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Full Length Research Paper

A Study on the Seasonal Variations of Different Physico chemical Water Quality Parameters of Indrapuri Dam Rohtas District Bihar

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Abstract

The present paper deals with the study of physico chemical parameters of Indrapuri Dam in Rohtas district of Bihar. Monthly variations in the physical and chemical parameters were investigated for a period of one year (2011-2012).The study revealed that Air temperature ranging from 23.0- 35.7°C,Water temperature ranging from 21.3- 28.8°C,pH ranging from 7.2 - 8.9, TDS ranging from 143-188 mg/l;DO ranging from 8.2-10.8 mg/l; Alkalinity ranging from 182-245 mg/l;Total hardness ranging from 123- 158 mg/l; Chloride ranging from 41- 70 mg/l; and Sulphate ranging from 32-58 mg/l. All the parameters were compared with standard values which are recommended by BIS and WHO.During the entire study period, selected parameters were within permissible limits. This represents that the Indrapuri dam is less polluted and can be used for agriculture, fish culture and domestic use.

Key words: *Alkalinity, Dissolved oxygen, Hardness, Irrigation, pH, Temperature, Water*

Introduction

Life is possible on earth due to the presence of water. About three-fourths of the earth's surface is covered with water. Water is also found below the earth's surface. It is present in air in the form of water vapour. About 70 per cent of the human body is water. The bodies of all plants and animals contain water. Water is found in three different forms - liquid, solid or gas, depending on the temperature but it constantly changes from one form to another. Changes in temperature will determine which of these forms predominates in a particular area. Water regulates the earth's temperature [1]. It also regulates the temperature of the human body, carries nutrients and oxygen to cells, cushions joints, protects organs and tissues, and removes waste. Water is continuously moving around the earth and constantly changing its form. It evaporates from land and water bodies and is also produced by all forms of life on earth. This water vapour moves through the atmosphere, condenses to form clouds and precipitates as rain and snow [2]. In time, the water returns to where it came from, and the process begins all over again. Although, water is constantly moving, its total quantity on Earth's surface is constant.Surface water and groundwater have been studied and managed as separate resources, although they are interrelated. Surface water seeps through the soil and becomes groundwater. Conversely, groundwater can also feed surface water sources.

India is rich in water resources, being endowed with a network of rivers and blessed with snow cover in the Himalaya range that can meet a variety of water requirements of the country. However, with rapid increase in the population of the country and the need to meet the increasing demands of irrigation, human and industrial consumption, the available water resources in many parts of the country are getting de-pleted and the water quality has deteriorated[3].A dam is a barrier that impounds water or underground streams. A dam can also be used to collect water or for storage of water which can be evenly distributed between locations. In Table No 1, Drinking water standards of BIS (1998) and WHO(1993)is given. In Table No 2, classification of total hardness is given.

Table 1. Drinking Water Standards of BIS, 1998 and WHO, 1993.

S. No	Parameters	Units	BIS,1998		WHO,1993		Methods
1	pH	-	6.5	*9.2*	6.5	8.5	Electrometric
2	EC	(µS/cm)	-	-	-	-	Electrometric
3	TDS	mg/l	*500*	*1000*	300	600	Electrometric
4	TSS	mg/l	-	-	-	-	Electrometric
5	Total Hardness	mg/l	*300*	*600*	-	-	Titration *(EDTA method)*
6	Alkalinity	mg/l	*200*	*600*	-	-	Titration
7	Chloride	mg/l	*250*	*1000*	200	600	Titration
8	Dissolved Oxygen	mg/l	-	-	-	-	Winkler method

9	Free CO_2	mg/l	-	-	-	-	Titration
10	Nitrate	mg/l	-	-	-	-	Titration

Table: 2 Classification of Total Hardness

S. No	Grain per million	Parts per million	Classification
1	Less than 1.0	Less than 17.1	Soft
2	1.0-3.5	17.1-60	Slightly hard
3	3.5-7.0	60-120	Moderately hard
4	7.0-10.5	120-180	Hard
5	Over 10.5	Over 180	Very hard

Material and Methods

Study area

Indrapuri Barrage *(also known as the Sone Barrage, Opening date: 1968*) is across the Sone River in Rohtas district.The SoneRiver originates near Amarkantak in Madhya Pradesh just east of the headwater of the Narmada River, and flows north-northwest through Madhya Pradesh state before turning sharply eastward where it encounters the southwest-northeast-running Kaimur Range. The SoneRiver parallels the Kaimur hills, flowing east-northeast through Uttar Pradesh, Jharkhand and Bihar states to join the Ganges just above Danapur, Patna.

