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# Determination of water quality parameters of the river Yamuna at different locations of Delhi by using Vernier sensors

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***Abstract-*** ***The primary objective of this work was to monitor the water quality of the river Yamuna at different locations in the National Capital Territory (NCT) of Delhi. The first step was the familiarization with the river and life on its banks. The research methodology adopted included hands-on measurements of water quality parameters by using commercially available Vernier sensors and real-time data-acquisition system interfaced to computers. The water samples were collected from Jagatpur Village, Madanpur khadar, Nizamuddine, Rajghat and Nigambodh ghat . Physical parameters like pH, Conductivity, Turbidity and Dissolved Oxygen (DO) were studied in the collected water samples. These parameters were studied before rain and after rain respectively. The value of Dissolved Oxygen ( 0.1mg/L ) of Rajghat was found to be very less then permissible limits of World Health Organization ( WHO ) . The value of turbidity was obtained in more amount ( 9.67 NTU ) in the water sample of Nigambodh Ghat than other sites.***

***Key-Words-*** **Monitor, Water quality Parameters, Dissolve Oxygen (DO), Conductivity, Turbidity, Vernier Sensor, Permissible Limits.**

## I. INTRODUCTION

Yamuna River which is the main source of water supply to Delhi-National Capital, plays a vital role in its growth. It is an integral part of the low economic group people who use the river water for bathing, irrigation purposes, cloth washing, drinking etc. It flows through the state of Uttaranchal, Haryana, Delhi an Uttar Pradesh before merging with the Ganges in Allahabad. The Yamuna river once had 'clear blue' water but now the river is one of the most polluted rivers in the world especially around New Delhi. The capital dumps 58% of its waste into the river. Presently 70% of Delhi is drinking treated water of the Yamuna river. Delhi discharges about 3,684 MLD (million litres per day) of sewage through its 18 drains into the Yamuna and along with Agra it account for 90 percent of the pollution in the river. So that every effort should be made to get safe drinking-water to protect the health of human beings.

The use of chemical disinfectants in water treatment usually results in the formation of chemical by-products. However, the risks to health from these by-products are extremely small in comparison with the risks associated with inadequate disinfection but it is important to control the formation of such type of by-products wherever disinfectants are used . The amount of chlorine as disinfectants can be easily monitored and controlled in drinking-water by different methods.

Multivariate statistical techniques have been used to study the surface water quality of the Fuji river basin of Japan [1]. Determination of nitrate in water has been done using spectrophotometry [2]. Estimation Technique has been used for censored trace level water quality data [3]. Relationships between levels of heterotrophic bacteria and water quality parameters in a drinking water distribution has been studied by J.T. Carter [4]. The effect of natural organic matter (NOM) characteristics and water quality parameters on NOM adsorption to multiwalled carbon nanotubes (MWNT) has been investigated using modified Freundlich Isotherm Model [5]. Inter-calibration of OH radical sources and water quality parameters have been investigated by Jürg Hoigné in 1997 [6]. Water quality assessment and apportionment of pollution sources of Gomti River (India) have also been studied using multivariate statistical [7]. Remote sensing of cyan bacteria-dominant algal blooms and water quality parameters in Zeekoevlei, a small hypertrophic lake has been done using Medium Resolution Imaging Spectrometer MERIS [8]. A Case Study on Suquía River Basin (Córdoba–Argentina) has been done by Pattern Recognition Techniques for the Evaluation of Spatial and Temporal Variations in Water Quality [9]. Electrochemical analysis of water has been by impedance spectroscopy and cyclic voltammetry [10]

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The aim of this paper was to detect the level of pollution in the water of Yamuna at various sites of Delhi and to compare the value of certain parameters with prescribed limits of the World Health Organization ( WHO ). The value of these parameters of water which are used to judge the quality of water and to ensure that the water is fit for drinking and all other households purpose.

