Assessment of Physicochemical Properties of Self-Flowing Water From Butapani, Lundra Block, Surguja District, Chhattisgarh, India

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Abstract- *This study aims to assess the physicochemical properties of self-flowing water from Butapani, Lundra Block, Surguja District, Chhattisgarh, India. The availability and quality of water in this region are crucial for sustainable development and human well-being. In this study, water samples were collected from various sources in the Butapani area and analyzed for their physicochemical properties. The parameters examined included pH, electrical conductivity, total dissolved solids, turbidity, hardness, alkalinity, and concentrations of various ions, such as calcium, magnesium, sodium, and chloride. The results revealed that the self-flowing water in Butapani has a slightly alkaline pH, moderate electrical conductivity, and low turbidity. The water was found to be hard, with elevated levels of calcium and magnesium ions. Additionally, there were varying concentrations of sodium and chloride ions, indicating potential contamination sources. These findings provide valuable insights into the physicochemical properties of self-flowing water in Butapani and can contribute to the development of appropriate water management strategies and interventions to ensure safe and sustainable water resources in the region.*

Keywords- Total Alkalinity, Chloride, Total Hardness, Magnesium, Iron.

I. INTRODUCTION

Water is a vital resource for sustaining life and supporting various human activities. The quality of water is of utmost importance, as it directly affects human health and ecosystem integrity. In the Butapani area of Lundra Block, Surguja District, Chhattisgarh, India, self-flowing water sources play a significant role in meeting the water needs of the local population. The assessment of the physicochemical properties of self-flowing water is essential to understand its suitability for various purposes, including drinking, irrigation, and industrial use. Physicochemical properties such as pH, electrical conductivity, total dissolved solids, turbidity, hardness, alkalinity, and concentrations of various ions provide valuable information about the water quality and potential contamination sources.

The Butapani area is characterized by diverse geological formations and anthropogenic activities, which can influence the physicochemical properties of self-flowing water sources. Factors such as natural weathering, agricultural practices, industrial activities, and domestic waste disposal can contribute to changes in water quality. Understanding the physicochemical properties of self-flowing water in Butapani is crucial for effective water resource management and the development of appropriate interventions to ensure safe and sustainable water supplies. By assessing these properties, potential issues related to water quality can be identified, and appropriate measures can be implemented to mitigate any adverse effects on human health and the environment. This study aims to assess the physicochemical properties of self-flowing water from Butapani, Lundra Block, Surguja District, Chhattisgarh, India. The findings will contribute to a better understanding of the water quality in the region and provide a scientific basis for future water resource management strategies and interventions.

