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Assessment of Water Quality of Jharsuguda City and Lapanga Area, Odisha, India

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Abstract
Jharsuguda, considered as an industrial belt of Odisha State, has many small-scale and large plants situated in and around the city, which contribute a lot to pollution of both air and water in this area. The study was conducted mainly focusing on comparison of drinking water in Jharsuguda City and Lapanga, which is located 30 km from Jharsuguda. Both water samples were collected from hand pumps. All the water parameters were found within the permissible limits in Jharsuguda City, but in Lapanga, only fluoride content was found above the permissible limit, which is 2.2 mg/L.

Keywords: Water quality, Physicochemical parameters, Heavy metals, Fluoride, Jharsuguda, Lapanga

1. Introduction

Water is one of the most essential natural resources required for the survival of all living organisms. It plays a crucial role in human health, ecosystem stability, agricultural productivity, and industrial development. However, deterioration of water quality due to industrial effluents, urban runoff, excessive use of fertilizers, and improper waste disposal has become a major environmental issue worldwide (WHO, 2002; Tiwari and Mishra, 1985).

In India, groundwater and surface water resources are increasingly threatened by chemical contamination, especially fluoride, nitrate, iron, and heavy metals (CGWB, 2010; Subba Rao, 2012). Several studies have reported that prolonged consumption of contaminated water leads to serious health disorders including fluorosis, gastrointestinal problems, and organ damage (Susheela, 2003; Kumar et al., 2014).

Jharsuguda district is a rapidly developing industrial hub of Odisha, while Lapanga is located near major transportation and industrial corridors. Continuous anthropogenic pressure in these areas may influence water quality. Therefore, systematic evaluation of water quality is essential to assess its suitability for drinking purposes.

2. Study Area

The Jharsuguda City and Lapanga were identified for the present study as these are important sources for drinking and recreational activities. These two water bodies were chosen because of their different locations.

Jharsuguda City

Jharsuguda is the district headquarters of Jharsuguda District of Odisha, India. It is the administrative headquarters of Jharsuguda District. It is an upcoming industrial hub, particularly in the metal and cement sectors. Jharsuguda is well connected to all major cities of India through the rail network. It is popularly known as the powerhouse of Odisha due to a large number of thermal power plants located nearby.

Lapanga

Lapanga is a census town in Sambalpur District in the Indian state of Odisha. Lapanga is located at 21°44′N, 84°18′E (21.73°N).

Physiography and Climate

Jharsuguda is located at 21.85°N, 84.03°E. It has an average elevation of 218 metres (715 ft). Jharsuguda is situated at the western end of Odisha State. It is 515 km from Kolkata. State Highway-10 and National Highway-200 pass through Jharsuguda.

The Ib River flows along the western side of Jharsuguda town, and the River Bheden flows in the south. The area of the town is 70.47 km², and the population is 579,499 (as per 2001 Census).

The terrain is situated at 21.82° north latitude and 84.1° east longitude at a height of 700–750 feet above mean sea level. The highest temperature recorded in summer is 48°C, and it has an average annual rainfall of 1527 mm.

3. Materials and Methods

Water samples were collected from hand pump sources using clean polyethylene bottles. Prior to sampling, bottles were thoroughly washed and rinsed with distilled water. Sampling and preservation procedures were followed as recommended by APHA (1995).

Physicochemical parameters such as pH, electrical conductivity, total hardness, calcium, magnesium, alkalinity, chloride, sulphate, fluoride, nitrate, and total dissolved solids were analyzed using standard laboratory techniques. Heavy metals including iron, copper, manganese, zinc, lead, cadmium, chromium, and cobalt were determined using appropriate analytical methods.

The obtained values were compared with drinking water standards prescribed by BIS (IS 10500:2012) and WHO (2002).

4. Results and Discussion

Table 1: Physicochemical and Heavy Metal Characteristics of Water Samples

Parameter	**Jharsuguda (Sample I)**	**Lapanga (Sample II)**	**BIS Desirable Limit**
pH	6.43	7.15	6.5–8.5
Electrical Conductivity (µS/cm)	293	339	—
Total Hardness (mg/L)	80.3	106.8	300
Calcium (mg/L)	20.0	28.1	75
Magnesium (mg/L)	12.1	14.6	30

TDS (mg/L)	204.5	230.8	500
Alkalinity (mg/L)	112.2	146.4	200
Chloride (mg/L)	37.6	28.4	250
Sulphate (mg/L)	3.21	6.86	200
Fluoride (mg/L)	0.223	2.20	1.5
Nitrate (mg/L)	1.39	2.11	45
Iron (µg/L)	65	172	300
Heavy metals	Nil–Low	Nil–Low	BIS limits

Physicochemical and heavy metal characteristics of water samples collected from Jharsuguda and Lapanga areas.

