, harming ecosystems and water quality. Alkalinity: Alkalinity reflects the ability of water to neutralize acids. Nitrite (Nitrite_NO_2_mg/L): Nitrites are often found in groundwater due to fertilizer runoff or wastewater contamination. Elevated nitrite levels can be toxic to plants and pose risks to human health. Ammonia (Ammonia_mg/L): Ammonia contamination, typically from fertilizers or animal waste, can lower water quality Dissolved Oxygen (DO_mg/L): The level of dissolved oxygen in groundwater is vital for maintaining healthy ecosystems and supporting microbial life. Low levels of DO can indicate organic pollution or anaerobic conditions that are harmful to both plants and aquatic organisms. Fluoride (Fluoride_mg/L): Fluoride concentrations in groundwater are often linked to geological sources. While low fluoride levels can be beneficial, excessive concentrations may pose health risks Chloride (Chloride_mg/L): Chloride levels in groundwater can increase due to irrigation with saline water or contamination from industrial waste. High chloride concentrations may lead to soil salinization, affecting plant health and reducing agricultural productivity. Electrical Conductivity (EC_µs/cm): EC measures the ability of water to conduct electricity, which correlates with the concentration of dissolved salts. High EC values indicate salinity issues Total Dissolved Solids (TDS_mg/L): TDS indicates the total concentration of dissolved substances in water. Elevated TDS levels suggest high mineral content, which may affect human health.

Objective

The main aim of the study objective have taken for this present research work: To determine the quality of water using various parameter uses in drinking water and generalize the water is good or bad for drinking purpose

Study Area:

The study area is a located in Ahilyanagr district part of Sangamner, Rahata, Shrirampur and Newasa Tahsil of Maharashtra state is located between $19^0$66'to$19^0$50' North Latitude and 74031'to 74095' East Longitude(Image 1). In Study areas is Bhandardara dam left bank canal camand area of Pravra River so total of area is under the agriculture with dominant crop of sugarcane in that total population of from this most of the population

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is engage in agriculture sector and dominance of area is rural most use of drinking water is groundwater.

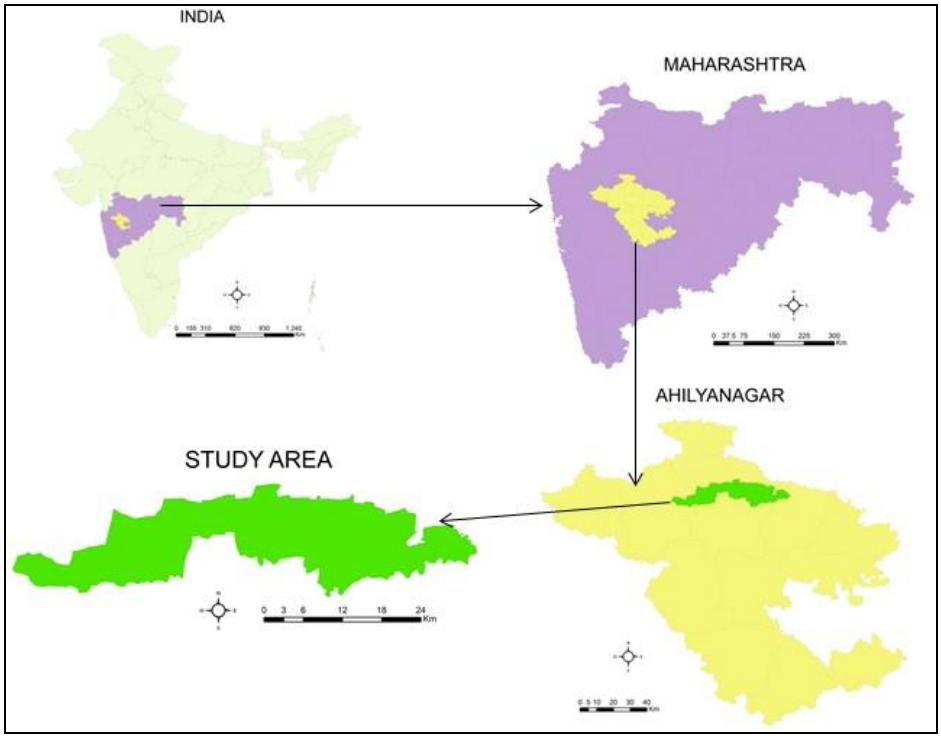

Image 1: Location Map

Data Collection

Water samples are collected randomly from different locations of Bhandardara Left Bank Canal command area (Table no1). Nearly twenty two samples were collected for determination of water quality analysis of drinking purpose of long duration irrigated area to analysis of physio-chemical properties of that collected water samples were analysed and reported.