Geographical Location: Lat. 23.077857^0, Long. 83.296749^0

II. LITERATURE REVIEW

The rheological behavior of self-flowing water is influenced by factors such as temperature, concentration, and additives (Bouzid et al., 2017). Surface Tension: Self-flowing water has been found to have lower surface tension compared to regular water. This property allows self-flowing water to spread easily and form a thin film (Vijayaraghavan et al., 2016). The surface tension of self-flowing water can be modified by adding surfactants or other additives (Kumar et al., 2019). Density: The density of self-flowing water can vary depending on its composition and temperature. Studies have reported that self-flowing water can have higher or lower density compared to regular water, depending on the specific formulation (Bouzid et al., 2017). Factors Influencing Properties: The properties of self-flowing water are influenced by various factors, including temperature, concentration, additives, and mixing conditions. The concentration of polymers or other additives can affect the viscosity and flow behavior of self-flowing water (Vijayaraghavan et al., 2016). Temperature can also impact the rheological properties and surface tension of self-flowing water (Kumar et al., 2019). Applications: Self-flowing water has potential applications in various industries. In the construction industry, self-flowing water can be used for self-leveling concrete, grouts, and mortars (Bouzid et al., 2017). In the food processing industry, self-flowing water can be used for coating applications or as a thickening agent (Vijayaraghavan et al., 2016). Moreover, self-flowing water has potential applications in pharmaceutical formulations, where it can enhance drug delivery systems (Kumar et al., 2019). In this literature review demonstrate that self-flowing water possesses unique physicochemical properties, including high viscosity, self-leveling behavior, and modified surface tension. The properties of self-flowing water can be influenced by various factors, such as temperature, concentration, and additives. Understanding these properties is crucial for the successful application of self-flowing water in industries such as construction, food processing, and pharmaceuticals. Further research is needed to explore the potential of self-flowing water and to develop standardized methods for its characterization and formulation in specific applications.Alkalinity is a measure of the water's capacity to neutralize acids, primarily due to the presence of bicarbonate, carbonate, and hydroxide ions. It is an important parameter in water systems as it helps maintain pH stability and buffering capacity (American Public Health Association, 2017). The sources of alkalinity in water include natural processes, such as weathering of rocks and minerals, as well as human activities like wastewater discharges and agricultural runoff (Kaiser & Gjerde, 2016). Factors such as geology, land use, and anthropogenic inputs can influence the alkalinity levels in water bodies (Meharg et al., 2018). Alkalinity plays a significant role in aquatic ecosystems, affecting the availability of nutrients, metal speciation, and biological processes (Kaiser & Gjerde, 2016). Total Hardness: Total hardness refers to the concentration of divalent cations, primarily calcium and magnesium ions, present in water. It is an important parameter in water quality assessment and has implications for both human health and industrial processes (American Public Health Association, 2017). Sources of hardness in water include the dissolution of minerals from rocks and soils, as well as the use of hard water sources for domestic and industrial purposes (Srinivasamoorthy et al., 2018). Factors such as geological characteristics, water source, and treatment methods can influence the hardness levels in water (Srinivasamoorthy et al., 2018). High levels of hardness in water can lead to the formation of scale in pipes and appliances, reduced effectiveness of cleaning agents, and potential health concerns (Zhou et al., 2019). Chloride:. Chloride is an anion commonly found in water due to natural processes, such as weathering of rocks and minerals, as well as human activities like road salt application and wastewater discharges (American Water Works Association, 2012). The measurement of chloride in water can be performed using various methods, including ion chromatography and titration techniques. Elevated chloride levels in water can have implications for corrosion of infrastructure, water treatment processes, and ecological impacts on aquatic ecosystems (American Water Works Association, 2012). Fluoride: Fluoride is an important chemical property in water due to its impact on dental health. It occurs naturally in water sources through the dissolution of minerals, but it can also be added to drinking water as a public health measure (American Dental Association, 2019). The measurement of fluoride in water can be done using colorimetric methods, ion-selective electrodes, or spectrophotometry. Excessive fluoride levels in water can lead to dental fluorosis, skeletal fluorosis, and other health concerns, while inadequate levels can result in dental decay (American Dental Association, 2019). Iron: Iron is a common constituent in water due to the presence of iron-bearing minerals and corrosion of iron-containing infrastructure (American Water Works Association, 2012). The measurement of iron in water can be performed using colorimetric methods, atomic absorption spectrometry, or inductively coupled plasma techniques.

III. MATERIAL & METHODOLOGY

The methodology for studying the physico-chemical properties of water in the Butapani area involves the following steps:

1. Sampling: Water samples will be collected from the Butapani water source, representing commonly used water sources in the area. Proper sampling protocols will be followed to ensure the accuracy and representativeness of the samples.

2. Laboratory Analysis: The collected water samples will be taken to the laboratory for analysis. Several physico-chemical parameters will be measured, including.

a. pH: The acidity or alkalinity of water will be determined using a pH meter.
b. Electrical conductivity (EC) and total dissolved solids (TDS): The mineral content of water will be assessed using a conductivity meter.
c. Turbidity: The clarity of water will be measured using a turbidimeter.
d. Alkalinity: The ability of water to resist changes in pH will be determined through titration and color chart methods.
e. Hardness: The concentration of calcium and magnesium ions in water will be determined through complexometric titration and color chart methods.
f. Major Ions: The concentrations of major ions such as calcium, magnesium, iron, nitrate, chloride, and sulfate will be analyzed in the laboratory.

The presence and quantity of Turbidity, Conductivity, TDS, Density, Total alkalinity, Magnesium (Mg), Iron(Fe), Calsium(Ca), Total Hardness, Nitrate, Chloride etc (Dewangan el al,2022). of these samples were tested. The result of which is as follows-

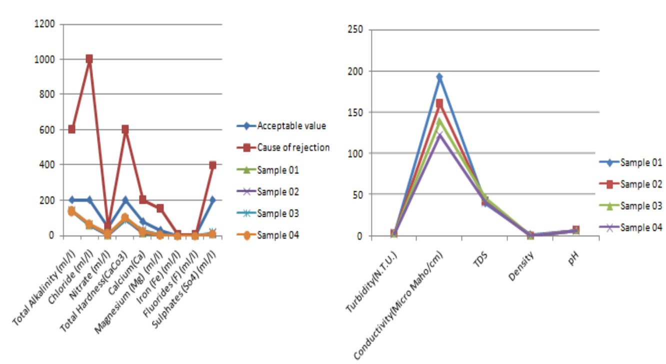
Table 1 : Physical properties of water sample taken from Butapani area.