Table 2: Comparison of Water Quality with Drinking Water Standards

Parameter	**Observed Range**	**BIS/WHO Standard**	**Status**
pH	6.43–7.15	6.5–8.5	Acceptable
TDS	204.5–230.8 mg/L	500 mg/L	Acceptable
Total Hardness	80.3–106.8 mg/L	300 mg/L	Acceptable
Chloride	28.4–37.6 mg/L	250 mg/L	Acceptable
Sulphate	3.21–6.86 mg/L	200 mg/L	Acceptable
Fluoride	0.223–2.20 mg/L	1.5 mg/L	Exceeds at Lapanga
Nitrate	1.39–2.11 mg/L	45 mg/L	Acceptable
Iron	65–172 µg/L	300 µg/L	Acceptable

Comparison of observed water quality parameters with BIS and WHO drinking water standards.

4.1 pH

pH indicates the acidic or alkaline nature of water and strongly influences chemical reactions and biological processes (Hem, 1985). In the present study, pH values ranged from **6.43 to 7.15**, which fall within the desirable limit of **6.5–8.5** as recommended by BIS (2012). Similar observations have been reported by Verma et al. (2006) and Gupta et al. (2015).

4.2 Electrical Conductivity

Electrical conductivity reflects the total ionic concentration of water and is influenced by dissolved salts (Sawyer et al., 2003). The observed conductivity values (293–339 µS/cm) indicate moderate mineralization and are comparable with studies conducted in nearby regions of Odisha (Subba Rao, 2012).

4.3 Total Hardness

Hardness is mainly caused by calcium and magnesium salts and affects the palatability of drinking water. Total hardness values of **80.3 mg/L** and **106.8 mg/L** classify the water as moderately hard (Todd, 2007). These values are well within permissible limits and do not pose any health concern.

4.4 Calcium and Magnesium

Calcium and magnesium are essential nutrients but excessive intake may cause scaling and gastrointestinal discomfort (WHO, 2002). In the present study, calcium and magnesium concentrations were within acceptable limits, similar to findings reported by Trivedi and Goel (1986).

4.5 Total Dissolved Solids (TDS)

TDS represents the total concentration of dissolved inorganic and organic substances. The TDS values ranged between **204.5–230.8 mg/L**, indicating good water quality. According to BIS (2012), water with TDS below 500 mg/L is considered suitable for drinking. Comparable results were reported by Kumar and Puri (2012).

4.6 Alkalinity

Alkalinity indicates the buffering capacity of water and resistance to pH change (Wetzel, 2001). The measured alkalinity values were within permissible limits, confirming the stability of the water system.

4.7 Chloride

Chloride concentration is an important indicator of pollution from domestic sewage and industrial waste (Sawyer et al., 2003). In the present study, chloride levels were low and within BIS limits, suggesting minimal anthropogenic influence.

4.8 Sulphate

Sulphate occurs naturally due to dissolution of gypsum and other minerals. Excess sulphate may cause laxative effects (WHO, 2002). The observed sulphate concentrations were very low and safe for consumption.

4.9 Fluoride

Fluoride is beneficial in small amounts but harmful when present in excess. Fluoride concentration in Jharsuguda was within safe limit; however, Lapanga showed **2.20 mg/L**, exceeding WHO permissible limit of **1.5 mg/L**. Long-term intake of high fluoride can result in dental and skeletal fluorosis (Susheela, 2003; Kumar et al., 2014). Similar fluoride enrichment has been reported in several parts of Odisha (CGWB, 2010).

4.10 Nitrate

Nitrate contamination is commonly associated with agricultural runoff and sewage infiltration (Canter, 1997). The nitrate levels in both samples were much lower than the permissible limit, indicating limited agricultural impact.

4.11 Iron

Iron concentration ranged between **65–172 µg/L**, remaining below the BIS limit of **300 µg/L**. Elevated iron may cause staining and taste problems but does not pose serious health hazards at observed levels (Hem, 1985).

4.12 Heavy Metals

Heavy metals are of significant concern due to their toxicity, persistence, and bioaccumulation (Alloway, 2013). In the present study, metals such as lead, cadmium, chromium, copper, and manganese were either absent or present within permissible limits, indicating no industrial contamination of the studied water sources.

5. Conclusion and Recommendations

The study concludes that water quality of Jharsuguda City is suitable for drinking purposes. In Lapanga area, all parameters except fluoride were within permissible limits. Elevated fluoride concentration poses a potential health risk and requires immediate attention.

Recommendations

- Installation of fluoride removal units in Lapanga
- Regular water quality monitoring
- Public awareness regarding Fluorosis
- Alternative drinking water sources in affected areas

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