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"ASSESSMENT OF PHYSICO-CHEMICAL CHARACTERISTICS OF DAM WATER IN KHODRI REGION, CHHATTISGARH FOR DRINKING AND IRRIGATION SUITABILITY"

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A. ABSTRACT:

The present study focuses on the assessment of physico-chemical characteristics of storage dam water in the Khodri region, including Khanda and Jamgahana villages of Chhattisgarh, India, to evaluate its suitability for drinking and irrigation purposes. Water samples were collected from different locations of the storage dam and analyzed using standard procedures. Key physico-chemical parameters such as temperature, pH, turbidity, electrical conductivity (EC), total dissolved solids (TDS), total hardness, alkalinity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chlorides, nitrates, sulfates, calcium, magnesium, fluoride, and iron were determined. The results indicate that most parameters were within the permissible limits prescribed by the Bureau of Indian Standards (BIS) and the World Health Organization (WHO) for drinking water, although slight variations were observed across sampling sites. Elevated turbidity and nutrient levels at certain locations suggest localized influences of agricultural runoff and anthropogenic activities**.** The water quality was found to be generally suitable for irrigation, supported by acceptable salinity and hardness levels. The study highlights the importance of continuous monitoring of storage dam water, as seasonal

variations and human activities may impact its quality over time. Proper management and preventive measures are recommended to maintain water quality and ensure its safe utilization for domestic and agricultural purposes. This research provides baseline data for future environmental assessment and sustainable water resource management in the Khodri region.

B. KEYWORDS: Physico-chemical analysis, Dam water quality, Drinking water suitability, Irrigation water quality, Water quality assessment, Khodri region, Water Quality Index (WQI).

C. INTRODUCTION:

Water is one of the most vital natural resources, essential for sustaining life, agricultural productivity, and socio-economic development. In rural regions such as Khodri, including Khanda and Jamgahana villages of Chhattisgarh, **storage dams (reservoirs)** serve as a primary source of water for **drinking, irrigation, and domestic purposes**. However, the quality of reservoir water is highly influenced by both natural processes and human activities, making its regular assessment crucial for ensuring safe and sustainable use.

The **physico-chemical characteristics of water** provide important insights into its quality and suitability for various purposes. Parameters such as pH, temperature, turbidity, electrical conductivity (EC), total dissolved solids (TDS), total hardness, alkalinity, dissolved oxygen (DO), biochemical oxygen demand (BOD), and concentrations of major ions like chlorides, nitrates, sulfates, calcium, and magnesium are commonly used to evaluate water quality. Variations in these parameters may arise due to geological formations, seasonal changes, surface runoff, and anthropogenic influences such as agricultural activities, disposal of domestic waste, and soil erosion.

Figure 1: Sampling site Khodri village area.

Storage dam water bodies are particularly vulnerable to contamination because they collect runoff from surrounding catchment areas. In agricultural regions, the use of fertilizers and pesticides can lead to increased levels of nutrients such as nitrates and phosphates, which may deteriorate water quality and pose risks to human health. Additionally, changes in water quality can directly impact irrigation practices by affecting soil properties, crop yield, and long-term agricultural sustainability. To ensure the safe use of water, national and international standards such as those prescribed by the Bureau of Indian Standards (BIS) and the World Health Organization (WHO) provide guideline values for various physico-chemical parameters. Comparing observed values with these standards helps in determining whether the water is suitable for drinking and irrigation purposes. The present study aims to assess the physico-chemical characteristics of storage dam water in the Khodri region of Chhattisgarh and to evaluate its suitability for drinking and agricultural use. The study also seeks to identify possible sources of contamination and provide baseline data for future monitoring and water resource management. Such investigations are essential for promoting sustainable utilization and protecting water quality in rural environments.

D. Literature review:

Water is a fundamental natural resource essential for human survival, agriculture, and ecosystem stability, and its quality is determined by its physical, chemical, and biological characteristics (Singh & Yadav, 2022) . Physico-chemical analysis is widely used as a reliable method to evaluate water quality, as it provides detailed information about the composition and suitability of water for various purposes (Dewangan et al., 2024) . Key

