Water Pollution in River Ganga

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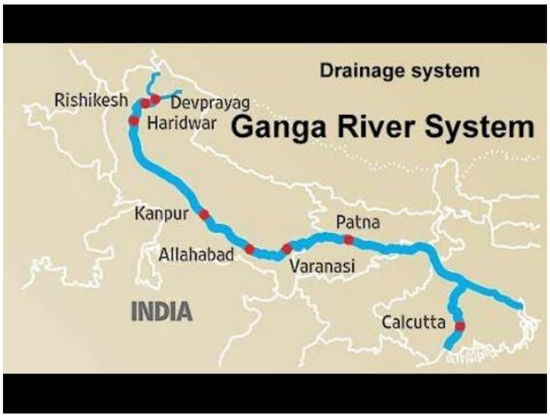
Abstract: ***Water pollution may be defined as the presence of one or more contaminants or combinations thereof in such quantities and of such durations in the water tend to be injurious to human, animal or plant life,(aquatic life) or property, or which unreasonably interferes with the comfortable enjoyment of life or property. In easier words, it is the contamination of water bodies like lakes, rivers, ponds, seas, oceans and even groundwater. This is due to discharge of environmental pollutants or effluents into water bodies without treatment. Water pollution affects the entire biosphere, including not only the individual species but also their natural biological communities. It results in the death of much of the aquatic life residing inside the contaminated water body. It also leads to various diseases like cholera, dysentery, diarrhea, malaria, dengue, chickingunia, etc. and even fatal in some cases if that water is consumed without treatment***

Keywords: Ganga River, Water pollutant, WQI, Hardness, alkalinity

1. Introduction

The Ganga is a trans-boundary river of the Indian subcontinent which flows through the nations of India and Bangladesh. The 2,525 km (1,569 mi) river rises in the western Himalayas in the Indian state of Uttarakhand, and flows south and east through the Gangetic Plain of North India. After entering West Bengal, it divides into two rivers: the Hooghly and the Padma River. The Hooghly, or Adi Ganga, flows through several districts of West Bengal and into the Bay of Bengal near Sagar Island. The other, the Padma, also flows into and through Bangladesh, and joins the Meghna river which ultimately empties into the Bay of Bengal.

The Ganges is one of the most sacred rivers to Hindus.[4] It is also a lifeline to millions of Indians who live along its course and depend on it for their daily needs. It is worshipped in Hinduism and personified as the goddess Gaṅgā. It has also been important historically, with many former provincial or imperial capitals (such as Kannauj, Kampilya, Kara, Prayag or Allahabad, Kashi, Pataliputra or Patna, Hajipur, Munger, Bhagalpur, Baranagar, Murshidabad, Baharampur, Nabadwip, Saptagram and Kolkata) located on its banks.



The Ganges is highly polluted. Pollution threatens not only humans, but also more than 140 fish species, 90 amphibian species and the endangered Ganges river dolphin. The Ganges is a major source of global ocean plastic pollution. The levels of fecal coliform bacteria from human waste in the waters of the river near Varanasi are more than 100 times the Indian government's official limit. The Ganga Action Plan, an environmental initiative to clean up the river, has been a major failure thus far, due to rampant corruption, lack of will on behalf of the government and its bureaucracy, lack of technical expertise, poor environmental planning, and lack of support from religious authorities.

2. The Pollutant

The Ganges suffers from extreme pollution levels, caused by the 400 million people who live close to the river. Sewage from many cities along the river's course, industrial waste and religious offerings wrapped in non-degradable plastics add large amounts of pollutants to the river as it flows through densely populated areas. The problem is exacerbated by the fact that many poorer people rely on the river on a daily basis for bathing, washing, and cooking. The World Bank estimates that the health costs of water pollution in India equal three percent of India's GDP. It has also been suggested that eighty percent of all illnesses in India and one-third of deaths can be attributed to water-borne diseases. The main cause of water pollution in the Ganga river are the increase in the population density, various human activities such as bathing, washing clothes, the bathing of animals, and dumping of various harmful industrial waste into the rivers.