Sr. No	Village	Sample_No	Sr. No	Village	Sample_No
1	Ozar KH	1	12	Nandur BK	12
2	Ashwi BK	2	13	Belapur	13
3	Pratapur	3	14	Bhokar	14
4	Hanumantgav	5	15	Khokar	16
5	Dadh BK	4	16	Matapur	17
6	Chandrapur	6	17	Bherdapur	15
7	Loni KH	7	18	Pachegav	20
8	Kolhar BK	8	19	Taklibhan 2	18
9	Mamdapur	9	20	Belpimpalgan 2	19
10	Rajuri	10	21	Punatgaon	21
11	Nandur KH	11	22	Newase BK	22

Table No1 Water samples location village

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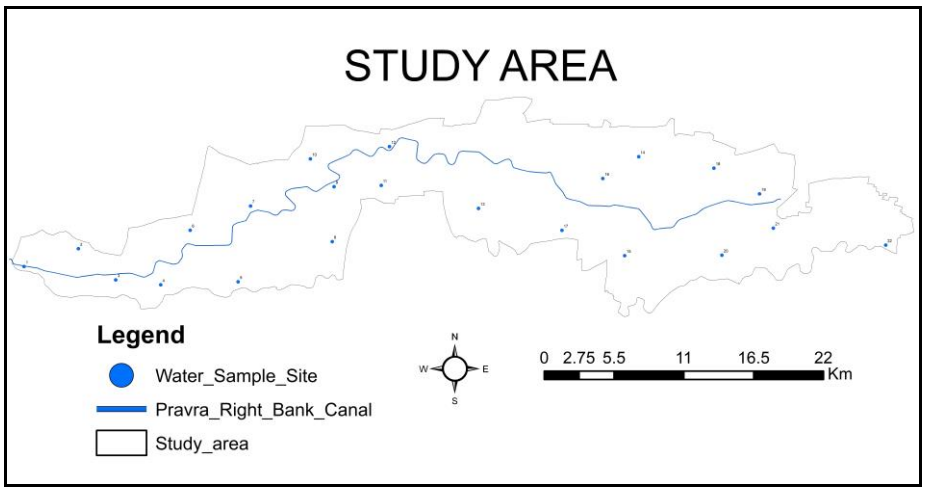

Image No2. Map of Study area Water sample site and Pravra Left Bank Canal

Result and desiccation:

Determination of water quality is established through the measurement of various important physico- chemical parameters of the drinking water. The physico-chemical parameters of twenty-two different samples (1, 2, 3, 4, 5, 6…….22) are summarized (Table 2). There are some remarkable variations of physico-chemical data are found at all the twenty-two sampling sites in study area (Bhandardara Left Bank Canal command area district Ahilyanagar, Maharashtra).

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Sample_no	PH	_Hard_ mg/L	COD_ mg/L	hate_ mg/L	Alkalinity	_NO2_ mg/L	nia_mg/L	DO_ mg/L	de mg/L	de_mg/L	EC_µs/cm	TDS_ mg/L
1	8.3	120	20	0	150	0.10	0	4.80	0.14	160	426	211
2	8	30	24	0	325	0.10	0	7.20	0.15	90	1930	965
3	8.2	150	48	0	350	0.10	0	6.40	0.14	75	2070	1014
4	8.3	105	20	0	350	0.10	0	5.60	0.12	170	2318	1159
5	8.2	90	20	0	150	0.10	0	5.60	0.16	150	292	146
6	8.1	45	28	0.03	200	0.20	0	7.20	0.12	85	720	370
7	8.1	30	32	0.02	225	0.20	0	6.40	0.14	75	820	450
8	7.9	60	36	0	300	0.10	0	7.20	0.18	85	1980	970
9	8.1	75	28	0	275	0.10	0	5.60	0.14	60	1650	612
10	7.9	45	28	0.02	275	0.20	0	6.40	0.18	70	790	385
11	8	90	24	0	275	0.10	0	7.20	0.25	60	1210	315
12	8	90	16	0	325	0.10	0	6.30	0.22	70	1320	350
13	8	60	24	0	250	0.20	0	7.10	0.25	190	920	290
14	8	75	16	0	275	0.20	0	7.00	0.18	120	920	320
15	8.1	60	28	0.02	275	0.20	0	6.20	0.18	170	1250	312
16	7.9	75	24	0.02	175	0.50	0	7.20	0.12	80	815	355
17	7.8	45	28	0.02	225	0.50	0	7.20	0.13	70	780	412
18	7.8	90	28	0.02	175	0.20	0	6.80	0.14	110	1570	580
19	7.8	90	28	0.02	225	0.10	0	7.10	0.16	85	1850	515
20	8	90	16	0.02	250	0.20	0	7.20	0.14	120	1360	390
21	8.2	60	24	0.03	200	0.10	0	7.10	0.18	70	780	290
22	8.2	45	28	0.03	275	0.10	0	7.20	0.18	70	960	360

