ASSESSMENT OF PHYSIO CHEMICAL PARAMETERS AND WATER QUALITY INDEX OF DIFFERENT GHATS OF RIVER GANGA AT VARANASI, UTTAR PRADESH

Abstract

Ganga, the longest river in India, provides water to millions of people who live along its bank and depend on it for their livelihood throughout the year. For about 40% of the population, it provides water for drinking and irrigation. This study was conducted to analyse the physico-chemical parameters and WQI of five different Ghats of River Ganga at Varanasi. The data recorded from the present investigation revealed that the maximum value of pH was recorded at Dasaswamedh Ghat with 8.57 in the month of March and minimum was 7.53 recorded in the month of February Harish Chandra Ghat. EC value was recorded maximum at Tulsi Ghat with 564 mmhos/cm in the month of April and the minimum value was 131 mmhos/cm in the month of January recorded at Assi Ghat. The maximum value of TDS was 319.67mg/l in the month of February recorded at Assi ghat and minimum data recorded was 229mg/l in the month of January at Manikarnika Ghat. The DO value was recorded maximum at Manikarnika Ghat with 8.20mg/l in the month of January and the minimum value was5.97mg/l recorded in the month of January at Tulsi Ghat. The BOD value was recorded maximum at Assi Ghat with 4.63mg/l in the month of March and minimum of 2.70 mg/l recorded in the month of January at Harish Chandra Ghat. The Total Hardness value was recorded maximum at Tulsi Ghat with 138.33mg/l in the month of February and minimum value of 78.33mg/l recorded in the month of January at Assi Ghat. The Total Alkalinity value was recorded maximum with 114.33mg/l in the month of April at Ghat and minimum value was 78.67mg/l recorded in the month of January at Harish Chandra Ghat. The chloride value was recorded maximum at Harish Chandra Ghat with 31.67mg/l in the month of February and minimum value was 10mg/l recorded in the month of January at Manikarnika Ghat. The results of the different parameters when compared with BIS standards were found to be within the permissible limit except for pH and BOD. The WQI of the different Ghats indicated poor category of water quality.

Keywords: BIS, Ghats, Parameters, River, Varanasi, Water, WQI

Introduction

Rivers have always been the most important fresh water resources, along the banks of which our ancient civilizations have flourished and most developmental activities are still dependent upon them. River water finds multiple uses in every sector of development like agriculture industry, transportation, aquaculture, public water supply etc **(Dubey, 2011)**. Among the fresh water rivers, the sacred river Ganga flows in the south-Asian region and supports the livelihood of one-third human population of India with sustaining a very rich ecological diversity in its fertile alluvial basin (**Bhutiani *et al.*, 2016**). Ganga is the longest river of India and due to the ease of accessibility of water throughout the year, it is the lifeline of millions of people living along its bank and depends on it for their livelihood. It provides water for drinking and irrigation to around 40% of the Indian population but presently it is considered as the fifth most polluted river in the world (**Bhattacharya *et al.*, 2008)**. In the recent decades, the unchecked and unplanned rapid urbanization, discharge of partially treated and untreated waste water, mismanagement of land use pattern, overcrowded religious bathing, and dumping of solid waste in and around the river stretch have caused severe deterioration of ecological health of the river Ganga (**Singh *et al.*, 2019**).

There are more than 75 ghats situated on the left bank of the river Ganga in Varanasi and most of the ghats are lined by stones or concretes and used for several purposes such as bathing, recreation, washing, fishing, drinking, boating and swimming etc. But in recent years due to unplanned industrialization and urbanization, the river water is under heavy pollution stress due to incorporation of huge quantity of city sewage mixed with industrial effluents containing toxic heavy metals, poisonous chemicals and other pollutants **(Dubey, 2011)**. The assessment of water quality both biologically and chemically is necessary because the biological indicators show the degree of ecological imbalance that has been cause, whereas the chemical analysis measures the chemical concentration of pollutants **(Patil, 2002)**. As chemical analysis of water provides significant information about the present status of pollution river water with special reference to environmental health. This will prove the current suitability and future physico-chemical status of Ganga River water if it is discharged effluent by industries in current manner and current rate **(Singh, 2011)**. In spite of being a major governmental focus with involvement of governing bodies, experts, and regulatory systems, the water quality in the river Ganga has not been improved rather became unsatisfactory and unsuitable for sustaining biodiversity (**Tripathi and Singal, 2019**).