## II. METHODOLOGY

***STUDY SITES***

1. Juragatpur
2. Nizamuddin
3. Rajghat
4. Nigambodh Ghat
5. Madanpur Khadar

## III. SAMPLE COLLECTION

A 500 ml plastic bottle was taken. It was inverted in the system from which sample was to be taken. The lid was closed with the bottle inverted in the system. It was ensured that no air was allowed to enter while collecting the sample.

## IV. INSTRUMENT USED

Vernier Sensors with LabPro computer interface was used to determine the water quality parameters. The data's were collected with help of LoggerPro Software. A sensor is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument. For example a thermocouple converts temperature to an output voltage which can be read by a voltmeter. For accuracy, most sensors are calibrated against known standards. The water samples were analysed for the following parameters:

- Conductivity
- pH
- Turbidity
- Dissolved Oxygen(DO)

## V. PH SENSOR-PRINCIPLE AND WORKING

It has an amplifier inside the polycarbonated body which allows the interface to study the electrode inside. Measures a voltage of 1.25V for neutral (7) pH and the voltage value increases by 0.25V for each unit increase in pH value.

## VI. TURBIDITY SENSOR

Infrared light is directed at a cuvette containing the sample water and is scattered in all directions off the particles in the water. A detector consisting of a photodiode is placed at a 90° angle to the light source. The amount of light being scattered directly into the detector is measured in volts and translated into Nephelometric Turbidity Units (NTU).

## VII. CALIBARATION OF DO SENSOR

It is not necessary to calibrate if we are looking only at a change in dissolved oxygen. But if we are making discrete measurements and want to improve the accuracy of your measurements, then it is best to perform a new two point calibration. The values of DO are with respect to standard value of sodium sulphite solution (calibrating solution).

**Collecting data:** The tip of the probe was placed into the water being tested (submerge 4–6 cm). It should not be completely submerge. It was important to keep stirring the probe in the water sample.

**Preparing Sensor for use**

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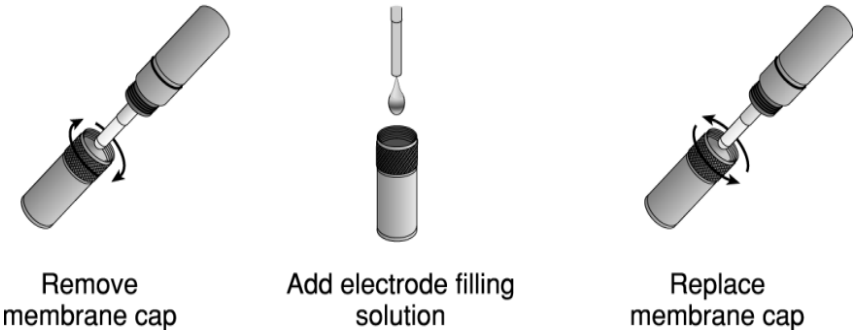


**Table -I: Water quality parameters of different sites of Yamuna before rain**

| SITE | CONDUCTIVITY (S/cm) | pH | TURBIDITY (NTU) | DO (mg/L) |
|---|---|---|---|---|
| JAGATPUR | 393.3 | 4.85 | 7.986 | 0.8 |
| NIZAMUDDIN | 279.1 | 7.01 | 6.643 | 0.5 |
| RAJGHAT | 280.4 | 6.95 | 6.38 | 0.2 |
| NIGAMBODH GHAT | 280.8 | 6.05 | 9.67 | 0.6 |
| MADANPUR KHADAR | 261 | 6.9 | 8.0 | 0.3 |

