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To Study the Toxicity Effect of Super Thermal Power Project on Ecology in Narmada River in Madhya Pradesh

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Abstract:- Heavy metal pollution is a global problem. It has harmful effects on human health and aquatic organisms. At Gadrwara, the concentration and transport of copper, zinc and cadmium under high and low flow conditions of the Narmada River were investigated. A total of 35 surface water samples taken from the river were examined. Copper (Cu) was the most abundant heavy metal in the Narmada River, followed by zinc (Zn) and cadmium (Cd). Zinc concentrations were found to be low in both high and low flow conditions, while copper concentrations were found to be low in low flow conditions. Further research revealed that the chrome river had high conductivity and pH levels. The final conclusion of the study was that both the concentration of heavy metals and the throughput of the above mentioned NTPC Super Thermal Power Project Gadarwara are minimal.

Keywords:- *Narmada River, Industrial Tributary, Heavy Metal Pollution, Heavy Metal Transport.*

I. INTRODUCTION

Narmada, India's largest west-flowing river, rises in the Makhala Hills in the Shahdol district of Madhya Pradesh and flows 1,300 kilometers through Gujarat and Madhya Pradesh before emptying into the Gulf of Khmbhat on the Arabian Sea. In view of the environmental and religious importance of the Narmada River, a study to assess the impact of water abstraction and discharge on the Gadarwara STPP Super Thermal Power Project is carried out. Rapid population growth and industrial development near rivers have increased stress on rivers, and with increased stress comes water pollution and environmental health degradation. Heavy metals are transported by the interaction between watersoil and seawater as well as through interactions with the atmosphere. The geochemical processes and human activities are to blame for the contamination of ecosystems with heavy metals. There are adverse effects on water bodies in the form of increased concentrations of dangerous substances such as lead, iron, mercury, cadmium, zinc, Arsenic, copper and chromium.

Table 1 Heavy Metals Permissible Concentration ppm in Water. (Svobodova, 1993 and Engwa *et.al.*,2019)

Heavy metals	Minimum concentration water (ppm)
Aluminum	0.05 -0.2
Arsenic	0.01
Mercury	0.002
Lead	0.015
Chromium	0.1

Gadarwara Super Thermal Power Project STPP is a coal-fired power plant near Gadarwara village in Narsinghpur, Madhya Pradesh. The project has been commissioned and is operating with two 800 MW units with a total capacity of 1,600 MW. Gadarwara STPP Stage-I (2x800 MW) received environmental clearance from MOEFandCC.

The sites are located in Gangai, Umariya, Mehrakheda, Chorbarheta, Dongargaon and Kudari villages in Gardarwara Tehsil, Narsinghpur District, Madhya Pradesh. The site is about 115 km southwest of Jabalpur towards Hoshangabad and about 9 km from Gadarwara town. The final capacity of the project was initially estimated at 3200 MW (2x800 2x800 MW) and the water consumption commitment for the final phase was 125 months (12742.58 m3/H). However, the capacity of the thermal energy project is currently limited to only 1600 MW (2x800 MW) and the water consumption has been revised to 62.7 Cusec. In addition, the actual demand of the project is limited to 4800 m3/h according to MOEF and CC.

- *Purpose of the Study*

The proposed topic is based on the evaluation of the quality of water systems related to continuous metal pollution. Effects of heavy metals on waterways by examining surface toxicity levels of heavy metals leached after material treatment and their effects on surface waters. Due to toxicity, the concentration of some heavy metals (Ni, Zn, Cu, Cd, As, Cr, Pb, Co, Ti, Zr, Fe, Mn, etc.) is analyzed to check the current state of the Narmada river.

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➢ *Statement of the Problem*

Ecological effects: Pollution can damage the local water ecosystem, especially if it is dramatic; can kill insects, fish and amphibians. Animals are generally thought to be victims of water pollution, but multicellular aquatic plants are also at risk when pollution alters the local aquatic ecosystem.

➢ *Objective*

- To Study the Toxicity effect of water withdrawal on flow and aquatic ecology of Narmada River in Madhya Pradesh.Which may include (Two locations near Shakker River Gadarwara at water discharge point and second location Near Narmada Ghats District Jabalpur.

