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A Comparative Statistical Study on Water Pollution Between the Ganga and the Yamuna Rivers

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***Abstract*:- The Water pollution is the biggest environmental problems on the earth. The most of all countries are affective for this problem. The quality of water flowing in the river which being polluted by water by sewage and animal waste and can cause diseases like gastroenteritis, salmonella infection, dysentery, hepatitis .According to water pollution OD and BOD are decreased and the water quality in terms of OD and BOD is not fit for designated best uses in the India. The water of the rivers is not healthy for human's body, biological environments and ecological systems. In this research paper we discussed for comparison between the Ganga and Yamuna rivers on waters pollution. The paper concludes with multidimensional recommendations for the improvement of water quality of both the Rivers.**

Keywords: Ganga River, Yamuna River, water quality, trends, parameter analysis, Oxygen Dissolved, BOD, Median test.

INTRODUCTION:

Water is one of the mainly essential of all natural resources known on earth. It is important to all livingorganisms, most ecological systems, human health,food production and economic development (Postel*et al.*, 1996).The water is used for various purposessuch as drinking without treatment, bathing, noncontactrecreational uses, public water supplies,industrial, agricultural, aquaculture and wildlifepropagation, navigation and waste receiving etc.(Sundararajan and Anand, 2011), But the clarity doesnot remain constant and varies from place to placein nature. Today pollution is one of the biggestproblems of water quality degradation in the Gangaand its tributaries increasing from year to year dueto the increase pollutant loads particularly fromcommercial and domestic sources, sewage dischargeand industrial effluent (Matta et *al.*, 2014). Thewater is contaminated due to population explosion,urbanization, industrialization and agriculturalpollution cause major alteration of water pollution.It is estimated that the Global annual risk ofcontracting infections disease from eating rawvegetables irrigated with untreated wastewater is in the range of 5-15% (Fattal *et al.*, 2004). The Ganga basin accounts for a little more than one-fourth(26.3%) of the country's total geographical area and is the biggest basin in India, covering the entirestates of Uttarakhand (CPCB, 2013). The Ganga has great ritual importance among pilgrims and touristsin India. The Ganga is a division and parcel of everyday life in the city and thousands of peoplebath daily in the Ganga, but the heaviness on the Ganga is increasing enormously due to ever increasing population, industrial and urban growth in the basin.

The Canal is being polluted due to massbathing, washing, disposal of sewage, industrial waste and these human activities are deterioratingits water quality (Seth *et al.*, 2013).

Clean water is absolutely essential for a healthy living. Pollution of river bodies has become a major global problem that is more critical in developing nations of the world due to inadequate measures to protect the surface water quality. All kinds of wastes (domestic, industrial, agricultural and others) are often discharged into the surface water bodies like lagoons, rivers and streams with little or no regard to their assimilative capacities. A wide variety of water quality variables is affected by various human activities while interacting with the water bodies. Dissolved oxygen (DO) of the river is one such parameter that is often used to measure the effect of pollution on the river. The biodegradable contaminants in water are quantified in terms of BOD, a parameter most related to DO. Both these parameters together are useful in tracing the pollution conditions and natural purification abilities of river and in determining permissible level of organic pollutants discharged in to the water bodies. The DO conditions in a river are provided by appropriate mathematical models relating the BOD-DO concentrations after the discharge of organic pollutants in a water body

MATERIALS AND METHOD:

The study area was located in Allahabad city in the south-eastern part of U.P (98m above the mean sea level). Allahabad district cover an area of 5246 sq.km. Population of Allahabad district as per the census 2011 was 5959798.The sampling station has been referred as Ganga (S1-Rasoolabad, S2- Mahaveerpuri, S3-Phaphamau, S4-Daraganj and S5-Ramghat) and Yamuna (S6-Old Bridge, S7-New Bridge and S8-Saraswati ghat).

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SAMPLE COLLECTION OF WATER QUALITY TREND OF THE GANGA AND YAMUNA RIVERS:

Water sample from the sampling station were collected on main bathing dates during the Mass bathing period and parameter was analyzed by the standard method.

S.NO	Years	BOD IN GANGA RIVER (G)	BOD IN YAMUNA RIVER(Y)
1.	2002	16.8	38
2.	2003	27	58
3.	2004	14.4	40
4.	2005	15.3	59
5.	2006	18.4	144
6.	2007	14	59
7.	2008	21	70
8.	2009	16	103
9.	2010	15	84
10.	2011	11	41
11.	2012	13	15
12.	2013	9	25
13.	2014	18	105
14.	2015	12	20
15.	2016	10	39
16.	2017	12.5	81