Table No2 water quality parameters of Bhandardara dam left bank canal camand area

PH: pH measures the hydrogen ion concentration in solution. It is measured on logarithmic scale and equals to negative logarithm of hydrogen ion concentration (activity). The desirable limit of pH is 6.5 to 8.5. from the collected sample analysis of pH is Average pH: 8.04 Minimum pH: 7.8 and Maximum pH: 8.3 All pH values are within the acceptable range of 6.5 to 8.5, indicating that the water is suitable for drinking in terms of pH level.

Hardness : The hardness of water refers to the concentration of dissolved minerals, primarily calcium (Ca^{2+}) and magnesium (Mg^{2+}), in the water. Hard water can have significant implications for both domestic and industrial water usage, particularly in terms of its impact on household appliances, plumbing, and even on health. Hardness Classification: Soft Water: 0-60 mg/L**,** Moderately Hard Water: 61-120 mg/L, Hard Water: 121-180 mg/L, Very Hard Water: Above 180 mg/L for drinking water, the desired limit of hardness is generally: 300 mg/L (as $CaCO_3$) for drinking water (IS 10500:2012). Values above this level may indicate poor water quality for drinking, leading to scale formation in pipes and adverse health effects. Analysis of the collected samples data: Soft Water (0-60 mg/L): Values of 60 and below the Soft: Total of 10 samples, Moderately Hard Water (61-120 mg/L): Values from 61 to 120 mg/L. in moderately hard: Total of 11samples and only one sample is 150mg/L is Hard Water (121-180 mg/L fall into this category.

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COD

COD in Drinking Water Analysis According to Indian Standards In India, the Bureau of Indian Standards (BIS) sets the Standard for Drinking Water Quality under IS 10500:2012. The Chemical Oxygen Demand (COD) is not directly listed as a primary parameter in the standard. However, it is an important indicator for assessing the organic pollution in water and can give a general sense of water quality. Analysis of the collected samples data Low COD values (16–20 mg/L): Indicate relatively clean water. These values are within a range where water might be safe for drinking in this range six samples are indicate low COD value, Moderate COD values (24–28 mg/L): These values represent moderate contamination, likely from organic matter or wastewater. They are on the higher end of the acceptable range for drinking water. Water in this range may still be drinkable if treated properly. in this range six samples are indicate Moderate COD value High COD value (30< mg/L): A value of more than30 mg/L indicates higher levels of organic pollution. It suggests a possible contamination source that needs attention. In a drinking water context, this would require advanced treatment to reduce the organic load before the water is safe to drink. in this range three samples are indicate high COD value

Alkalinity: -

In India, the BIS Standards sets guidelines for the quality of drinking water, including a permissible range for alkalinity. According to the IS 10500:2012 standard, the permissible limit for total alkalinity in drinking water is 200 mg/L as $CaCO_3$ for acceptable quality. However, up to 600 mg/L is considered permissible in some cases for drinking water, though water with alkalinity beyond this value may cause issues like taste, scaling, or corrosion. From the samples analysis the 150 mg/L to 200 mg/L: These values fall within the desirable limit (150 mg/L to 200 mg/L) for drinking water quality according to Indian standards in these six samples are indicate. This range is considered optimal for drinking water because it provides enough buffering capacity without causing undesirable effects on taste or plumbing, 175 mg/L to 225 mg/L: These values are also acceptable and fall within the range of being acceptable by the standards for drinking water seven samples are indicate this range and 300 mg/L to 325 mg/L: These values are on the higher end, above the desirable limit of 200 mg/L, but still well below the upper permissible limit of 600 mg/L. While they are still safe, they may affect the water's taste and could lead to scaling in pipes and appliances in this range five samples are indicating this category

Nitrite (NO_2) Levels in Drinking Water

According to **IS 10500**, the permissible limit for nitrite (NO_2) in drinking water is 1 mg/L. This means that any concentration of nitrite in drinking water above 1 mg/L would be considered unsafe for consumption. The Range of all samples nitrite concentration values range from 0.10 mg/L to 0.50 mg/L. Concentration Comparison: Maximum Value: The maximum concentration is 0.50 mg/L. Minimum Value: The minimum concentration is 0.10 mg/L. Average: The average concentration can give a clearer sense of the overall water quality, but based on the data analysis, it's clear that the values are all significantly below the maximum permissible limit of 1 mg/L for nitrite.