The Indrapuri Barrage at Indrapuri is 1,407 metres (4,616 ft) long and is the fourth longest barrage in the world. It was constructed by HCC, the company which constructed the 2,253 m long Farakka Barrage, the longest in the world. Construction of the Indrapuri barrage was taken up in the 1960s and it was commissioned in 1968. In 1873-74, one of the oldest irrigation systems in the country was developed with an anicut across the Sone at Dehri. Water from the Sone fed canal systems on both sides of the river and irrigated large areas. A barrage was constructed 8 Km upstream of the anicut. Two link canals connected the new reservoir to the old irrigation system and also extended it. There are 209 miles of main canals, 149 of branch canals and 1,235 of distributaries. The canals are of enormous benefit to cultivation. They have converted a large area of infertile land in to a richly productive area. There is a proposal for the construction of a dam across the Son, between Kadwan in Garhwa district of Jharkhand and Matiwan in Rohtas district of Bihar.

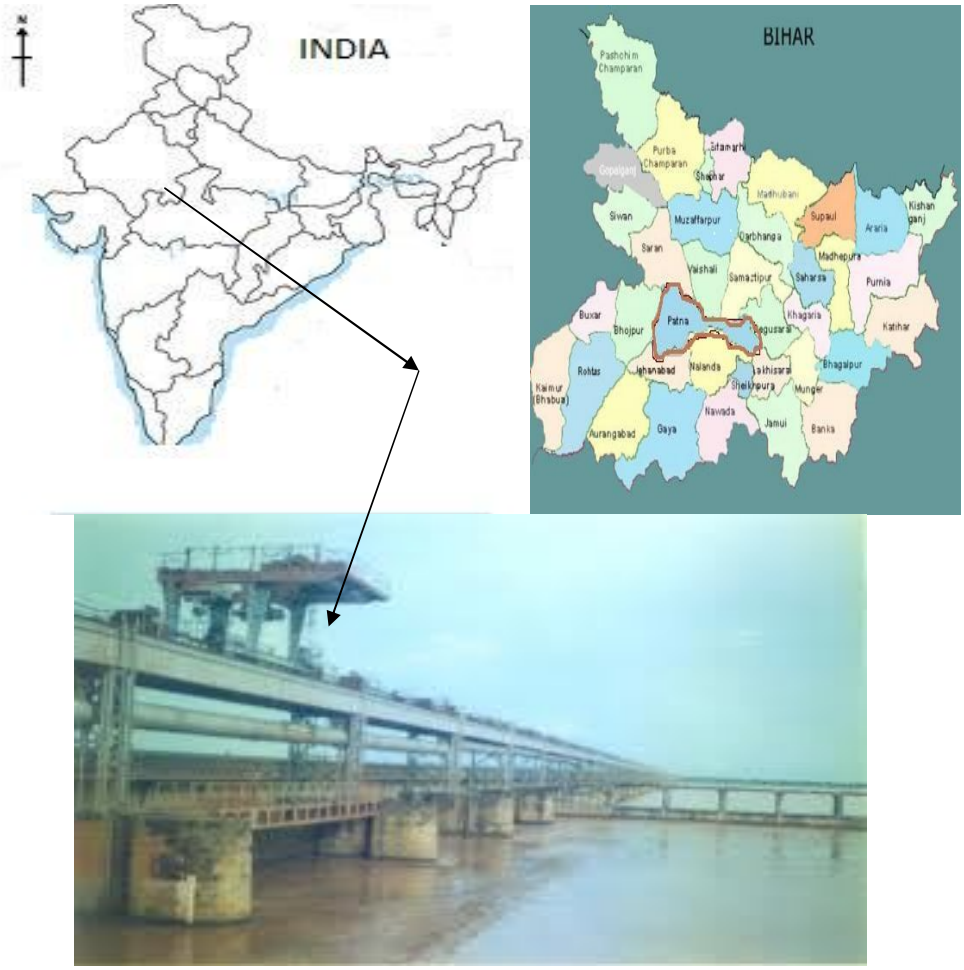

Figure 1. Map of Study Area (Indrapuri Dam, Rohtas)

