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Science

WATER QUALITY MONITORING OF RIVER KUAKHAI IN SMART CITY BHUBANESWAR

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ABSTRACT Water management should be at the heart of all smart cities planning .While there is a lot of emphasis on transportation and infrastructure development, water management remains limited to treatment of waste water, quality monitoring and smart metering in the government's smart cities strategy. Better management of waste water, so that it is not discharged untreated into nature and ends up polluting water sources, would mean that we could reuse the treated water for industry, agriculture and even domestic use .Today many water sources are polluted and others are under serious strain. Inefficiencies and water losses in urban water utility systems mean no Indian city yet supplies water 24x7 hours to its citizens. Factors such as population increase and especially urbanization mean that the world is forecast to use about 30% more water in 2025 than it did in 2000, with further water shortages expected. The present investigation is aimed at assessing the current water quality standard of the river Kuakhai in terms of physicochemical parameters. The river Kuakhai is a distributary of the river Mahanadi. The water of river Kuakhai is getting polluted due to discharge of domestic waste and water in to it. The different parameters measured were pH, DO, Total hardness, BOD, COD etc. The present study indicates that the water quality of the river Kuakhai is well within the tolerance limits taking the physicochemical parameters into considerations.

KEYWORDS : Smart city, Kuakhai, pH, DO, total hardness, BOD, COD.

1. INTRODUCTION:

A smart city is an urban development vision to integrate multiple information and communication technology (ICT), "Big Data" and Internet of Things (IoT) Solutions in a secure fashion to manage a city's assets for sustainability, resilience and livability. Meanwhile, water quality monitoring has been evolving to the latest wireless Sensor network (WSN) based solutions in recent decades. Water is said to be our life because we need it for drinking, bathing, relaxing, fishing and irrigating our crops (Senapati et al, 2018). Besides these we produce hydro energy from water and navigate in it. Water is so much an essential part of our life that ancient civilizations have been developed in almost all river valleys o0f our country. With the growth of the modern civilization our life is threatened due to pollution of water both from surface and underground. The doctors.

forecast that several stomach, liver and skin diseases spread due to polluted water. In our country, especially in the state of Odisha, the scarcity of pure drinking water is so much felt that 50% of urban people and 80% of rural people are affected by water pollution.

According to world Health Organization (WHO) estimates, about 80% of water pollution in developing countries like India is caused by domestic waste (Bhubaneswaran et al, 1999). In India numbers of studies have been carried out to access the water quality in terms of various physicochemical / biological characteristics and heavy metals of surface and ground water at various places (Gleick et al, 1993, Haribhau et al, 2012, Manimaran et a,l 2012, Parihar et al, 2012 and Patil et al, 2012). The growth in numbers lacking access to safe water and sanitation will be driven in large part by the growth rate of the people living in urban areas.

1) The water quality is assessed on use based water quality status. According to this concept, out of several uses a water body is put to the use which demands highest quality of water is termed as Designated Best Use (DBU) and accordingly the water body is designated. In India, water quality is usually assessed in respect of five broad categories as described in the following table.

Table 1: Use Based Classification

Class	Use
A	Drinking water source without conventional treatment but after disinfection
B	Organized outdoor bathing
C	Drinking water source with conventional treatment followed by disinfection
D	Fish culture and wild life propagation
E	Irrigation, industrial cooling or controlled waste disposal

Parameters for the above classifications are grouped in three categories.

I) Simple parameters(sanitary surrounding, general appearance, color, smell, transparency, presence of fish and insects)
ii) Regular monitoring parameters and
iii) Special parameters to be monitored when need or apprehensions arise.

2) The requirements in respect of regular monitoring parameters for different classes are given in the following table.
Table 2: standards for regular monitoring parameters

Parameters		Requirements	
	Excellent	Desirable	Acceptable
pH	7.0-8.5	6.5-9.0	6.5-9.0
DO	6-8	6-9	5-9
Hardness	70-120	60-120	60-140
BOD(mg/L)	Below 2	Below 5	Below 8

Concentrations of all parameters are in mg/L except pH.
The present study aims at detecting the quality of water of the river Kuakhai in respect of physicochemical parameter studies.