- **Human waste**

The river flows through 30 cities with populations over 100,000; 23 cities with populations between 50,000 and 100,000, and about 48 towns.[12] A large proportion of the sewage water with higher organic load in the Ganga is from this population through domestic water usage.

- **Industrial waste**

Because of the establishment of a large number of industrial cities on the bank of the Ganga like Kanpur, Prayagraj, Varanasi and Patna, countless tanneries, chemical plants, textile mills, distilleries, slaughterhouses, and hospitals prosper and grow along this and contribute to the pollution of the Ganga by dumping untreated waste into it. One coal-based power plant on the banks of the Pandu River, a Ganga tributary near the city of Kanpur, burns 600,000 tons of coal each year and produces 210,000 tons of fly ash. The ash is dumped into ponds from which a slurry is filtered, mixed with domestic wastewater, and then released into the Pandu River. Fly ash contains toxic heavy metals such as lead and copper.

The amount of parts per million of copper released in the Pandu before it even reaches the Ganga is a thousand times higher than in uncontaminated water. Industrial effluents are about 12% of the total volume of effluent reaching the Ganga. Although a relatively low proportion, they are a cause for major concern because they are often toxic and non-biodegradable.

- **Religious traditions**

During festival seasons, over 70 million people bath in the Ganga to clean themselves from their past sins. Some materials like food, waste or leaves are left in the Ganga which are responsible for its pollution. Traditional beliefs hold that being cremated on its banks and to float down the Ganga will atone for the sins of those who die and carry them directly to salvation. In Varanasi alone, an estimated forty thousand bodies are cremated every year, many of those are only half-burnt.

- **Water shortage**

Along with ever-increasing pollution, water shortages are getting noticeably worse. Some sections of the river are already completely dry. Around Varanasi, the river once had an average depth of 60 metres (200 ft), but in some places, it is now only 10 metres (33 ft). To cope with its chronic water shortages, India employs electric groundwater pumps, diesel-powered tankers, and coal-fed power plants. If the country increasingly relies on these energy-intensive short-term fixes, the whole planet's climate will bear the consequences. India is under enormous pressure to develop its economic potential while also protecting its environment something few, if any, countries have accomplished. What India does with its water will be a test of whether that combination is possible.

- **Mining**

In Kumbh Illegal mining in the Ganges river bed for stones and sand for construction work has long been a problem in Haridwar district, Uttarakhand, where it touches the plains for the first time. This is despite the fact that quarrying has been banned Mela area zone covering 140 km2 area in Haridwar.

3. Materials and Methods

Samples were collected as per standard procedures. Various parameters were studied using standard methods and the results obtained were compared with the WHO and ISI standards. All reagents employed were prepared using AR grade chemicals. Glass distilled water was used throughout the analysis. Systronics – Conduct meter and Digital Systronics pH – meter was used for the determination of Electrical Conductivity and pH respectively. Other parameters that were studied during the analysis were ions of Calcium and Magnesium, Alkalinity, Total dissolved solids, Total hardness.

4. Calculation of Water Quality Index

The complicated scientific information can be converted into a single number through WQI. It is a dimensionless number that can be arrived by studying many parameters that affects water quality into a single number making it easy for a common man to understand the quality of water. WQI is calculated on the basis of several physic – chemical parameters which is then multiplied by a weighing factor and the final aggregate is obtained using arithmetic mean. WQI tool is used successfully by many authors as a means to state the quality of water for water bodies. The calculation of the WQI is well explained and the same formula was applied to calculate the WQI in the present study.

Calculation of Quality rating (Qi):

Quality rating for each parameter was calculated by using the following equation

$$Qi = \frac{(V_{actual} - V_{ideal})}{(V_{standard} - V_{ideal})} \times 100$$

Where,

Qi = Quality rating of ith parameter for a total of n water quality parameters.

V_{actual} = Actual value of the water quality parameter obtained from laboratory analysis

V_{ideal} = ideal value of that quality parameter can be obtained from the standard tables.

