

# Effect of Religious Festivals on Physico-Chemical Characteristics of River Water and Water Quality Modeling

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**Abstract-** The Godavari river, life of millions people, provides water for the essential requirements of life .this river comes under the category of sacred river and it is unique in terms of religious and ecological significance, eutrofication, anthropogenic pressure, holy rituals and mass bathing have been the major factors which are responsible for the deterioration of river Godavari. bioremedial measures alone will no longer be effective to restore the river water quality. For present study six sampling stations were selected as they are allocated for shahi-snan during three parvani's. In this quality of Godavari river water is analyzed for physico-chemical characteristics for the period of forty five days. Every water sample is analyzed for temperature, pH, turbidity, electrical conductivity, total hardness, dissolved oxygen, biological oxygen demand, chemical oxygen demand, total dissolved solids, total suspended solids and chloride content. The study reveals that the river water was alkaline. the electrical conductivity and chloride concentrations were high in all six sampling stations after parvani. the stations which show grater pollution load had lower concentration of dissolved oxygen even of some stations it is absent. The use of software QUAL2K describes that hoe self purification capacity of the river is affected by the religious activities in kumbhamela as it generates waste in the form of nirmalya, sanitary waste etc.

**Keywords-** kumbhamela, Godavari, qual2k software, self purification capacity of river

## I. INTRODUCTION

Godavari is the holy river and there are many religious festivals celebrated along the bank of river such as kartik poornima, adhik mass, ganpati visarjan etc in which thousands of people gather and take holy dip but there is one more festival which is widely celebrated along the bank of river i.e. kumbhamela in which Millions of people take bath in to the sacred river during this period.

Simhastha kumbhamela along the bank of river Godavari River at Nasik it is one of the most important religious festival in Indian culture and heritage. Mass bathing in water bodies is an old ritual in India. the water bodies are used not only for holy dips but also for holy sip (Aachman).it is believed that holy dip purges away all the sins. Hence millions of people take holy dips in river, especially on some auspicious occasion. Kumbhamela and ardh kumbhamela are the events in which many such millions of people take holy dips in river. Generally, it is restricted to limited stretches of river as they are considered to be more sacred such as ramkund and kushawart in nashik. It is the power of faith that can part a river, move mountains, and endure the hardships that come bundled up for being an integral part of Kumbh Mela, a congregation of millions, gathered together to be freed from the vicious earthly cycle of life and death and move towards a heavenly realm, which knows no suffering or pain. It's the mythological history of India and the sacred religious texts that bind us carnal souls to an eternal hope - things will be better, without the ever-imminent fear of them getting worse that cripples us here. "An eternal life free of sins" is the promise that comes attached with the magnificent event of Kumbh Mela. It's a promise to which millions want to be bound with, and it is this promise that has made Kumbh Mela what it is today.

Legend has it that in the mythological times, during a waging war between the demigods and demons for the possession of elixir of eternal life, a few drops of it had fallen on to four places that are today known as Prayag, Haridwar, Ujjain, and Nasik. It is believed that these drops gave mystical powers to these places. It is to make oneself gain on those powers that Kumbh Mela has been celebrated in each of the four places since long as one can remember. The normal Kumbh Mela is held every 3 years, the Ardh (half) Kumbh Mela is held every six years at Haridwar and Allahabad (Prayag) while the Purna (complete) Kumbh mela takes place every twelve years, at four places Prayag (Allahabad), Haridwar, Ujjain, and Nashik, based on planetary movements. The Maha Kumbh Mela is celebrated at Prayag after 144 years

(after 12 'Purna Kumbh Melas').As we know all these aspects and all the beliefs of people from last many decades people come with faith and take holy bath in these sacred places. Depending on what position the Sun, Moon, and Jupiter hold in that period in different zodiac signs, the venue for Kumbh Mela is decided. The calculations have been provided below for information

- **Kumbh Mela at Nasik**

when Sun and Jupiter are in Leo during the Hindu month of Bhadrprada (August-September)

## II. OBJECTIVES

1. To assess the changes in water quality between the pre and post bathing period as on the day of shahisnani (parvati) specially from 27th August to 10th October.2015
2. To evolve remedial measures to prevent environmental hazards due to mass bathing and alternatives for maintain bathing water quality of Godavari River.
3. To develop the model for predicting river water quality

## III. LITERATURE REVIEW

Neha Gupta et al. [11]-: describes that this study assessed the physicochemical properties of Yamuna River water from nine different locations (viz. Runkata, Naire Ghat, Kailash Mandir, Sikandra, Balkeshwar, Rambagh, Etmadudaula,Hathi Ghat and Tajganj) of Agra city, during the months of March and April 2011.it shows that water quality is very poor

Pankaj Malviya et al. [2]-: By analyzing various physico-chemical parameters and by integrating them is very much necessary in order to determine and maintain the water quality of the rivers.