parameters such as pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), turbidity, and dissolved oxygen (DO) are considered essential indicators in water quality assessment studies (Zine et al., 2025) . Several studies have reported that deviations in these parameters can significantly affect human health, agricultural productivity, and aquatic life (Patil et al., 2012). Natural processes such as weathering of rocks, soil leaching, and seasonal variations also influence the physico-chemical properties of surface water (Patil et al., 2012) . Anthropogenic activities including industrial discharge, agricultural runoff, and urbanization have been identified as major contributors to water pollution and deterioration of water quality (Dewangan et al., 2024) . Water quality assessment using physico-chemical parameters is an essential tool for identifying pollution sources and implementing effective water management strategies (Kumar et al., 2022) . Temperature and pH play a crucial role in controlling chemical reactions and biological processes in water bodies, thereby influencing overall water quality (Ma et al., 2020) . The presence of major ions such as calcium, magnesium, chloride, nitrate, and sulfate helps in determining the hardness, alkalinity, and suitability of water for drinking and irrigation (Udhayakumar et al., 2016). Studies have also emphasized that physico-chemical parameters are closely linked with aquatic biodiversity and ecosystem health, making them vital for environmental monitoring (Khan & Butt, 2022). Comparative analysis of water quality data with national and international standards such as BIS and WHO is necessary to determine its safety for human consumption (Udhayakumar et al., 2016).

E. MATERIALS AND METHODS:

1. Sampling Procedure

A single grab water sample was collected from the study site following standard sampling protocols. Grab sampling is widely used for preliminary assessment of water quality .

- The sample was collected from approximately 1–2 m away from the bank to avoid contamination from sediments and shoreline disturbances .
- Care was taken to collect water from a depth of about 30–50 cm below the surface to ensure representativeness.
- The sampling point was selected in a relatively undisturbed and deeper section of the water body, as recommended for single-sample studies .

2. Sample Collection and Preservation

- Water samples were collected in clean, acid-washed polyethylene bottles (1 L capacity).

- Prior to collection, bottles were rinsed with distilled water and then with sample water.
- The collected sample was properly labeled with date, time, and location.
- The sample was transported to the laboratory in an icebox and stored at 4°C to prevent physicochemical changes.
- Analysis was carried out within 24 hours of collection .

3. Materials and Instruments Used

- pH meter
- Conductivity meter
- Thermometer
- Turbidity meter
- Dissolved Oxygen (DO) meter / Winkler titration setup
- TDS meter
- Burettes, pipettes, conical flasks
- Spectrophotometer (for chemical parameters)
- Reagents of Analytical Grade (AR)

4. Physico-Chemical Parameters Analyzed

The following parameters were analyzed using standard procedures:

Physical Parameters

- Temperature
- Colour
- Turbidity
- Total Dissolved Solids (TDS)

Chemical Parameters

- pH
- Electrical Conductivity (EC)
- Dissolved Oxygen (DO)
- Total Hardness
- Total Alkalinity
- Chloride
- Nitrate
- Sulphate
- Calcium and Magnesium

These parameters are commonly used to evaluate water quality for drinking and irrigation purposes .

5. Analytical Methods

- All analyses were performed according to standard methods prescribed by APHA (American Public Health Association).
- pH was measured using an electrometric method.
- Total hardness and alkalinity were determined by titrimetric methods.
- DO was measured by Winkler's method.
- TDS and EC were measured using digital meters.
- Major ions (chloride, nitrate, sulphate) were analyzed using standard chemical and spectrophotometric methods .