✓ To analyze different heavy metal toxicity.
✓ To analyze various water parameter

II. METHODOLOGY

➢ *The analytical methods commonly used in estimation of heavy metals in water and waste waters are:*

- Inductively coupled plasma analyser (ICP)
- Atomic absorption spectrophotometry (AAS)
- Colorimetric methods
- Polarographic estimation
- Ion Selective Electrodes (ISE)

Table 2 Flame-Gas Combination for Metal Ion Analysis by AAS

Metal Name	Flame-Gas Combination	Metal Name	Flame-Gas Combination
Arsenic Aluminium Boron Cadmium Calcium Chromium Copper Iron	Air-Act N-Act N-Act Air-Act N-Act Air-Act Air-Act Air-Act Air-Act	Mercury Manganese Magnesium Nickel Lead Selenium Zinc	Air-Act Air-Act Air-Act Air-Act Air-Act Air-Act Air-Act Air-Act

Air-Act = air-acetylene; N-Act = nitrous oxide-acetylene

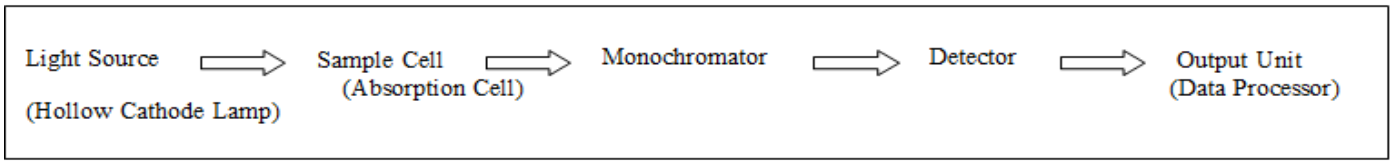

Fig 1 Schematic Diagram of an Atomic Absorption Spectrophotometer

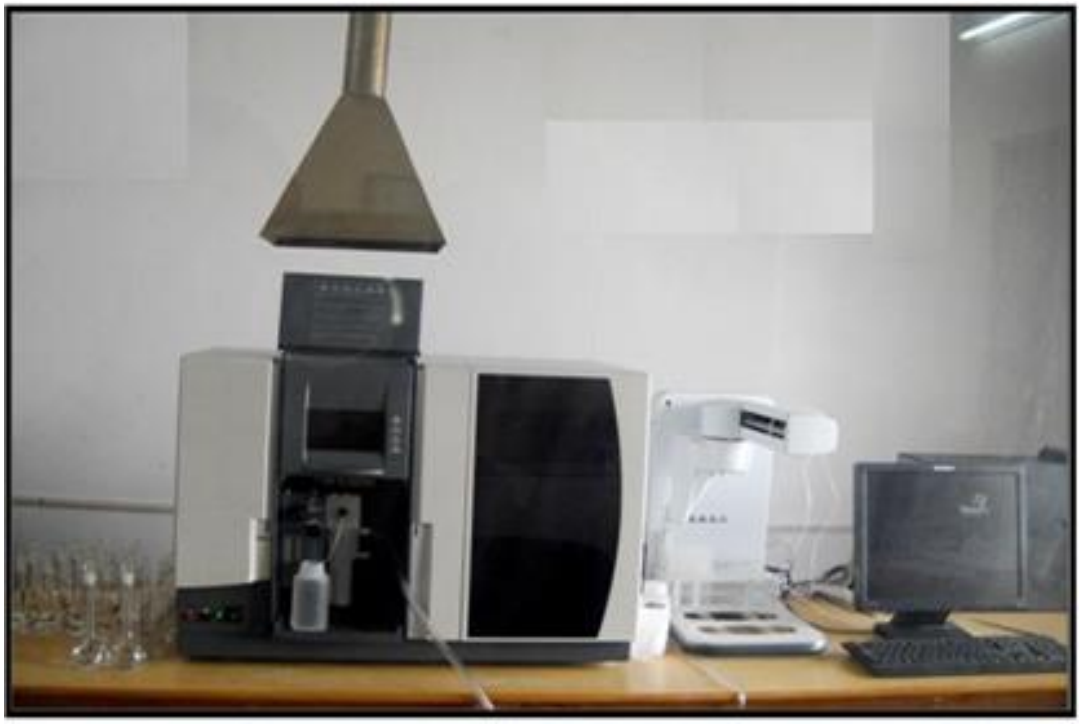

Fig 2 An Atomic Absorption Spectrophotometer Instrument in the Laboratory

➢ *Technical Programme of Work*

- *Location of Work-*

NTPC Gadarwara Super Thermal power plant near village Gadarwara in District Narsinghpur, Madhya Pradesh and Near Narmada Ghats District Jabalpur Madhya Pradesh

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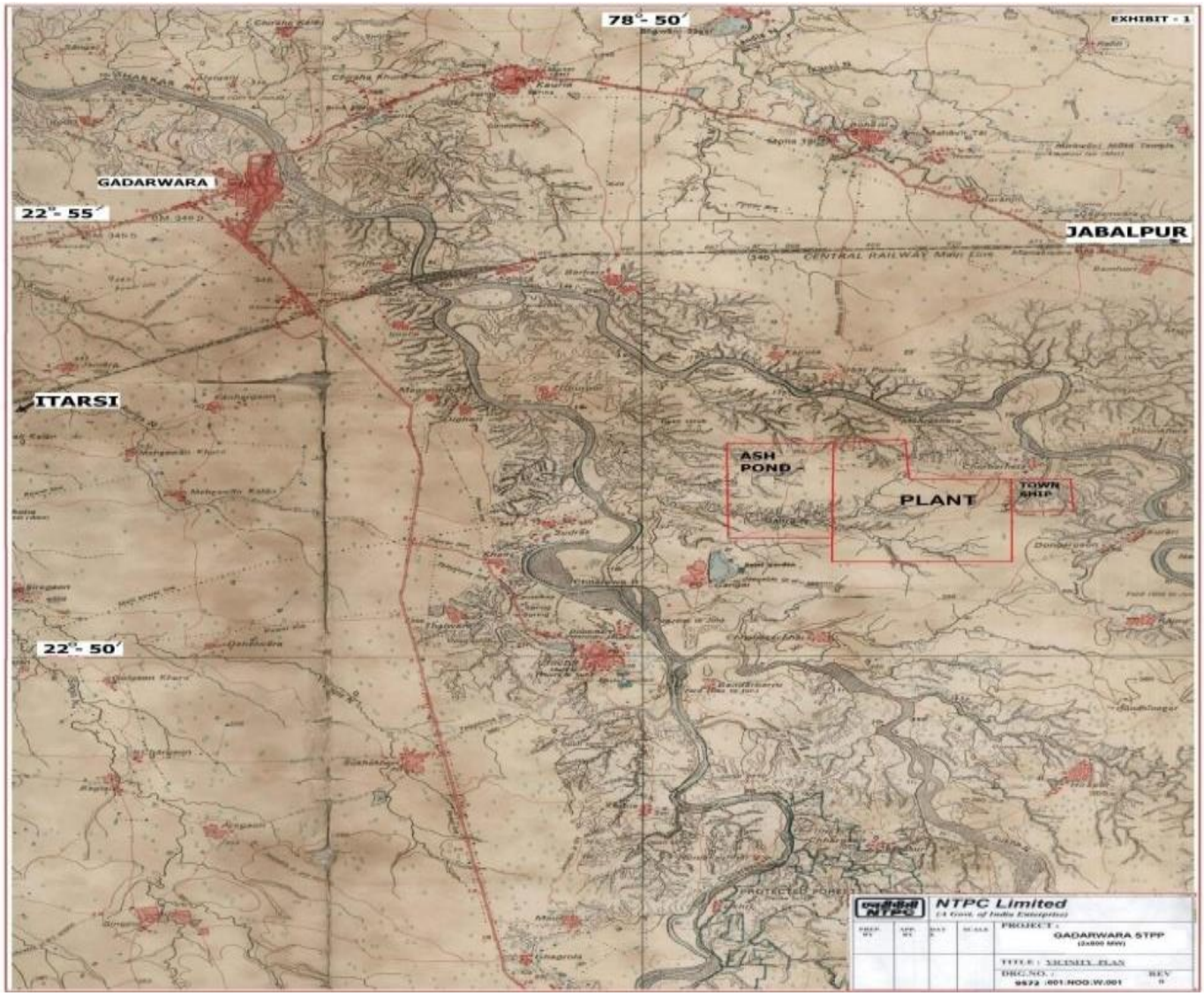