One of the most popular concepts for illustrating the quality of a water resource is the Water Quality Index (WQI). Policy makers and other stakeholders generally agree with this idea since it provides a clear and thorough picture of the level of pollution in a water body. According to **Tripathi and Singal (2019),** the standard steps in developing a WQI are parameter selection, weight assignment, developing sub-index functions, and final aggregation of weighted sub-index data. Globally, various water quality indices have been developed for monitoring surface water quality of rivers such as the Weighted Arithmetic Water Quality Index, National Sanitation Foundation Water Quality Index, Comprehensive Pollution Index, Carlson's trophic index, and Canadian Council of Ministers of the Environment Water Quality Index **(Gupta *et al.*, 2017**).

Materials & Methods:

One of the world's oldest cities is Varanasi, also known as Banaras. It occupies a 1535 sq. km. area and is located on the banks of the Ganga in the Indian state of Uttar Pradesh. The samples were collected from five **different Ghats of River Ganga at Varanasi**, U.P. for a period of four months **(January- April 2023)**. The samples were analyzed as per standard method for eight different Physio chemical parameters namely **pH, electrical conductivity, TDS, DO, BOD, total hardness, total alkalinity and chloride**. The data have been compared with the standard values given by BIS and WQI was also calculated.

Result &discussion

pH- The maximum value of pH for January month was 7.93 recorded at Dasaswamedh Ghat whereas the minimum value was 7.60 recorded at S4 Manikarnika Ghat. The maximum value of pH for February month was 8.07 at Dasaswamedh Ghat whereas the minimum value 7.50 was recorded at Assi Ghat. The maximum value of pH for the month of March was 8.5 at S2 (Dasaswamedh Ghat) whereas the minimum value was 7.83 recorded at Harish Chandra Ghat. The maximum value of pH for the month of April was 8.20 at Dasaswamedh Ghat whereas the minimum value was 7.70 at Harish Chandra Ghat. The pH value was recorded maximum 8.57 in the month of March at Dasaswamedh Ghat and minimum 7.53 recorded in the month of February at Harish Chandra ghat. The average pH value of all the sites of River Ganga were under the permissible limit given by BIS. Discharge of sewage from the drains also affects the pH **(Mishra *et al.*, 2021)**.

EC- The maximum value of EC for January month was 0.23mmhos/cm recorded at Dasaswamedh Ghat whereas the minimum value was 0.13mmhos/cm recorded at

Manikarnika Ghat. The maximum value of EC for the month of February was 0.26mmhos/cm at Dasaswamedh Ghat whereas the minimum value 0.16mmhos/cm was recorded at Manikarnika Ghat. The maximum value of EC for March was 0.40mmhos/cm at Tulsi Ghat whereas the minimum value was 0.22mmhos/cm recorded at Assi Ghat. The maximum value of EC for April was 0.56mmhos/cm at Tulsi Ghat whereas the minimum value was 0.31mmhos/cm at Assi Ghat. The increased in EC values of water indicate that there is a source of dissolved ions in the vicinity. Increasing levels of conductivity and cations are the products of decomposition and mineralization of organic materials **(Singh *et al*., 2016)**.

TDS- The maximum value of TDS for January was 295.33mg/l recorded at Dasaswamedh Ghat whereas the minimum value 246.67mg/l was recorded at Harish chandra Ghat. The maximum value of TDS for February was 319.67mg/l at Assi Ghat whereas the minimum value was 250.67mg/l was recorded at Harish chandra Ghat. The maximum value of TDS for the month of March was 299.33mg/l at Tulsi Ghat whereas the minimum value was 234.33mg/l recorded at Manikarnika Ghat. The maximum value of TDS for the month of April was 316.67mg/l at Dasaswamedh Ghat whereas the minimum value was 239mg/l at (Harish Chandra Ghat). TDS in water is a measure of combined chemicals of all inorganic and organic substances present in water as molecule **(Sharma and Chhipa 2012)**, ions or micro granular suspended form.