2. METHODS AND PROCEDURES OF INVESTIGATION:

The entire area of Bhubaneswar is thoroughly studied and locations of the river Kuakhai were earmarked. Water samples were collected near Palasuni at five strategic locations two Kms distance apart from each other. One litre capacity of air tight polypropylene sampling bottles were taken for collecting the water samples. The bottles were sterilized before the collection of samples. The bottles were rinsed with the proposed collected water samples and the water samples were collected from different locations of the river Kuakhai. The temperature of the different water samples was determined at the site by the sensitive Red Mercury Thermometer, just after collecting the water samples. pH of the water samples were determined by the field pHmeter as well as the laboratory pHmeter. The Dissolved Oxygen

(DO) content was measured by the standard Winkler's alkali Iodide –azide method. The total hardness was measured by EDTA Complexometric titration method. The BOD test was carried out by the standard dilution method. The COD was estimated by titrating the experimental sample against standard potassium dichromate solution.

3. RESULTS AND DISCUSSIONS:

The river Kuakhai is a distributary of the river Mahanadi and the main source of water for the smart city Bhubaneswar and its adjoining areas. River Kuakhai receives a huge amount of domestic waste and waste water along with the untreated sewerage generated from the city. Due to rapid industrialization and urbanization the river is regularly contaminated with the discharge of effluents. To ascertain the quality and physicochemical characteristics of river Kuakhai, a thorough study has been conducted throughout from January 2017 to December 2017.

The variation of different water parameters in different seasons are described a s follows.

Winter

In winter pH of water samples were varied between 7.7 to 8.2. The DO of water samples were varied between 7.9mg/ L to 8.4 mg/L. The total hardnesss of water samples were varied from 67-80mg/L.BOD of water samples were varied from 1.3 to 1.7mg/L. The COD values were varied from12.1 mg./ to 15mg/L.

Summer

In summer pH of water samples were varied between 8.0 to 8.3. The DO of water samples were varied between 7.0mg/ L to 8.4 mg/L. The total hardnesss of water samples were varied from 68-84mg/L. BOD of water samples were varied from 1.3 to 2.0 mg/L. The COD values were varied from10.1 mg./ to 11.8mg/L.

Pre Monsoon

In summer pH of water samples were varied between 7.4 to 8.0. The DO of water samples were varied between 7.8mg/ L to 8.5 mg/L. The total hardnesss of water samples were varied from 58-70mg/L. BOD of water samples were varied from 1.6 to 2.0 mg/L. The COD values were varied from 10 mg./ to 10.7.8mg/L.

Monsoon

In summer pH of water samples were varied between 7.8to 8.0. The DO of water samples were varied between 7.6mg/ L to 8.5 mg/L. The total hardnesss of water samples were varied from 67-86mg/L. BOD of water samples were varied from 1.2to 2.0 mg/L. The COD values were varied from 15.6 mg./ to 16..8mg/L.

Post Monsoon

In summer pH of water samples were varied between 7.7to 8.2. The DO of water samples were varied between 7.5mg/ L to 8.7 mg/L. The total hardnesss of water samples were varied from 65-87mg/L. BOD of water samples were varied from 1.1 mg/L to 1.5 mg/L. The COD values were varied from 15.2 mg/L to 16.0mg/L.

Season description: water quality data has been described in terms of seasonal values. The seasons are defined as follows:

Winter (W): November, December, January,
Summer(S): February March, April, May,
Pre Monsoon (PRM): June
Monsoon (M): July, August, September
Post Monsoon (POM): October

The Data of the parameters measured is given in the following tables.

Table – I: Seasonal Average Values of pH

Sample	W	S	PRM	M	POM
S1	7.9	8.0	7.4	7.8	8.0
S2	7.8	8.2	7.5	7.9	7.8
S3	7.7	8.3	7.6	8.0	7.7
S4	8.1	8.2	7.9	8.0	7.9
S5	8.2	8.1	8	7.9	8.2

Table – II: Seasonal Average Values of DO in mg/l

Sample	W	S	PRM	M	POM
S1	8.4	7	8.2	8.5	8.0
S2	7.9	8.4	8.4	8.0	7.5
S3	8.3	7.5	8.5	7.8	7.8
S4	8.5	7.9	7.9	7.6	8.7
S5	8.1	7.8	7.8	7.8	8.6

Table – III: Seasonal Average Values of Hardness in mg/l

Sample	W	S	PRM	M	POM
S1	75	70	58	67	65
S2	67	68	60	72	72
S3	70	72	61	69	70
S4	73	82	63	78	76
S5	80	84	70	86	87