Chaurasia Sadhana and Karan Raj [3]-: the study is based on The Rivers in India have religious importance. The various pollutants entering into eco-system through drains may be bio-degradable and non-biodegradable; these pollutants have also higher BOD and COD level. Keeping the above points in mind, the study of river and various drains joining to the river Mandakini at Chitrakoot has been selected for the study.

Gagan Matta and Ajendra Kumar [4] -: The present study revealed that major factors contributing to deterioration of water quality might be continues discharge of industrial discharge, tourism, anthropogenic and spiritual practices.

Therefore, to restore the vitality and water quality of river, proper water resource planning programmed should be developed.

Ram S. Lokhande et al. [5] -: The experimental data suggests a need to implement common objectives, compatible policies and programmers for improvement in the industrial waste water treatment methods.

Inderdeep Kaur and Deen Dayal Verma [6]-: Yamuna merges into Ganga at Triveni Sangam in Allahabad. During festival season people take a holy dip in the Ganga river and Sangam and also use it for drinking. Sangam is the site for the Kumbh Mela every twelve years, Ardh Kumbh Mela every six years and Magh Mela every year Thus after Vasudevan et al. [7]-: These wastes usually contain a wide variety of organic and inorganic pollutants including solvents, oils, grease, plastics, plasticizers, phenols, heavy metals, pesticides and suspended solids. The understanding of the hydrological and water quality parameters of a system is essential to predict the carrying capacity and to provide suitable control measures. The modeling of water quality in river Yamuna using the enhanced version QUAL2K is discussed in this study.

analyzing the water at three different locations in terms of physicochemical and microbiological parameters, it is clear that the Yamuna, Ganga and Sangam water is unfit for drinking, washing and irrigation also.

G. Annalakshmi et al. [8]-: Study indicates the rivers were slightly polluted by anthropogenic performance due to local anthropogenic activities, agricultural runoff and discharge of untreated municipal sewage, religious credence and subject to amend owed to seasons, climate and flows and influx of waters from various tributaries. In addition present study points out that the river Arasalar facing severe pollution followed by the river Cauvery.

Prakash Raj Kannel et al. [9]-: . The results showed the local oxygenation is effective to keep DO concentration well above minimum levels. The combination of wastewater modification, flow augmentation and local oxygenation is suitable to meet the water quality criteria within acceptable limits.

## IV. MATERIALS AND METHODS

### 3.1 Collection of Water Samples

In this work samples of raw water were collected from six different spots i.e ramkund, dwarka bridge, laxminarayan bridge, triveni sangam, takali bridge and

dashakpanch . The samples were supposed to be collected before after and during parvanibu for better analysis the samples were collected for the period of total 45 days from 27<sup>th</sup> august 2015 to 10<sup>th</sup> October 2015.

**3.2 Experimental Analysis of Water Samples**

The raw water samples were experimentally tested to know the raw water parameters pH, turbidity, hardness, TDS, chlorides, TSS, temperature, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, electrical conductivity respectively. Mainly the water parameters dissolved oxygen, biochemical oxygen demand, chemical oxygen demand was been focused in order to decide the self purification capacity of river .By sampling and testing of raw water mainly after and before bath to analyze how the water quality get affected by religious activities like mass bathing, nirmalya visargan etc



1) Ramkund –Area 63000sqm



2)DwarkaBridge –Area 8600sqm



3)laxminarayan bridge – 8000sqm



4)Triveni Sangam -7800sqm



5) Dashakpanch – 7132sqm



6) Takali Bridge -8186sqm

**Various ramghats provided for shahisnan**

For analysis of water quality the parameters to be tested along with respective methods and equipments used are listed below:-