DO- The maximum value of DO for the month of January was 8.20mg/l recorded at Manikarnika Ghat whereas the minimum value was 5.97mg/l recorded at Tulsi Ghat. For February was maximum value was 8.10mg/l observed at Harish chandra Ghat whereas the minimum value was 6.17mg/l recorded at Dasaswamedh Ghat. The maximum value of DO for March was 7.30mg/l at Tulsi Ghat whereas the minimum value was 6.73mg/l recorded at Assi Ghat. The maximum value of DO for the month of April was 7.97mg/l at Manikarnika Ghat whereas the minimum value was 6.83mg/l at S5 Tulsi Ghat. The decrease in DO is due to an increase in biological and photosynthetic activities. High pollution loads may also decrease dissolved oxygen value **(Bhardwaj, 2005)**.

BOD- The maximum value of BOD for the month of January 4.20mg/l was recorded at Tulsi Ghat whereas the minimum value was 2.70mg/l recorded at Harish Chandra Ghat. The maximum value of BOD for February was 4.17mg/l at Tulsi Ghat whereas the minimum value was 3.00mg/l was recorded at Harish chandra Ghat. The maximum value of BOD for March was 4.63mg/l at Assi Ghat whereas the minimum value was 2.90mg/l recorded at Manikarnika Ghat. The maximum value of BOD for the month of April was 3.97mg/l at Tulsi

Ghat whereas the minimum value was 2.83mg/l at Manikarnika Ghat. The range of BOD values was well within the prescribed standard indicating less organic matter in water **(Bora and Goswami, 2016)**.

Total Hardness- The maximum value of hardness for the month of January was 121.67mg/l recorded at Dasaswamedh Ghat whereas the minimum value was 78.33mg/l recorded at Assi Ghat. The maximum value of Hardness for the month of February was 138.33mg/l at Tulsi Ghat whereas the minimum value 95mg/l was recorded at Manikarnika Ghat. The maximum value of hardness for March was 125mg/l at Dasaswamedh Ghat whereas the minimum value was 90mg/l recorded at Harish chandra Ghat. The maximum value of hardness for the month of April was 125mg/l at Dasaswamedh Ghat whereas the minimum value was 83.33mg/l at Harish Chandra Ghat. Hardness in water indicates the quality of water mainly in terms of Ca2+ and Mg2+ bicarbonates, chlorides, sulphates and nitrates. **(Akram and Rehman, 2018)**

Total Alkalinity- The maximum value of alkalinity for January was 94mg/l recorded at Dasaswamedh Ghat whereas the minimum value was 78.67mg/l recorded at Harish chandra Ghat. The maximum value of alkalinity for February was 101mg/l at Dasaswamedh Ghat whereas the minimum value of 83.67mg/l was recorded at Harish Chandra Ghat. The maximum value of alkalinity for the month of March was 107.67mg/l at Assi Ghat whereas the minimum value was 92mg/l recorded at Harish chandra Ghat. The maximum value of alkalinity for April was 114.33mg/l at Tulsi Ghat whereas the minimum value was 95mg/l at Manikarnika Ghat.

Chloride- The maximum value of chloride for January was 21.67mg/l recorded at Assi Ghat whereas the minimum value was 10mg/l recorded at Manikarnika Ghat. The maximum value of chloride for February was 31.67mg/l at Harish chandra Ghat whereas a minimum value of 18.33mg/l was recorded at Tulsi Ghat. The maximum value of chloride for March was 30mg/l at Assi Ghat whereas the minimum value was 20mg/l recorded at Dasaswamedh Ghat. The maximum value of chloride for April was 31.67mg/l at Tulsi Ghat whereas the minimum value was 20mg/l at Manikarnika Ghat.