V_{ideal} for pH = 7 and for other parameters it is equating to zero and

DO V_{ideal} = 14.6 mg / L

$V_{standard}$ = Recommended WHO standard of the water quality parameter.

Calculation of Unit weight (Wi): Unit weight was calculated by a value inversely proportional to the recommended standard (Si) for the corresponding parameter using the following expression

$$Wi = \frac{K}{Si}$$

Where,
Wi = Unit weight for nth parameter,
Si = Standard permissible value for nth parameter
K = proportionality constant, For the sake of simplicity, K is assumed as 1, The overall WQI was calculated by aggregating the quality rating with unit weight linearly using the following equation

$$WQI = \frac{\sum WiQi}{\sum Wi}$$

Where,
Qi = quality rating,
Wi = Unit weight

5. Results and Discussion

a) Temperature

Temperature is an important parameter as it is responsible to increase the solubility of many minerals, salts and gases. It was found to be 20^0C for both the samples. (Table I).

b) pH

pH is defined as the negative logarithm of hydrogen ion concentration. The pH for potable water should be between 7 to 8. There are many factors that affect the pH of the water such as presence of dissolved gases, salts, bases, acids. In the present study the pH was found to be 7.88 for S_1 and 8.0 for S_2, which according to ISI and WHO standards is high. (Table I , Fig 1).

c) Alkalinity

Alkalinity is the capacity of water to neutralize the acids. The presence of bicarbonates, carbonates and hydroxides causes alkalinity in the water. These salts in water are due to the dissolution of minerals from rocks, soils, plant and microbial activities and discharge of industrial wastes. The alkalinity that was reported in the present study was also found to be on the higher end 125 mg/L in S_1 and 130 mg/L in S_2respectively.(Table I, Fig 1).

d) Electrical Conductivity

Electrical conductivity is capacity of water to conduct electrical current. It is due to the presence of dissolved salts and minerals. The conductivity was found to be 90 µs/cm for both S_1 and S_2 samples. (Table I , Fig 1).

e) Total hardness

Hardness is an important property of water that prevents lathering of water with the soap solution and if exceeds the tolerance limit may lead to serious illness. It causes serious damage to the products of industries and machinery if untreated water is used. The main causes of hardness in water are the presence of bicarbonates, chlorides and sulphates of calcium and magnesium. Total hardness was reported as 133 mg/L and 138 mg/L for samples S_1 and S_2 respectively, which according to WHO standards is high but average according to ISI standards.(Table I, Fig 1).

f) Total Dissolved Solids

Total Dissolved Solids is an aggregate of all the dissolved solids present in the water. The amount of Total Dissolved Solids was reported as 80 mg/L for both S_1 and S_2 samples which is not a matter of concern as it is in the safe limits. (Table I, Fig 1).

Parameter	Methods	WHO Standars	ISI Standards	S_1	S_2
Temperature	Thermometric	……..	…….	20^0	20^0
pH	pH metry	7.0-8.0	6.5-8.5	7.8	8.0
Alkalinity	Titration	120	200	125	130
Electrica Conductivity	Conductometry	1400	……	90	90
Total Dissolve Solid	Filtration method	1000	500	80	80
Total Hardness	EDTA titration	100	300	133	138

Table 2: Water Qaulity Index (Wqi) Status of Water Quality

Water Quality Index Level	Water Quality Status
0-25	Excellent water quality
25-50	Good water quality
50-75	Poor water quality
75-100	Very poor water quality
>100	Unsuitable for drinking

6. Conclusion

The above study is an eye opener because the quality of water is very poor (Table IV]) at Rishikesh where it is considered least polluted. The WQI is found to be 78.0 and 81.5 in the samples S_1 (Table II) and S_2 (Table III) respectively. Therefore, the water cannot be recommended for drinking and other domestic purposes without subjecting it to purification. The study suggests that it is a pitiable situation that water at almost its source is not fit for human consumption and as it flows through other major cities it is most likely that water becomes highly polluted rising to the toxic levels. Water quality assessments at other locations can be subject of further investigation.

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