Collection of Water Samples

Water samples of Indrapuri Dam were collected in high grade plastic bottles of one litre capacity rinsed with distilled water, and before collection of water samples they were rinsed thrice with sample water. The Dissolved oxygen (DO) was fixed at site and standard methods were adopted for the analysis of water samples.Some selected parameters were analysed within 36 hours. The reagents used for the analysis were AR grade and double distilled water used for the preparation of solution.

Results and Discussion

The results of the physico chemical analysis of different sampling seasons are presented in Table 3&4.

Table 3. Monthly variations of physico chemical parameters of Indrapuri Dam, Bihar.

S. No	Months	Atmospheric Temperature	Water Temperature	pH	TDS mg/L
1	October, 2011	27.5	24.4	7.2	148
2	November,	26.4	21.3	7.7	143
3	December	24.0	21.7	8.2	158
4	January, 2012	23.0	24.4	8.3	167
5	February	29.0	26.4	8.1	158
6	March	31.0	26.3	8.3	164
7	April	35.7	28.2	8.9	188
8	May	30.2	28.8	8.8	181
9	June	32.7	27.5	8.5	179
10	July	26.7	24.4	8.1	183
11	August	24.4	23.3	8.3	156
12	September	25.4	22.5	7.4	144

Atmospheric temperature: Atmospheric temperature is a measure of temperature at different levels of earth surface**.** It is governed by many factors including incoming solar radiation, humidity and altitude**.** Atmospheric **t**emperature varies as one move vertically upwards from the earth's surface. The atmospheric temperature was found to be in the range between 23^0C to 35.7^0C. It was minimum during January and December and maximum in the month of April &May.

Water temperature: Water temperature is an important factor which influences the chemical, biochemical and biological characteristics of water body. Water temperature of Indrapuri dam ranged between 21.3 mg/l to 28.8 mg/l. It was minimum during November and December and maximum in the month of April &May.

pH:pH is defined as a negative decimal logarithm of the hydrogen ion activity in a solution.In general, water with a low pH (< 6.5) could be acidic, soft, and corrosive. Therefore, the water could leach metal ions such as, iron, manganese, copper, lead, and zinc from the aquifer, plumbing fixtures, and piping. Therefore, water with a low pH could contain elevated levels of toxic metals, cause premature damage to metal piping, and have associated aestheticproblems such as a metallic or sour taste, staining of laundry. Water with a pH > 8.5 could indicate that the water is hard. Hard water does not pose a health risk, but can cause aesthetic problems.pHof the selected water sample was found in the range of 7.2 to 8.9.The minimum pH was recorded in the month of October and it was highest in the month of April and May.

Total Dissolved Solids (TDS): Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Some dissolved solids come from organic sources, industrials waste and sewage. Other sources come from urban areas, road salts used on street during winter and fertilizers and pesticides used on lawns and farms. In this investigation, the TDS ranged between 143 mg/litre to 188 mg/litre.Therefore, some total dissolved solids come from inorganic materials such as rocks and air that may contain calcium bicarbonate, nitrogen, iron, phosphate, sulphur and other minerals.