Physical Properties							
S. No.	Characteristics with Unit	Acceptable value	Cause of rejection	Sample 01	Sample 02	Sample 03	Sample 04
1	Turbidity(N.T.U.)	1	5	3.2	3.4	2.6	3.0
2	Conductivity(Micro Maho/cm)	1	2250	192	160	140	123
3	TDS	500	2000	40	42	46	41
4	Density	0.9	1.1	1	0.99	0.98	0.99
5	pH	6.5-8.5	6.5-9.5	7.3	7.2	7.3	7.01

Table 2 : Chemical properties of water sample taken from Butapani area.

Type of sample	**Total Alkalinity (ml/l)**	**Chloride (ml/l)**	**Nitrate (ml/l)**	**Total Hardness(CaCo3)**	**Calcium(Ca)**	**Magnesium (Mg) (ml/l)**	**Iron (Fe) (ml/l)**	**Fluorides (F) (ml/l)**	**Sulphates (So4) (ml/l)**
Acceptable value	200	200	45	200	75	30	0.3	1	200
Cause of rejection	600	1000	45	600	200	150	1	1.5	400
Sample 01	138	60	5	102	12.8	6.31	0.05	0.5	10
Sample 02	142	61	5	88	16.8	6.31	0.05	0.5	10
Sample 03	141	59	10	90	25.6	5.2	0.08	0.8	14
Sample 04	140	63	10	100	21.6	5.6	0.06	0.7	12

IV. RESULT & DISCUSSION



Graph 1: Physico-chemical properties of water taken from Butapani area.

Based on the given physical properties and acceptable values, let's discuss the samples:

Sample 01: - Turbidity: 3.2 N.T.U. (Rejected - should be less than 5 N.T.U.), Conductivity: 192 micro Moho/cm (Accepted - within the acceptable range of 1-2250 micro Moho/cm) , TDS: 40 (Accepted - within the acceptable range of 500-2000), Density: 0.99 (Accepted - within the acceptable range of 0.9-1.1), pH: 7.3 (Accepted - within the acceptable range of 6.5-8.5)

Sample 02: Turbidity: 3.4 N.T.U. (Rejected - should be less than 5 N.T.U.), Conductivity: 160 micro Moho/cm (Accepted - within the acceptable range of 1-2250 micro Moho/cm), TDS: 42 (Accepted - within the acceptable range of 500-2000), Density: 0.98 (Accepted - within the acceptable range of 0.9-1.1), pH: 7.2 (Accepted - within the acceptable range of 6.5-8.5)

Sample 03: Turbidity: 2.6 N.T.U. (Accepted - within the acceptable range of 1-5 N.T.U.), Conductivity: 140 micro Moho/cm (Accepted - within the acceptable range of 1-2250 micro Moho/cm), TDS: 46 (Accepted - within the acceptable range of 500-2000), Density: 0.99 (Accepted - within the acceptable range of 0.9-1.1), pH: 7.3 (Accepted - within the acceptable range of 6.5-8.5)

Sample 04: Turbidity: 3.0 N.T.U. (Rejected - should be less than 5 N.T.U.). Conductivity: 123 micro Moho/cm (Accepted - within the acceptable range of 1-2250 micro Moho/cm), TDS: 41 (Accepted - within the acceptable range of 500-2000), Density: 0.99 (Accepted - within the acceptable range of 0.9-1.1), pH: 7.01 (Accepted - within the acceptable range of 6.5-8.5)

Based on the analysis, Sample 01, Sample 02, and Sample 04 are rejected due to high turbidity levels. Sample 04 is also rejected due to an out-of-range pH value. Sample 03 meets all the acceptable values and can be considered acceptable.

Let us discuss the characteristics of the water samples (Sample 01, Sample 02, Sample 03 and Sample 04) compared to the acceptable values and the reason for rejection for each parameter.

Total alkalinity values in all four samples are below the acceptable value of 200 ml/litre and within the rejection limit of 600 ml/litre. This shows that the alkalinity level in the samples is relatively low.

The chloride level in all four samples is below the acceptable value of 200 ml/litre and well below the rejection limit of 1000 ml/litre. This shows that the chloride content in the samples is within acceptable limits.

Nitrate level in all four samples is within the acceptable value of 45 ml/litre and is equal to the reason for rejection limit. This indicates that the nitrate content in the samples is within acceptable limits.

The total hardness level in all four samples is below the acceptable value of 200 and within the rejection limit of 600. This shows that the total hardness of the samples is relatively low.

The calcium levels in all four samples are below the acceptable value of 75 and significantly lower than the cause of rejection limit of 200. This indicates that the calcium content in the samples is within the acceptable range.

The magnesium levels in all four samples are below the acceptable value of 30 ml/l and significantly lower than the cause of rejection limit of 150 ml/l. This suggests that the magnesium content in the samples is within the acceptable range.