Table no 1.parameters to be tested and their methods and materials

Parameters	Methods and equipments used
Temperature	Digital thermometer
Ph	Digital pH meter
EC	Digital conductivitymeter
DO,BOD,COD,TH,Chloride	Titrimetry method
TDS	Filtration followed by weighing
TSS	By the use of imhoff cone
Turbidity	Digital nephelometer

**3.3 Qual2k software for water quality modeling**

QUAL2E model, developed by United States Environmental Protection Agency (US EPA), is the most widely used mathematical model for conventional pollutant impact evaluation. However, several limitations of the QUAL2E have been reported in references. One of the major inadequacies is the lack of provision for conversion of algal death to carbonaceous biochemical oxygen demand (BOD). Park and Lee developed QUAL2K, 2002 after modification of QUAL2E. The modifications include the expansion of computational structures and addition of new constituent interactions: algal BOD, de-nitrification and dissolved oxygen (DO) change caused by fixed plants. Pelletier and Chapra developed a model QUAL2Kw by modifying QUAL2K, 2003 originally developed by Chapra and Pelletier. QUAL2K (Version 2.04), developed by Chapra et al., is a river and stream water quality model that is intended to represent a modernized version of the QUAL2E. In some of the studies carried out in the application of QUAL2K model, it was observed that the model represented the field data quite well and this reasonable modeling guarantees the use of QUAL2K for future river water quality options

## V. RESULT AND DISCUSSION

The result obtained by physic-chemical analysis of all samples are given in table 2 and marked variations in parameters were observed due to mass bathing, waste from rituals, higher sanitation load.

**Temperature-:** Temperature is one of the important factors in an aquatic environment. During sample collection temperature varied from 22.9 degree to 27.5 degree. The highest temperature values recorded in the month of September.

Turbidity in natural water it is caused by clay, silt, organic matter, plankton and other microscopic matter, turbidity in water restricts to the light of penetration required for the process of photosynthesis. Higher concentration of suspended particles observed in the period of anthropogenic activities like mass bathing, offering flowers, garlands etc. and it varied from 54 NTU TO 110 NTU (fig. 3)

pH regulates most of the biological processes and biochemical reactions. Scudrope reported that the higher pH, free CO<sub>2</sub> and ammonia are critical factors in the survival of aquatic plants and fishes. Fluctuations in the pH values mostly due to ingredient input in the water bodies. During kumbhamela period pH varies from 6.9 to 9.1

Dissolved oxygen in the water is of great importance to all aquatic organisms and is considered to be the factor which reflects physical and biological process taking place in

a water body. Dissolved oxygen concentration should be more than 4 mg/lit for the survival of aquatic life. But it is depleted from 7.3mg/lit to 2.3mg/lit.

Biochemical Oxygen Demand determine the amount of oxygen require for biological oxidation of organic matter with the help of microbial activities. The values differ due to loaded input of organic matter like offering flowers, garlands, mass bathing etc. in the present study BOD values ranged between 5.8 mg/lit to 18.2 mg/lit. (Fig 7) the highest value recorded on the days of parvani. It may be due to over loaded input of organic matter by waste from rituals like offering flowers, garlands and other religious matters, mass bathing etc.

Chemical Oxygen Demand determine the amount of oxygen require for the chemical oxidation of most of the organic matter and oxidizable inorganic substances with the help of strong chemical oxidant. In present study the COD values ranged from 30.2 to 43.2 mg/lit which shows high pollution status (fig 8). Not only because of religious activities but also due to disposal of sewage the COD values are high especially near takali bridge and nandur naka.

Electrical Conductivity values mainly depend on ionic concentration or dissolved inorganic substances. It denotes the salt concentration in water body. The conductivity values range from 252 to 320 (µmohs/cm) (fig 4) highest conductivity values were observed during last parvani mainly due to organic matter by anthropogenic activities not inorganic substances.

Total Dissolved Solids are simply the sum of cations and anions concentration expressed in mg/lit. A high content of dissolved solids elevates the density of water, influence osmoregulation of fresh water organisms, and reduces the solubility of gases (like O<sub>2</sub>), reduces the utility of water for drinking purpose and results in to eutrofication of river.

Chloride is found widely distributed in nature in the form of salt of sodium, potassium and calcium. The chloride status in river is indicative of pollution especially of animal origin. Salinity of water found due to excess of salt present in water. In present study the values range in between 39.2 mg/lit to 50.3 mg/lit. Highest values observed during last parvani mainly due to religious activities, mass bathing, and urination.