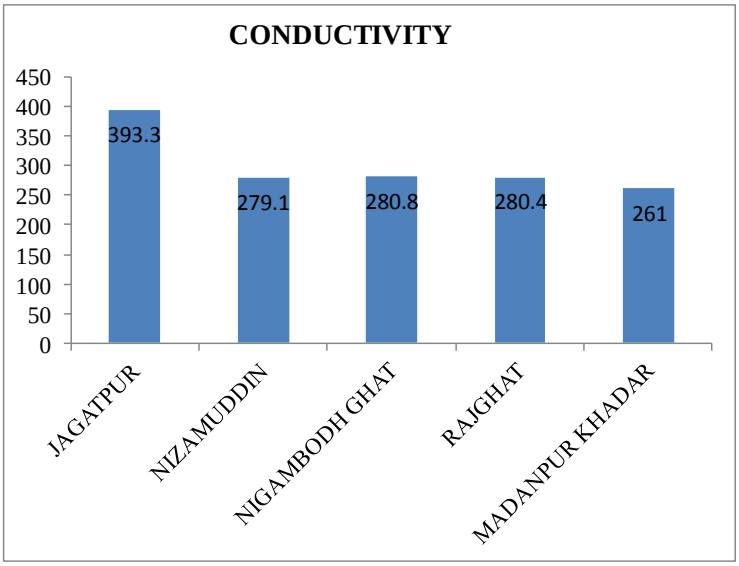


**Fig.- 1 : Conducivity of water samples collected from different site of Yamuna river before rain.**

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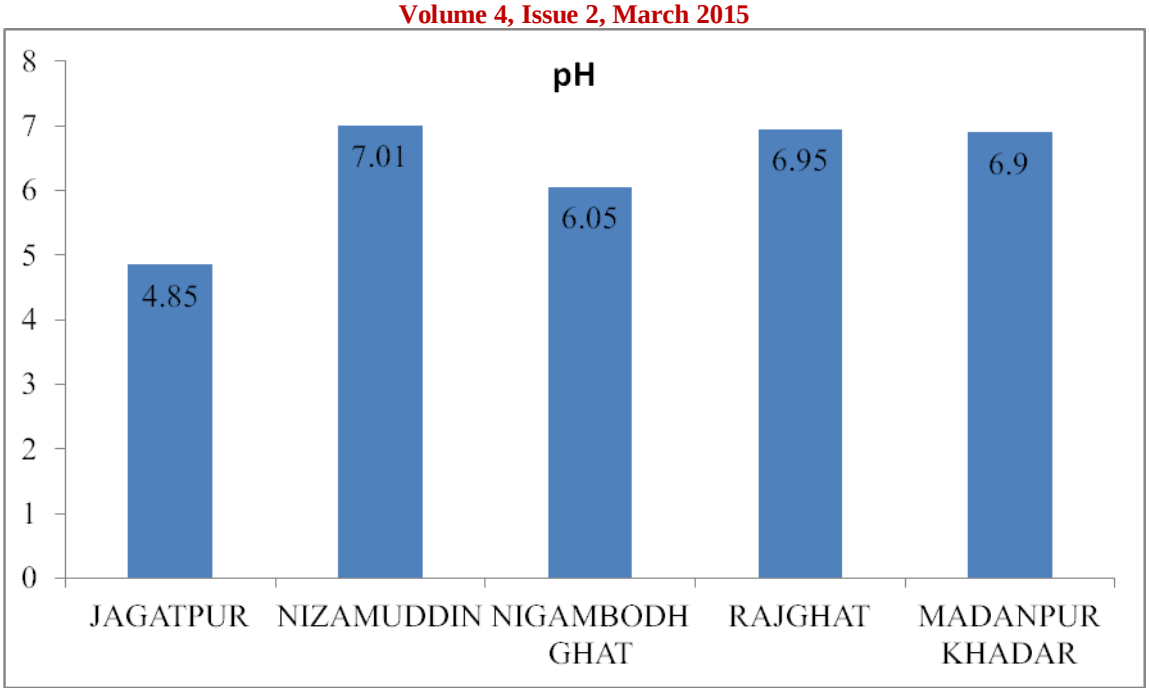