Table 4. Monthly variations of physic chemical parameters of Indrapuri Dam, Bihar

Months	Dissolved oxygen mg/L	Alkalinity mg/L	Total hardness mg/L	Chloride mg/L	Sulphate mg/L
October,2011	9.5	186	126	68	37
November,	9.8	191	123	70	34
December	9.2	205	128	65	38
January,2012	9.5	227	125	62	32
February	9.7	218	128	66	42
March	8.5	224	139	41	48

April	8.4	237	135	45	51
May	8.2	245	147	42	55
June	8.4	228	152	46	45
July	9.8	218	158	42	42
August	10.5	216	149	62	58
September	10.8	182	151	58	52

Dissolved oxygen: Dissolvedoxygen (DO) is an important water quality parameter for support aquatic life. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. The lower the concentration, the greater the stress. A high DO level in a water supply is good because it makes drinking water taste better. However, high DO levels speed up corrosion in water pipes. For this reason, industries use water with the least possible amount of dissolved oxygen. Water used in very low pressure boilers have no more than 2.0 ppm of DO, but most boiler plant operators try to keep oxygen levels to 0.007 pm or less. In the present study, the values of DO ranged from 8.2 mg/litre to 10.8 mg/litre. The minimum DO was recorded in the month of summer season and maximum in the month of winter season.

Alkalinity: Alkalinity is important to aquatic organisms because it protects them against rapid changes in pH. Alkalinity is important in areas where acid rain is a problem. Alkalinity imparts a bitter taste and sour taste to water bodies. Alkalinity depends on pH, CO_2 and chloride [4]. The high value of alkalinity indicates the presence of weak and strong base such as carbonates, bicarbonates and hydroxides in the water body. Alkalinity can increase the pH, when the alkalinity comes from a mineral source such as calcium carbonate ($CaCO_3$). When $CaCO_3$ dissolves in water, the carbonate (CO_3^{2-}) can react with water to form bicarbonate (HCO_3^-), which produces hydroxide (OH^-):

$$CaCO_3\,(s) \leftrightarrow Ca^{2+} + CO_3^{2-}$$

$$CO_3^{2-} + H_2O \leftrightarrow HCO_3^- + OH$$

In the present study, the values of alkalinity ranged from 182mg/litre to 245 mg/litres.The minimum alkalinity was recorded in the month of winter season and maximum in the month of summer season.

Total hardness: Total hardness mainly depends upon the dissolved salts present in water.The water is classified as very hard if the values exceed 180 mg/l, therefore water can be considered as hard.Hard water requires more soap and synthetic detergents for home laundry and washing, and contributes to scaling in boilers and industrial equipment.Calcium and magnesium dissolved in water are the two most common minerals that make water hard. As water moves through soil and rock, it dissolves very small amounts of minerals and contribute little bit of hardness in water body.During the period of investigation, hardness inthe water sample was ranged between 123 mg/litre to 158 mg/litre.

Chloride: Chloride is commonly found in sewage, streams and wastewater. Chlorides are leached from various rocks into soil and water by weathering. The chloride ionis highly mobile and is transported to closed basins. Chloride increases the electrical conductivity of water and thus increases its corrosivity. In metal pipes, chloride reacts with metal ions to form soluble salts, thus increasing levels of metals in drinking-water. In lead pipes, a protective oxide layer is built up, but chloride enhances galvanic corrosion. It can also increase the rate of pitting corrosion of metal pipes. During the period of investigation, the chloride ranged found between 41mg/litre to 70 mg/litre. The maximum values of chlorides recorded during monsoon season while in summer less chloride content was recorded.

Sulphate: Almost all natural waters contain sulphate ions.Their concentrations vary according to the mineral content of the earth. In small amounts they are not significant but in large concentrations they present problems. Sulfates can be more troublesome because they generally occur in greater concentrations. Low to moderate concentrations of sulphate ions add palatability to water. During the present investigation, the sulphate ranged between 32mg/litre to 58 mg/litre. The minimum sulphate values were recorded in winter season and maximum during rainy season.

Conclusion

Thesurface water samples which were taken from the selected sampling locations such as Indrapuri Dam in Rohtas district wereanalysed and following conclusions were drawn:

The investigation reveals that allwater quality parameters were within permissible limits. This represents that the Indrapuri dam is less polluted at present and can be used for agriculture, fish culture, recreation purposes andother purposes. In future, there is a need of protection of Indrapuri damsfrom the gradual increase of picnic party or touristsas well as human pressure so that aquatic plants, animals and birds species would not disturb.

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