Fig 3 Site Map

- *Duration of Work –*
  The work will be conducted for a period of 60 days**.**

- *Research Methodology and Experimental Design*
  Field survey, selection of sampling locations

✓ Duration of Survey – 60 Days
✓ Sample Size – 35

- *Sample Collection –*
  Fishes, Soil, Water and Aquatic plants will be collected from different sampling sites.

➢ *Materials and Equipment*

Hand nets, cylinder nets, oxygen samples and bottles will be used for assessing the effect of toxic waste on water and fish. For the purpose of the dissection of the sample, scissors and surgical blades shall be used. Other materials in the lab include atomic absorption spectrometers such as Atomic Absorption Spectrometer, Electronic Weightbalance System, Microoven masks, conicalian beakers, flasks, count needles, gloves, forceps, petri dishes, etc.

Table 3 Parameter and Methods

Parameters	Methods
Turbidity (NTU)	Turbidity tube method
Temperature (◦C or ◦F)	Mercury thermometer APHA 23rd Ed. 2017, 4500-H^+-B, 4-95
Total Dissolved Solids (PPM)	TDS Meter IS 3025 (Part 16):1984 Reaffirmed 2006, Ed.2.1(1999-12)
pH	pH Meter APHA 23rd Ed. 2017, 4500-H^+-B, 4-95
Electrical Conductivity	Electrical Conductivity Meter (EC Meter) APHA 23rd Ed. 2017, 2510- B, 2-58
Dissolved Oxygen (mg/L)	Winkler's Method
Hardness (mg/L)	Water Hardness testing kit

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III. DATA PREPARATION / COLLECTION

➢ *Analytical Method Employed*

Trace and toxic metals were analysed by using Agilent 240FS atomic absorption spectrophotometer. The wavelength, current, slit and method employed using atomic absorption spectrophotometer is give.

Table 4 The Wavelength, Current, Slit and Method used for Chemical Analysis by AAS

Sr.	Parameter	Wavelength (nm)	Current(mA)		Slit (nm)	Method used for analysis
			Recommended	Maximum		
1	**Arsenic**	193.7	10	12	0.5	By AAS with VGA
2	**Cadmium**	228.8	4	10	0.5	By AAS with Graphite Tube Analyzer (GTA)
3	**Chromium**	357.9	7	15	0.2	
4	**Copper**	324.8	4	10	0.5	
5	**Mercury**	253.7	4	8	0.5	By AAS with VGA
6	**Iron**	248.3	7	10	0.2	By AAS with Flame
7	**Lead**	217	10	12	1.0	By AAS with Graphite Tube Analyzer(GTA)
8	**Nickel**	232	4	10	0.2	
9	**Zinc**	213.9	5	10	1.0	

➢ *Data Analysis*

- *Copper Concentration*

The analyzed values showed that copper concentration was slightly higher in low flow conditions than in high flow conditions.

- *Zinc Concentration*

Comparing the limit value and the values obtained on a low flow day showed that the risk of biological effects is high even for short-term exposure at sites 2 and 3. Sites 2, 3, 4 showed a high risk of biological effects even with short-term exposure.

- *Heavy Metal Transport*

Table 6 Heavy Metal Transport of Copper and Zinc for both High and Low Flow Condition (kg/day) in Sampled Locations.