**Fig.- 2 : pH of water samples collected from different site of Yamuna river before rain.**

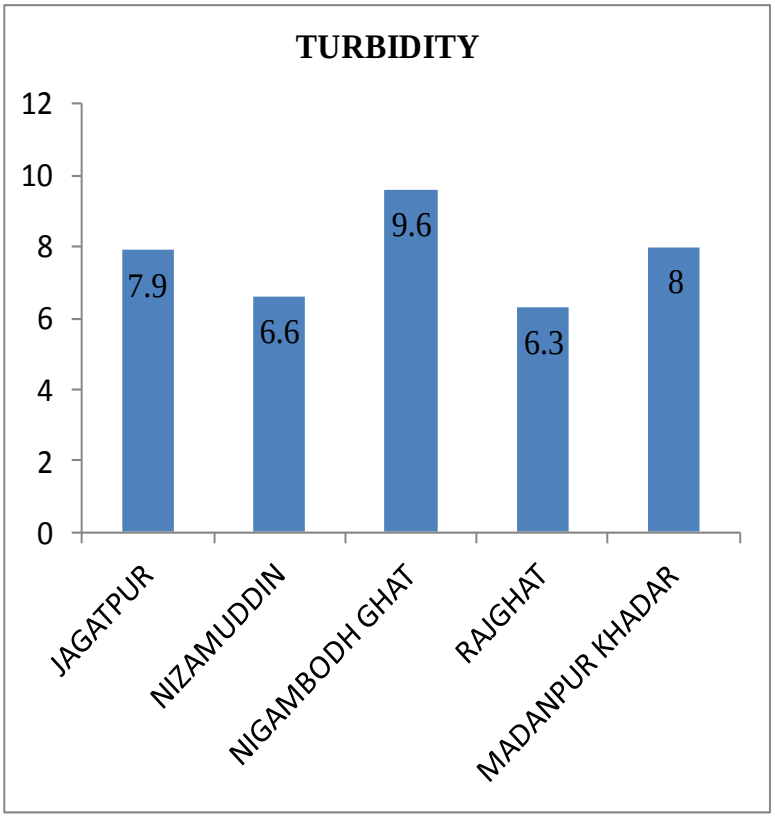


**Fig.3 : Turbidity of water samples collected from different site of Yamuna river before rain .**

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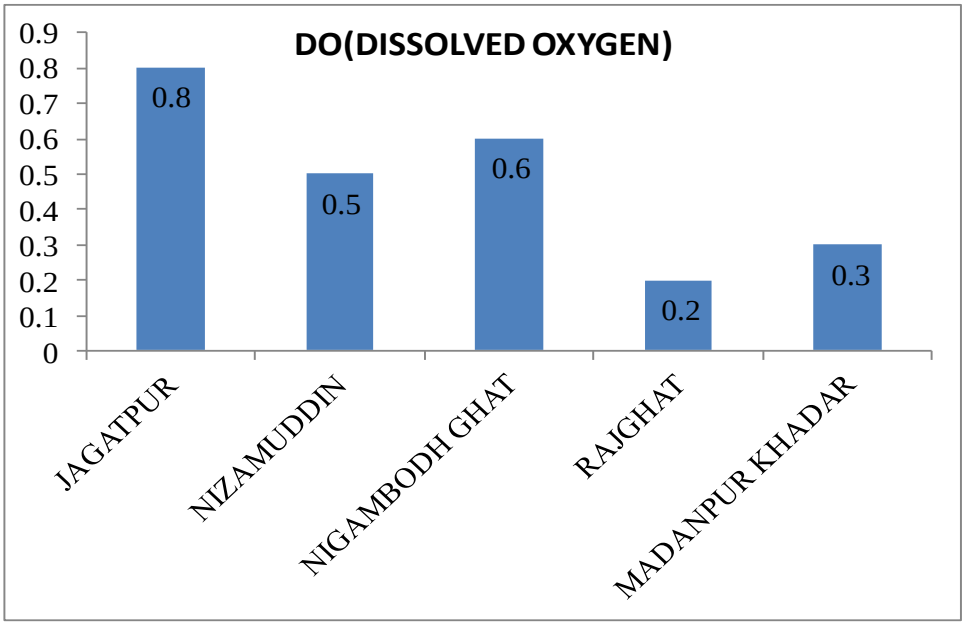