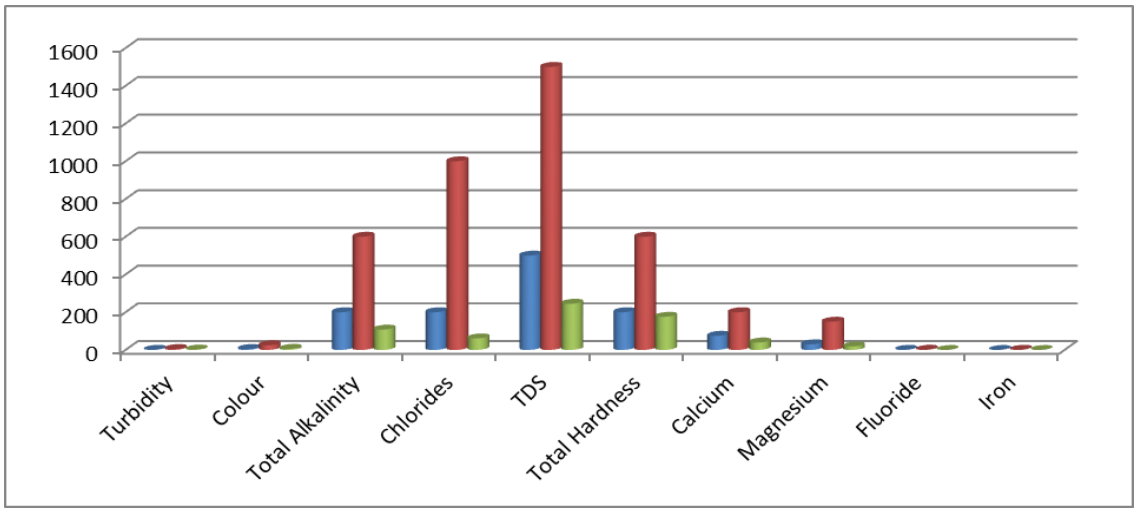
6. Data Analysis

- The obtained results were compared with BIS (IS 10500) and WHO standards for drinking water.
- Suitability for irrigation was assessed based on standard permissible limits of physicochemical parameters.
- If required, Water Quality Index (WQI) was calculated using standard formulas based on multiple parameters.

Table 1 : Physical properties of water sample taken from Water at Khodri village, Korea District Chhattisgarh.

S.No	Parameter	Unit	Acceptable	Cause of Rejection	Sample 1
1	Temperature	°C			
2	Turbidity	NTU	1	5	2.1
3	Colour	Pt.Co	5	25	6
4	pH		6.5-8.5	No Relaxation	10.14
5	Total Alkalinity	mg/l	200	600	108
6	Chlorides	mg/l	200	1000	61.44
7	TDS	mg/l	500	1500	245
8	Total Hardness	mg/l	200	600	175.86
9	Calcium	mg/l	75	200	39.59
10	Magnesium	mg/l	30	150	18.72
11	Fluoride	mg/l	1	1.5	0.2
12	Iron	mg/l	0.1	1	0.1

F. RESULT AND DISCUSSION:



Graph: 1: All Physico-chemical properties of water sample.

The analysis of Sample 1 indicates that turbidity (2.1 NTU) exceeds the acceptable limit of 1 NTU but remains within the permissible limit of 5 NTU, suggesting slight particulate contamination that may affect aesthetic quality (BIS, 2012; WHO, 2017).

The colour value (6 Pt-Co units) is marginally higher than the acceptable limit of 5 Pt-Co units, indicating the presence of dissolved organic matter or metallic ions, although still within permissible limits (BIS, 2012). The pH of the sample (10.14) is significantly higher than the acceptable range (6.5–8.5), indicating highly alkaline water, which may cause scaling, bitter taste, and potential health concerns (WHO, 2017; BIS, 2012). Total alkalinity (108 mg/L) is well within the acceptable limit of 200 mg/L, suggesting moderate buffering capacity and no immediate concern regarding alkalinity (APHA, 2017). Chloride concentration (61.44 mg/L) is within the acceptable limit of 200 mg/L, indicating minimal contamination from sewage or saline sources (WHO, 2017). Total dissolved solids (TDS) value (245 mg/L) falls within the desirable limit of 500 mg/L, reflecting good palatability and low mineralization (BIS, 2012).

Total hardness (175.86 mg/L) is within the acceptable range, classifying the water as moderately hard, which is generally suitable for drinking and domestic use (WHO, 2017). Calcium concentration (39.59 mg/L) is within acceptable limits, contributing positively to water hardness without posing health risks (APHA, 2017). Magnesium content (18.72 mg/L) is also within safe limits, indicating no adverse effect on taste or health (WHO, 2017). Fluoride level (0.2 mg/L) is below the optimum level (1.0 mg/L), which may reduce dental protection benefits, although it poses no risk of fluorosis (WHO, 2017). Iron concentration

(0.1 mg/L) is at the acceptable limit, indicating no significant issue related to staining or taste (BIS, 2012).

G. CONCLUSION:

Based on the physico-chemical analysis of Sample 1 and comparison with drinking water standards (BIS 10500:2012 and WHO guidelines), the overall water quality is mostly within acceptable limits, with a few important observations:

- Most parameters such as turbidity, total alkalinity, chlorides, TDS, total hardness, calcium, magnesium, fluoride, and iron are within acceptable or permissible limits, indicating good chemical quality of water.
- Colour (6 Pt-Co) slightly exceeds the acceptable limit (5 Pt-Co) but remains within the permissible range, suggesting minor aesthetic issues.
- Turbidity (2.1 NTU) is above the desirable limit but within the permissible limit, indicating slight suspended impurities.
- The most critical parameter is pH (10.14), which is significantly higher than the acceptable range (6.5–8.5), making the water highly alkaline.

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