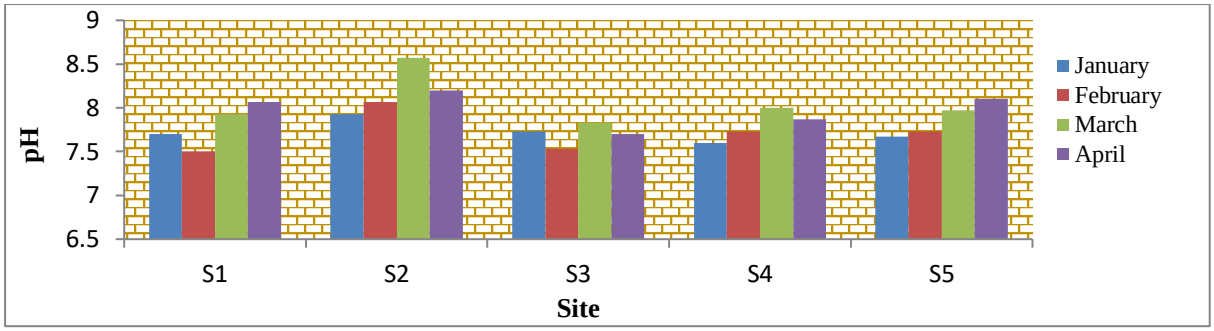

Fig 1: Graphical representation of pH of water from the different Ghats of River Ganga at Varanasi

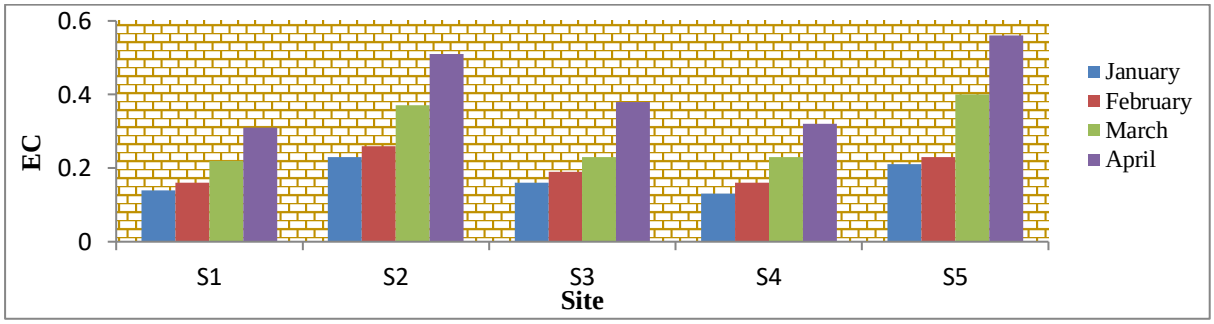

Fig 2: Graphical representation of EC of water from the different Ghats of River Ganga at Varanasi

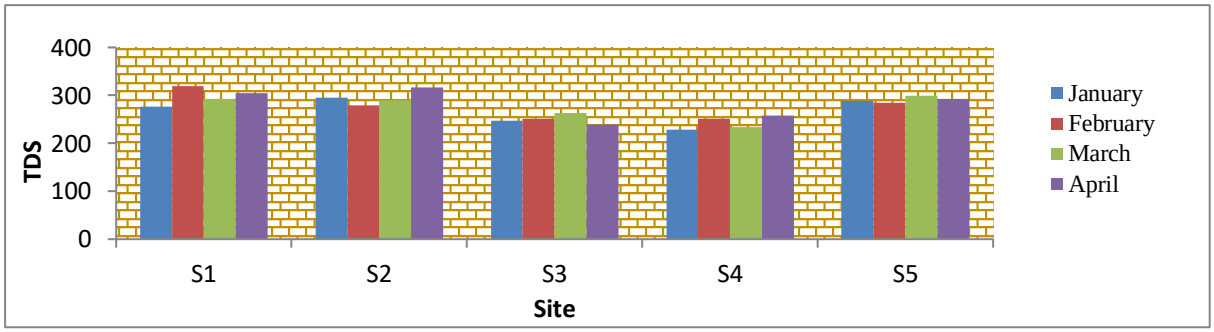

Fig 3: Graphical representation of TDS of water from the different Ghats of River Ganga at Varanasi

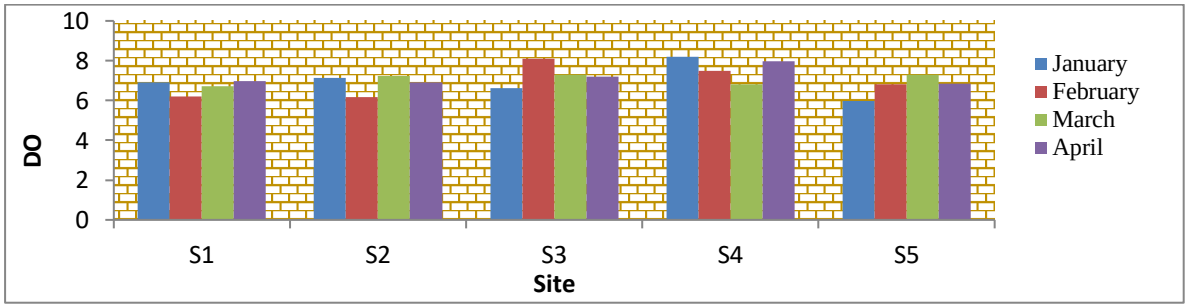

Fig 4: Graphical representation of DO of water from the different Ghats of River Ganga at Varanasi