**Fig. 4 : Dissolved Oxygen in water samples collected from different site of Yamuna river before rain.**

**Table- II : Water quality Parameters of different sites of Yamuna after rain .**

| SITE | CONDUCTIVITY (S/cm) | pH | TURBIDITY (NTU) | DO (mg/L) |
|---|---|---|---|---|
| JAGATPUR | 286.4 | 6.36 | 6.782 | 0.6 |
| NIZAMUDDIN | 125.6 | 7.48 | 2.113 | 0.1 |
| RAJGHAT | 124.1 | 7.16 | 2.754 | 0.1 |
| NIGAMBODH GHAT | 125.9 | 7.57 | 3.546 | 0.2 |

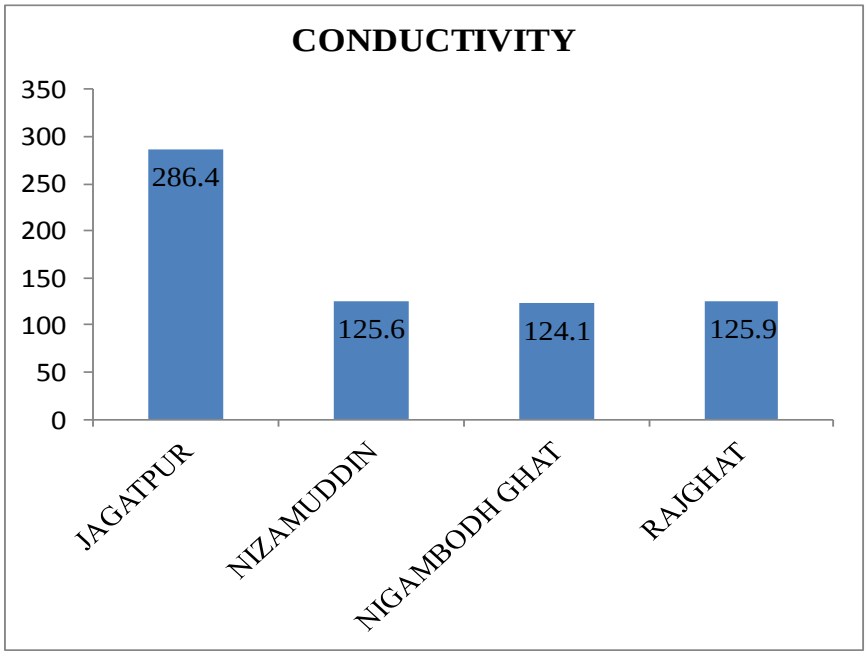


**Fig.5 : Conducivity of water samples collected from different site of Yamuna river after rain .**

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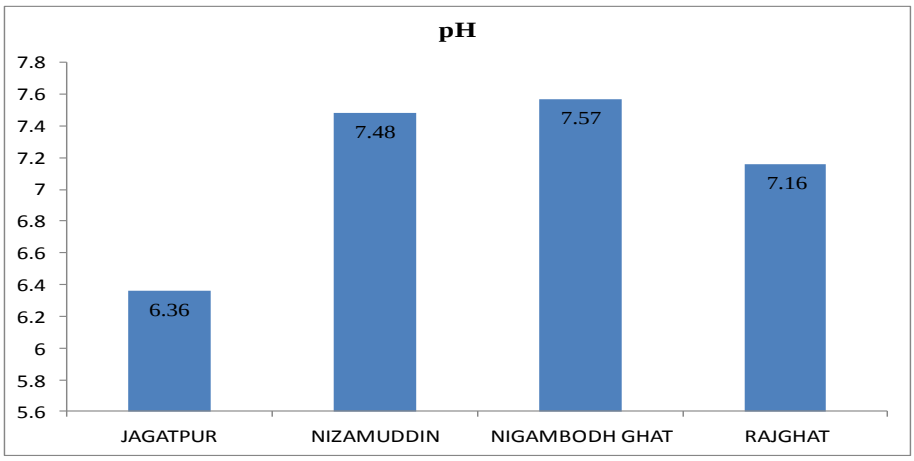