Since these parameters determine the quality of water and the load of pollutional agents which disturbs the river quality are studied and the improvement of river water is to be achieved.

Table no 2: The variation in various parameters before, after and during the kumbh mela

Sr no	Parameters	Units	27 <sup>th</sup> aug	28 <sup>th</sup> aug	29 <sup>th</sup> aug	13 <sup>th</sup> sep	18 <sup>th</sup> sep	27 <sup>th</sup> sep	10 <sup>th</sup> oct
1	Temperature	°c	22.9	25	27.5	26	25	26	24.3
2	PH		8.1	7.8	8.4	8.6	9.1	7.7	6.9
3	DO	mg/lit	7.3	7.2	7.5	7.6	7.4	4.1	2.3
4	Turbidity	NTU	54	59	89	96	110	80	75
5	Electrical conductivity	(µmohs/cm)	274	245	252	278	320	292	270
6	BOD	(mg/lit)	5.8	6.3	13.5	18.2	20.1	17.3	10.6
7	COD	(mg/lit)	31.8	33.5	39.5	41.2	43.2	38.5	30.2
8	Total hardness	(mg/lit)	144	140	148	167	179	146	116
9	Chlorides	(mg/lit)	39.5	35.6	43.2	49.1	50.3	41.3	39.2
10	TSS	(mg/lit)	35	38	41	45	47	42	39
11	TDS	(mg/lit)	72	75	77	80	85	77	75

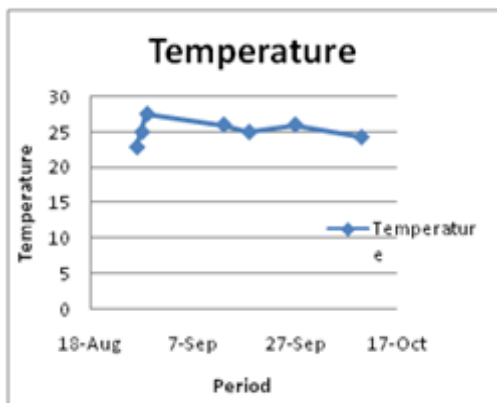
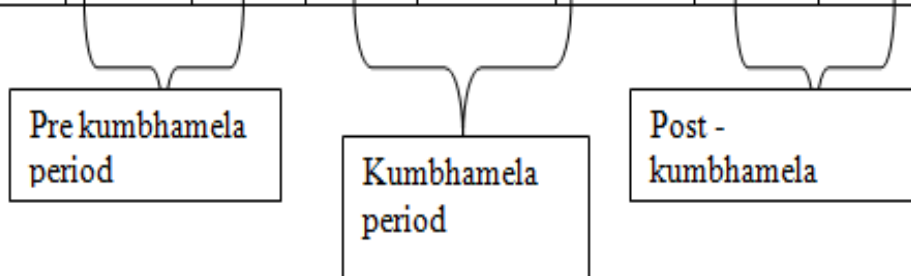


Fig. No.1 The average of various water temperatures 0°C at six different Ram-ghats including the days of Parvani

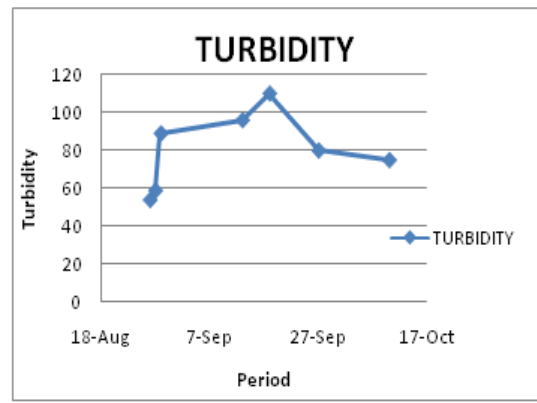


Fig.no.2 The average of various water turbidities at six different locations

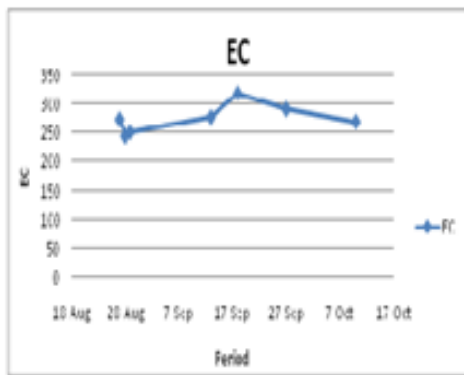


Fig.no.3.The average of various water conductivities At six different ram-ghats including the days of parvani