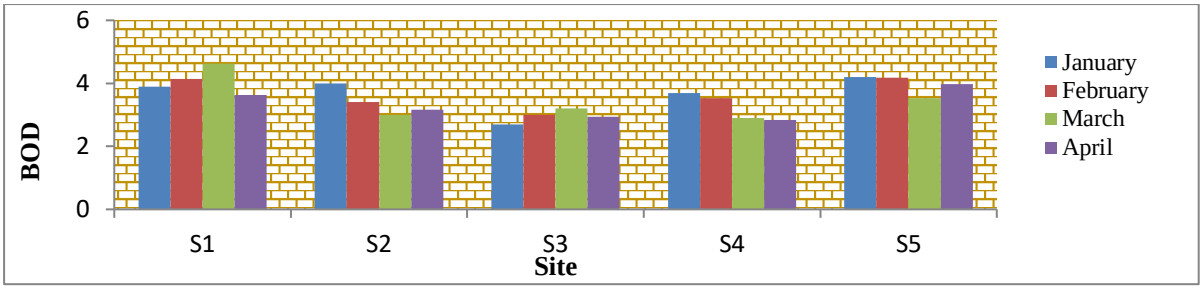

Fig 5: Graphical representation of BOD of water from the different Ghats of River Ganga at Varanasi

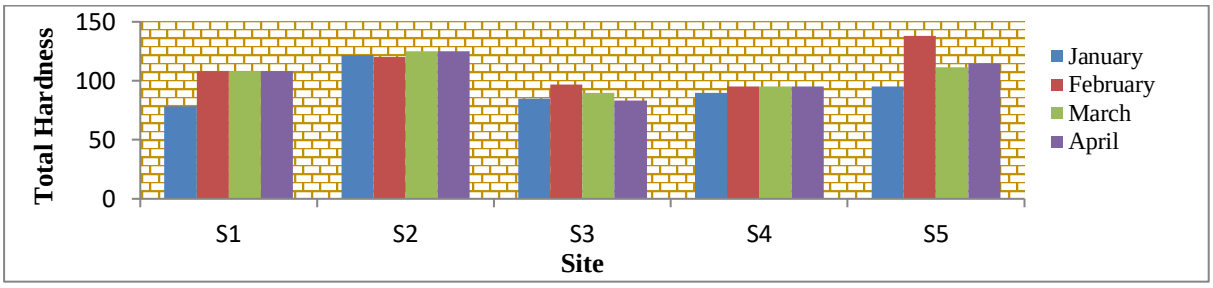

Fig 6: Graphical representation of Total Hardness of water from the different Ghats of River Ganga at Varanasi

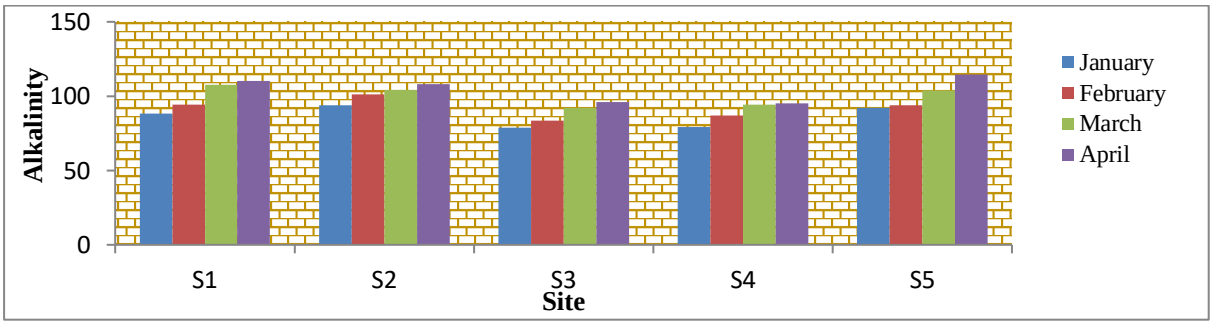

Fig 7: Graphical representation of Alkalinity of water from the different Ghats of River Ganga at Varanasi