**Fig.6 : pH of water samples collected from different site of Yamuna river after rain.**

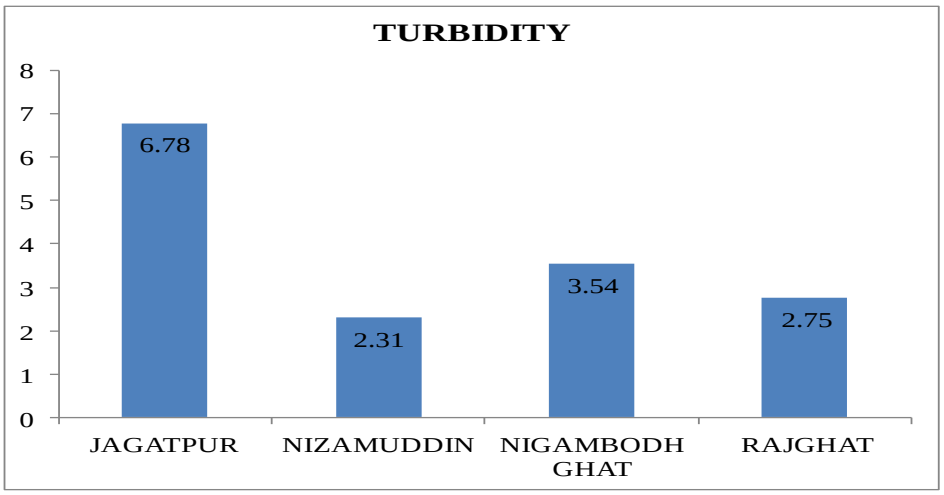


**Fig. -7 : Turbidity of water samples collected from different site of Yamuna river after rain .**

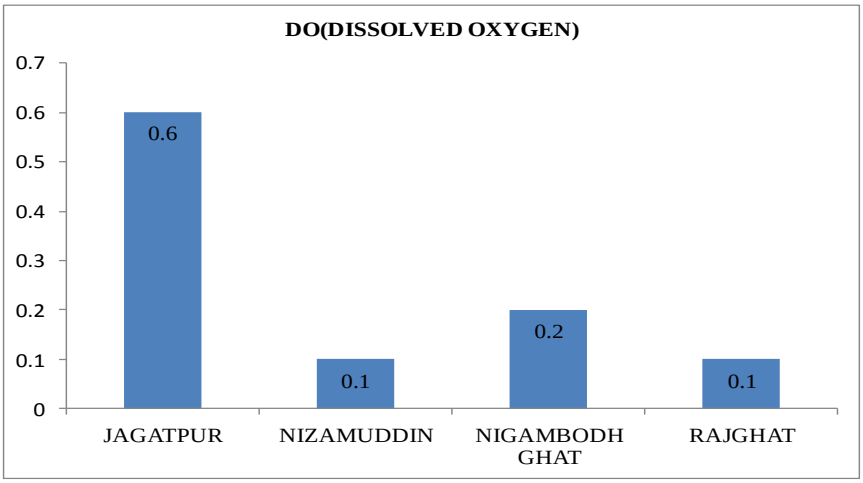


**Fig. 8: Dissolved Oxygen of water samples collected from different site of Yamuna river after rain.**

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## VIII. RESULT AND DISCUSSIONS

As we know that the conductivity is an indirect measure of the presence of inorganic dissolved solids such as chloride, nitrate, sulphate, phosphate, sodium, magnesium, calcium, iron and aluminium. These electrolytes increase the conductivity of a body of water. Inorganic dissolved solids are essential ingredients for aquatic life. They regulate the flow of water in and out of organisms' cells and are building blocks of the molecules necessary for life. A high concentration of dissolved solids can be cause of water balance problems for aquatic organisms and affects dissolved oxygen levels [12]