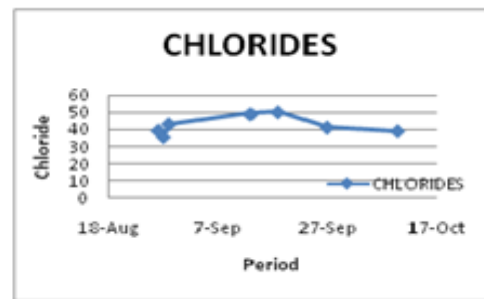


Fig.no.7.The average of various water Chlorides At six different ram-ghats including the days of parvani

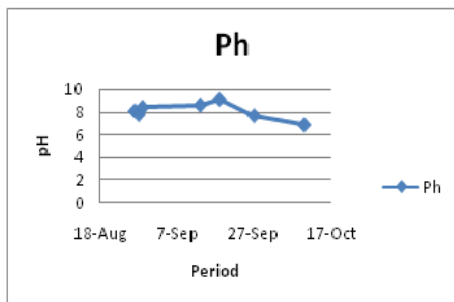


Fig.no.4 The average of various water pH values at six different ram-ghats including the days of parvani

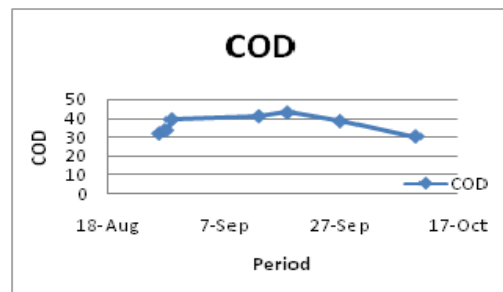


Fig.no.8 The average of various water COD values at six Different ram-ghats including the days of parvani

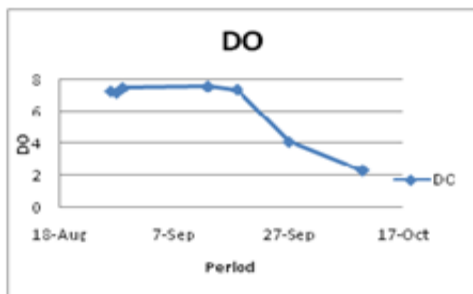


Fig.no.5.The average of various water dissolved oxygen At six different ram-ghats including the days of parvani

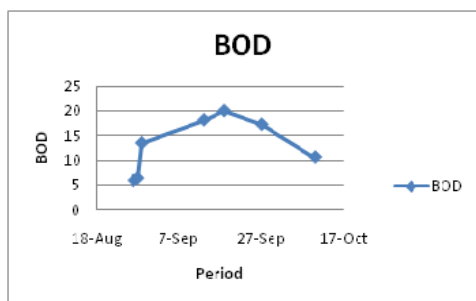


Fig.no.6 The average of various water BOD values at six Different ram-ghats including the days of parvani

## VI. CONCLUSION

The following conclusions can be drawn from the above literature review , methodology, results & discussions, and the study of QUAL2K software.

1. The study of Godavari river water particularly at six different locations provided for shahisnana exhibits low DO,high BOD, COD, Turbidity, Hardness, Chlorides ,etc. above the permissible limits which makes water undesirable for drinking as well as domestic use.
2. The high values of BOD are due to ritual activities like mass bathing, nirmalya visarjan, puja archana etc
3. During the period of kumbhamela such infected water caused many water borne diseases like cholera, typhoid etc
4. The high pollution load is seen as the time passes more from the day of parvani as the water level depleted and it shows pollution load clearly
5. The DO concentration is very low or even absent specially on dashakpanch and takali bridge as there are other sources of pollution for e.g the excess of sanitation load is directly diverted in to the river and these ghats are located near sewage treatment plant
6. From the use of software qual2k we get the idea that how self purification capacity is reduced along with time and

since we can take necessary remedial measures.as it gives clear idea about water quality before after and during fest of kumbhamela

Since it becomes necessary to give the water some sort of prior treatment. Because of the reason during kumbhamela the pollution load is significantly high especially on the day of parvani. Higher pH values indicate slightly alkaline nature of water.

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