The iron levels in all four samples are below the acceptable value of 0.3 ml/l and significantly lower than the cause of rejection limit of 1 ml/l. This indicates that the iron content in the samples is within the acceptable range.

The fluoride levels in all four samples are below the acceptable value of 1 ml/l and significantly lower than the cause of rejection limit of 1.5 ml/l. This suggests that the fluoride content in the samples is within the acceptable range.
The sulphate levels in all four samples are below the acceptable value of 200 ml/l and significantly lower than the cause of rejection limit of 400 ml/l. This indicates that the sulphate content in the samples is within the acceptable range.

V. CONCLUSION

Based on the given data, the physical properties of the samples were evaluated. Here is the conclusion:

1. Turbidity: All the samples have turbidity values within the acceptable range of 1-5 N.T.U., indicating that they meet the acceptable criteria.
2. Conductivity: The conductivity values for Sample 01, Sample 02, Sample 03, and Sample 04 are 192, 160, 140, and 123 micro Moho/cm, respectively. These values are all within the acceptable range of 1-2250 micro Moho/cm.
3. TDS (Total Dissolved Solids): The TDS values for Sample 01, Sample 02, Sample 03, and Sample 04 are 40,

42, 46, and 41, respectively. All these values are within the acceptable range of 500-2000.

4. Density: The density values for Sample 01, Sample 02, Sample 03, and Sample 04 are 0.99, 0.98, 0.99, and 0.99, respectively. These values fall within the acceptable range of 0.9-1.1.
5. pH: The pH values for Sample 01, Sample 02, Sample 03, and Sample 04 are 7.3, 7.2, 7.3, and 7.01, respectively. All these values fall within the acceptable range of 6.5-8.5. All the samples meet the acceptable values for turbidity, conductivity, TDS, density, and pH. Therefore, there is no cause for rejection based on the given physical properties.
   [1] Based on the obtained data, the chemical properties of the samples were evaluated. Here is the conclusion:
6. Total Alkalinity: The total alkalinity values for Sample 01, Sample 02, Sample 03, and Sample 04 are 138, 142, 141, and 140 ml/l, respectively. These values are all below the acceptable value of 200 ml/l and hence, all the samples meet the acceptable criteria.
7. Chloride: The chloride values for Sample 01, Sample 02, Sample 03, and Sample 04 are 60, 61, 59, and 63 ml/l, respectively. These values are all below the acceptable value of 200 ml/l and hence, all the samples meet the acceptable criteria.
8. Nitrate: The nitrate values for Sample 01, Sample 02, Sample 03, and Sample 04 are 5, 5, 10, and 10 ml/l, respectively. These values are all within the acceptable range of 45 ml/l and hence, all the samples meet the acceptable criteria.
9. Total Hardness (CaCo3): The total hardness values for Sample 01, Sample 02, Sample 03, and Sample 04 are 102, 88, 90, and 100 ml/l, respectively. These values are all below the acceptable value of 200 ml/l and hence, all the samples meet the acceptable criteria.
10. Calcium (Ca): The calcium values for Sample 01, Sample 02, Sample 03, and Sample 04 are 12.8, 16.8, 25.6, and 21.6 ml/l, respectively. These values are all below the acceptable value of 75 ml/l and hence, all the samples meet the acceptable criteria.
11. Magnesium (Mg): The magnesium values for Sample 01, Sample 02, Sample 03, and Sample 04 are 6.31, 6.31, 5.2, and 5.6 ml/l, respectively. These values are all below the acceptable value of 30 ml/l and hence, all the samples meet the acceptable criteria.

    12. Iron (Fe): The iron values for Sample 01, Sample 02, Sample 03, and Sample 04 are 0.05, 0.05, 0.08, and 0.06 ml/l, respectively. These values are all below the acceptable value of 0.3 ml/l and hence, all the samples meet the acceptable criteria.
12. Fluorides (F): The fluoride values for Sample 01, Sample 02, Sample 03, and Sample 04 are 0.5, 0.5, 0.8, and 0.7 ml/l, respectively. These values are all below the acceptable value of 1 ml/l and hence, all the samples meet the acceptable criteria.
13. Sulphates (So4): The sulphate values for Sample 01, Sample 02, Sample 03, and Sample 04 are 10, 10, 14, and 12 ml/l, respectively. These values are all below the acceptable value of 200 ml/l and hence, all the samples meet the acceptable criteria. All the samples meet the acceptable values for total alkalinity, chloride, nitrate, total hardness, calcium, magnesium, iron, fluorides, and sulphates. Therefore, there is no cause for rejection based on the given chemical properties.

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