It is evident from data's Table-I , Table-II that the values of conductivity are found to be within safety limits for all water samples collected from different sites (Permissible value of Conductivity: 50 - 1500 $\mu S\ cm^{-1}$ ) . The value of conductivity are found to be (393.3 $\mu S\ cm^{-1}$ before rain) and (286.4 $\mu S\ cm^{-1}$ after rain) respectively for water samples of Jagatpur Village than the values of other studied sites. Since after rain, the volume of river water in the increases hence because of the dilution, the concentration of various ions present in the river water decreases. So that values of conductivity for water samples are found to be less the before rain.

A range of pH 6.5 to pH 8.2 is optimum for most organisms. Acid rain containing nitric and sulphuric acids can sharply lower the pH of a stream as the rain runs quickly off streets and roofs into creeks. Rapidly growing algae remove carbon dioxide from the water during photosynthesis, which can result in a significant increase in pH levels.

Water sample of Jagatpur is found to be more acidic then other sites as shown in Fig. 2. People of Jagatpur don't use river water directly for their use as the river water is rich in pesticides and fertilizers which are directly discharged in river. Such type of discharge makes the water acidic and unfit for household purposes.

Since after rain the volume of water increases and due to dilution the pH increases to make the water almost neutral. So that all pH values have been found in optimum range for all the samples.

Turbidity can be due to soil erosion, waste discharge, urban runoff, large numbers of bottom feeders which stir up bottom sediments, excessive algal growth. Higher turbidity increases water temperatures since suspended particles absorb more heat, which reduces the concentration of dissolved oxygen (DO) because warm water holds less DO than cold. Higher turbidity also reduces the amount of light penetrating the water, which reduces photosynthesis and the production of DO. Turbidity for surface waters ranges between 1 to 50 NTU. For drinking water, turbidity should be between 0.5 to 1 NTU.

It is shown in figure-3 and Fig.-4 that the value of turbidity is obtained in more amount in the water sample of Nigambodh Ghat than other places. The river Yamuna is considered auspicious, therefore in Hindu mythology the last rituals of a dead person is performed at Nigambodh Ghat. Hence this water is rich in organic matter and therefore turbid.

Since after rain the volume of water increases and due to dilution the value of turbidity decreases after rain, for the entire respective site i.e. for jagatpur, nizamuddin, nigambodh ghat and rajghat.

Dissolved Oxygen is a temperature dependent parameter. It is clear from figure-IV and figure-VIII that the value of Dissolved Oxygen in water sample of Rajghat is found to be very less amount because the coolant over there which treats the water discharge from industries is not working efficiently. According to WHO DO level if less than 3 mg/L are stressful to most aquatic organisms? Most fish die at 1-2 mg/L. Water with low DO from 2 – 0.5 mg/L are considered hypoxic and the water with less than 0.5 mg/L is anoxic. It is clear from data's Table-I and Table-II that the DO levels are found to be less than the permissible limits for all the sites.

## IX. CONCLUSION

There are number of studies on the pollution load of the river Yamuna however there is a need for generation of data periodically to monitor the pollution load of the river. There is also requirement for more research studies on the river bed and its impact on the flora and fauna along the river. Public awareness is an important aspect to save the river from pollution. So efforts should be taken to involve citizens in building the campaign for clean Yamuna. It means the contamination can be control by preventing untreated sewage and effluents from being

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dumped into the river. The increment in water volume reduces the pollution load hence if less water is diverted during the dry season, it will help in controlling pollution.

Before to rains, the water is found to be highly polluted due to high values of ion concentration, conductivity, total dissolved solids and heavy metals content. But the work done after to rains, leading to an increase in the volume of water in the Yamuna and most of the parameters are found to be within safety limits.

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