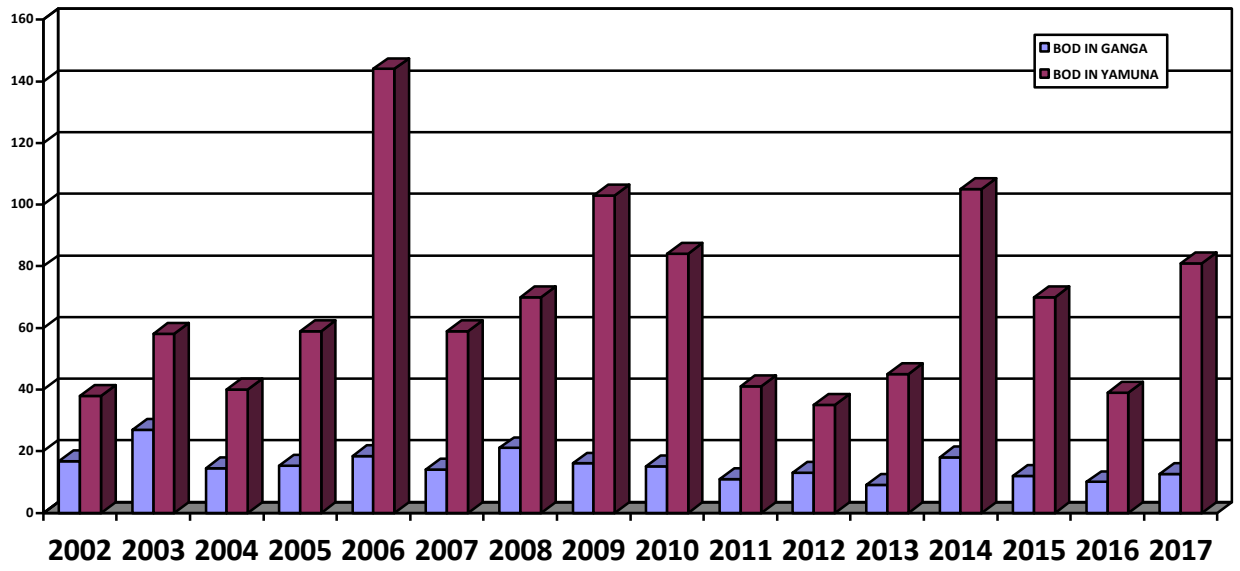

Figure 1

ENVIRONMENTAL MATHEMATICAL FORMULATION:

It is a important method for determining the economical growth may also elaborate the effect on GDP of that country. Although there has been substantial efforts to improve human health quality but less emphasis has been placed on the relevance of clean environment, particularly in developing countries like India. In India most public health policies and human development index have failed due to contaminated water supply. Clean healthy water will not only promote economic development but also ensure a healthy labour force. The economic growth and water quality interaction model make basis GDP of any nation. This model also expressed poverty in society; the optimal strategy for promoting economic growth would be healthy humankind. Diverse infectious and non-infectious water-related diseases have direct impact on economy.

Asume that the biological oxygen demand observation for the Ganga follows distribution G and for Yamuna follows Y.the hypothesis that we take solution be stated as ,

$H_0 : G = Y$ and $H_1 : G < Y$

Where $G < Y$

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If $T_M \le k$, we reject H_0 and the water pollution is higher in Ganga as compared to Yamuna river. The combined ordered sample is given by:

Observation	9	10	11	12	12.5	13	14	14.4	15	15.1	15.3	16	16.8	18	18.4	20
Sample indicators	X_1	X_1	X_1	X_1	X_1	X_1	X_1	X_1	X_1	Y_1	X_1	X_1	X_1	X_1	X_1	Y_1
Observation	21	25	27	38	39	40	41	58	59	59	70	81	84	103	105	144
Sample indicators	X_1	Y_1	X_1	Y_1	Y_1	Y_1	Y_1	Y_1	Y_1	Y_1	Y_1	Y_1	Y_1	Y_1	Y_1	Y_1

Since $n_1 + n_2 = 32$ is even , median =20.50

so the smallest value in the pooled ordered sample is any number between 20 to 21 .

Here , $T_M = 2$ the corresponding p- value calculated to

$$p-value = P(T_M \le 2 / H_o)$$

$$p-value = \sum_{k=o}^{k=2} \frac{\binom{n-n_1}{k}\binom{n_1}{n_2-k}}{\binom{n}{n_2}}$$

For $n = 32, n_1 = n_2 = 16$, we have

$$p-value = \sum_{k=o}^{k=2} \frac{\binom{16}{k}\binom{16}{16-k}}{\binom{32}{16}}$$

$$= \frac{1}{\binom{32}{16}}\left[\binom{16}{0}\binom{16}{16}+\binom{16}{1}\binom{16}{15}+\binom{16}{2}\binom{16}{14}\right]$$

= 0.0017982

= .002

Since $p-value = P(T_M \le 2 / H_o) = 0.002 < 0.05$

Therefore, we rejected the null hypothesis; we concluded that the Yamuna River is highly polluted with comparison to the Ganga River.

CONCLUSION:

In this paper, a model is presented that effectively address the situation and accurately predict the condition of DO in rivers when partially treated/untreated waste is discharged into the rivers. The robustness of the model is established by two case studies using the data already published in the literature.

To show the robustness of the presented model, a real life data for the river Ganges (INDIA) is used to compare the concentration of DO predicted by the presented model, Bhargava's model, one dimensional model and observed DO values. A very good agreement of the DO concentration as predicted by the presented model with the observed values shows that the DO conditions in rivers can be predicted more accurately by the presented model in the situation when partially treated/untreated waste enters a river.

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