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Ammonia_NH

To analyze the water quality for drinking purposes using the "Desirable Limit" of Indian Standards, particularly for Ammonia (NH_3), let's refer to the guidelines given by the BIS Standards in the Indian Standard IS 10500:2012, which outlines the standards for drinking water quality for is Ammonia is Desirable Limit drinking water is 0.5 mg/L. and Maximum Permissible Limit: The maximum permissible limit is 1.5 mg/L. from analysis of selected samples Your given data for Ammonia in water consists of the all readings l of which are 0 mg/L or not detected all the samples

DO_mg_l

To analyse the water quality for drinking purposes of Dissolved Oxygen (DO) in water to compare "Desirable Limit" for Dissolved Oxygen (DO) as per the Indian Standards (IS) for drinking water quality. According to the BIS, Standards the Desirable Limit of DO in drinking water is generally between 6.0 mg/L to 8.0 mg/L. Most of the analysis of sample values (19 out of 22) fall within the desirable limit (6.0 - 8.0 mg/L).and only , 3 values are below the desirable minimum of 6.0 mg/L (5.60, 5.60, 4.80).

Fluoride

To assess the water quality for drinking purposes in terms of fluoride concentration based on the Desirable Limits of Indian Standards (BIS) for drinking water, to compare the measured fluoride levels with the guidelines provided by the Bureau of Indian Standards (BIS). According to IS 10500: 2012 (Indian Standard for Drinking Water), the desirable limit for fluoride in drinking water is 0.5 to 1.0 mg/L (milligrams per liter), and the permissible limit in case of absence of alternate source of drinking water is 1.5 mg/L. All fluoride values of collected samples are below 1.0 mg/L (the upper limit of the desirable range). None of the fluoride values exceed the 1.5 mg/L permissible limit, so no values are out of the permissible range for drinking water. The fluoride concentration in the water is within the acceptable range for drinking purposes.

Chloride_m

To analyze the water quality for drinking purposes with respect to the chloride concentration, compare the calculated chloride values against the Desirable Limit as per Indian Standards for drinking water quality, which is set by the BIS Standards Desirable Limit: 250 mg/L Permissible Limit: 1000 mg/L (in the absence of an alternate source of drinking water). All values are acceptable for drinking purposes based on the Desirable Limit for chloride concentration. However, eight samples are above 100 mg/L might cause some taste issues for consumers, but they would still be safe for consumption.

EC

In order to analyze the water quality for drinking purposes based on electrical conductivity (EC), it's important to consider the acceptable range for EC values as per Indian standards are between 300 to 1500 µS/cm. Values higher than this can indicate the presence of excessive dissolved salts or minerals, which could affect the taste and safety of the water. Within Desirable Limits (300–1500 µS/cm): Most of the values of samples (15 out of 22) fall within the desirable range, which suggests that a significant portion of the water samples is within an

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acceptable level of conductivity for drinking purposes. Above Desirable Limits (Exceeding 1500 µS/cm): five values exceed the recommended EC limit for drinking water, which indicates a higher concentration of dissolved minerals or salts that may be undesirable for consumption. These values can affect the taste and could potentially pose health risks if consumed over a prolonged period.

TDS_mg_l

To assess the water quality for drinking purposes based on Total Dissolved Solids (TDS) values, need to refer to the Indian Standards for Drinking Water Quality Desirable limit for TDS: 500 mg/L and Maximum permissible limit is 2000 mg/L TDS ≤ 500 mg/L of the analysis of samples the samples of Excellent to Good) 14 values fall under this range , 500 < TDS ≤ 1000 mg/L (Acceptable with slight taste) 5 values fall under this range and TDS > 1000 mg/L (Water may have a noticeable taste, and can be borderline acceptable) 2 out of 22values fall under this range.

Conclusion:

The collected water samples are largely within the acceptable limits for drinking water quality, based on the various parameters analyzed. There are a few areas for concern, such as higher COD values, elevated EC in some samples, and hardness levels in a few instances, which may require further treatment to ensure the water is optimal for consumption. Nonetheless, most samples show satisfactory quality, with only a few requiring attention for improvement.

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