Table – IV: Seasonal Average Values of BOD in mg/l

Sample	W	S	PRM	M	POM
S1	1.5	2.0	1.8	1.9	1.5
S2	1.3	1.9	2.0	2.0	1.3
S3	1.7	1.7	1.7	1.6	1.4
S4	1.6	1.5	1.9	1.2	1.1
S5	1.4	1.3	1.6	1.3	1.2

Table –V Seasonal average values of COD in mg/L

Sample	W	S	PRM	M	POM
S1	15.0	11.8	10.0	15.6	15.2
S2	13.7	10.6	10.4	16.8	16.0
S3	12.3	11.0	10.6	16.4	15.8
S4	12.1	10.1	10.7	15.9	15.9
S5	14.6	11.7	10.3	16.6	15.6

4. CONCLUSIONS:

Water quality assessment of the river Kuakhai during the period Jan 2017 to Dec 2017 is discussed. Water quality assessment is done on the basis of use based classification, biological assessment and wholesomeness. From the discussions, it is observed that water quality of this river in all seasons conformed to class-D (fish culture and wild life propagation)

The river didn't confirm to class-A (drinking water source without conventional treatment but after disinfection) because of high total coliform bacterial counts. It also didn't conform to class-B (bathing water quality) with respect to coliform bacterial counts. Coliforms are a broad class of bacterial found in our environment including feces of man and other warm blooded animals.

The water quality also didn't conform to class-C (drinking water source after conventional treatment and after disinfection) with respect to BOD. The water quality is also deteriorated due to high coliform bacteria which may be attributed to the in stream activities on the river. It was observed that the water quality of the river is deteriorating day by day due to discharge of domestic waste and waste water into the river Kuakhai. In order to restore river water quality intact we must set up the septic tank of each household and the overflow of the septic tanks should be connected to the common drain carrying waste water. The waste water should be treated in the sewage treatment plant consisting of the grit chamber, primary clarifier, aeration tank and secondary clarifier (Ranjan et al, 2012). The result of the outlet should satisfy the general waste water discharge to inland surface water. Countries like Singapore which reuses nearly all of their waste water from domestic sewage to industrial waste. The treatment of waste water is of such high quality that some of Singapore's drinking water comes from completely treated waste water.

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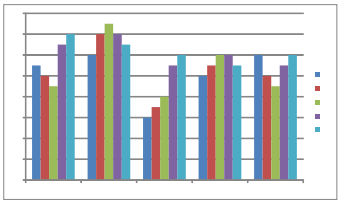

Fig.1 Seasonal Variation of pH at different locations

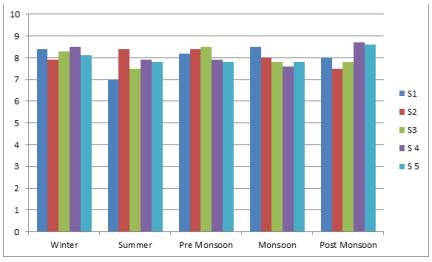

Fig.2 Seasonal Variation of DO at different locations

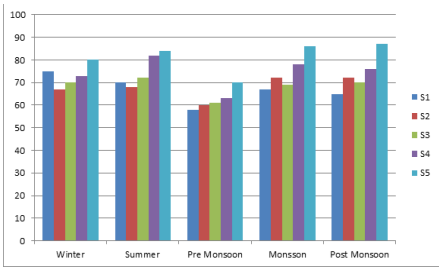

Fig.3 Seasonal Variation of total hardness at different locations

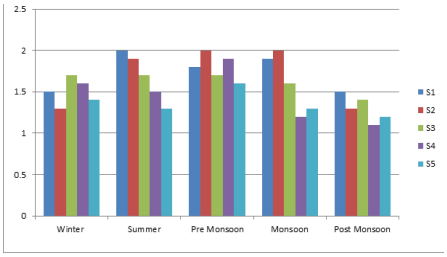

Fig.4 Seasonal Variation of BOD at different locations

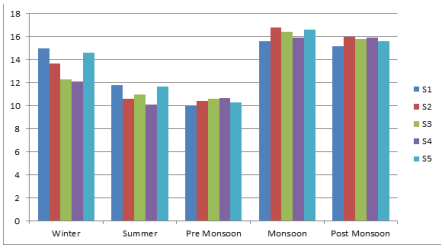

Fig.5 Seasonal Variation of COD at different locations

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