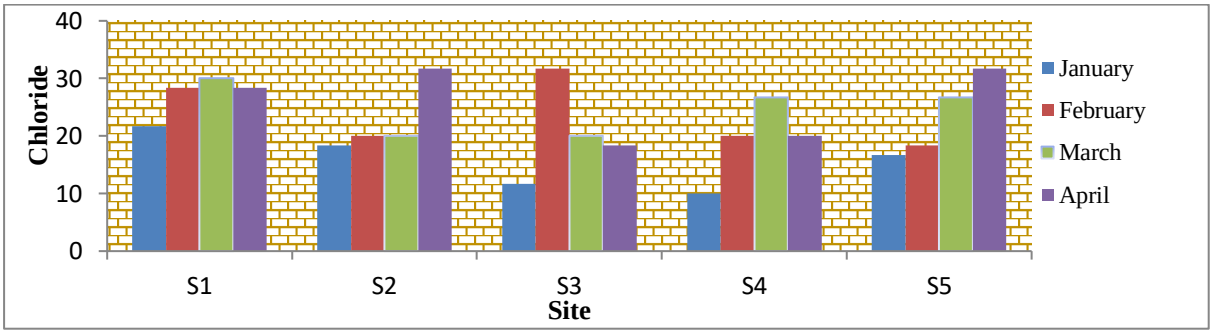

Fig 8: Graphical representation of Chloride of water from the different Ghats of River Ganga at Varanasi

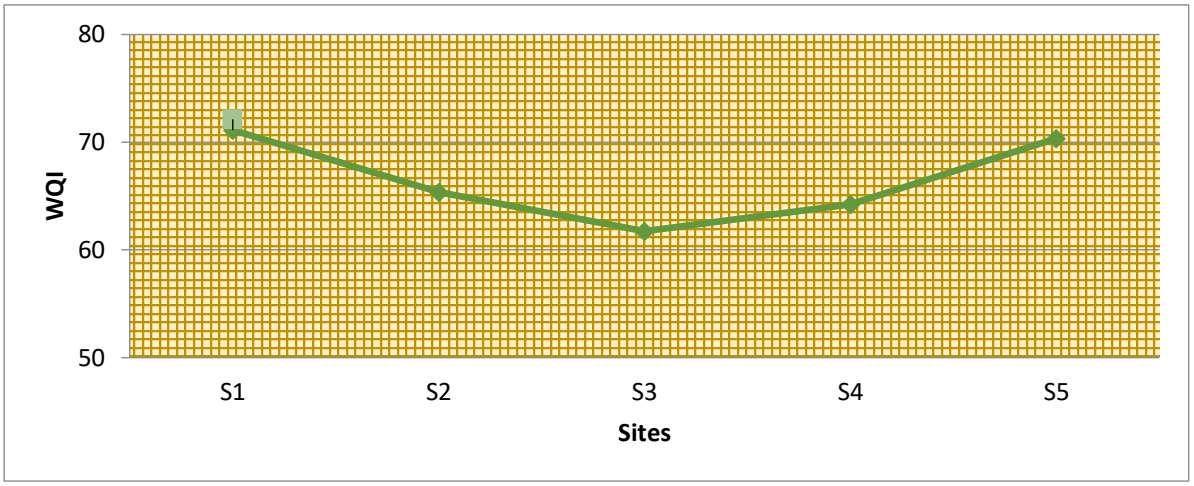

Fig 9 - WQI status of different Ghats of Varanasi

Conclusion

The river Ganga has been declared by the Government of India as National River in the year 2008. However, the river is getting polluted from many sources including domestic sewage, industrial wastewater and surface runoff from fields. The results of the analysis of the different parameters revealed that most of the values are within the permissible limit when compared with BIS except for pH and DO where the values are slightly higher than the permissible limit. The results obtained from WQI of the different sites indicated a slightly poor water quality.

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