Sam. No	High/Low flow	Copper (Kg/day)	Zinc (Kg/day)
1.	High	4.156116	2.097654
	Low	**9.720104**	**2.799004**
2.	High	2.000609	0.954426
	Low	2.958486	0.954426
3.	High	6.432307	1.177805
	Low	9.903514	1.841357

Samples were collected from both low and high flow levels respectively. High heavy metal flow was found in Gadarwara.

- *pH Value*

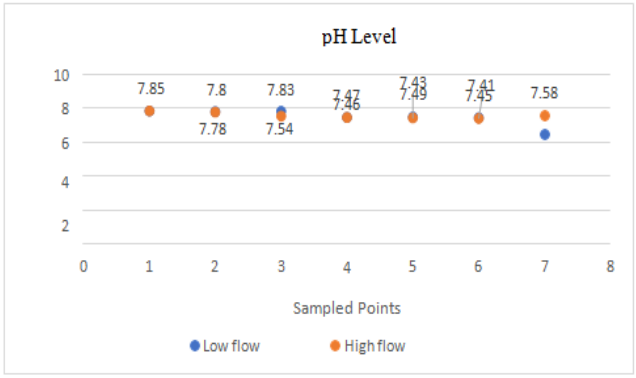

Fig 4 Graph of ph value-for both High and Low Flow Condition (1st October and 30th November)

The pH values for the sampled location for high and low flow respectively were measured.

- *Conductivity*

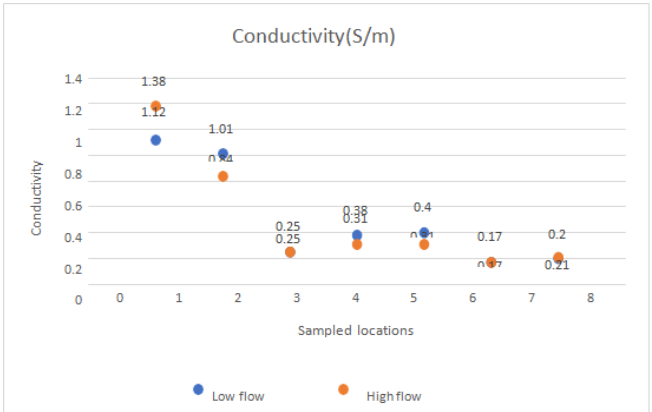

Fig 5 Graph of Conductivity for both High and Low Flow Condition (1st October and 30th November)

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The conductivity of the sample location at high and low current was measured, respectively. A graph of high and low flow values for different days shows that the conductivity value at sampling sites 1 and 2 is always higher regardless of the flow conditions. The measurement of turbidity reflects the transparency of the water.

- *Turbidity:*

Turbidity was observed in all water samples within the permissible limits

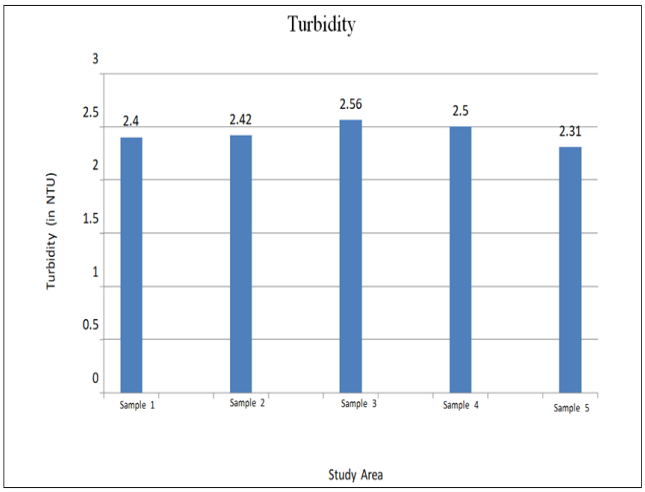

Fig 6 Average Turbidity of the Water Samples from Different Areas.

- *Total hardness*

The hardness of the water is questionable from a point of view. Based on the present study, hardness ranged from 40.2 to 45.2 mg/L. However, the permissible limit of drinking water hardness is 300 mg/l (IS 10500). According to the hardness classification (Durfor and Backer, 1964).

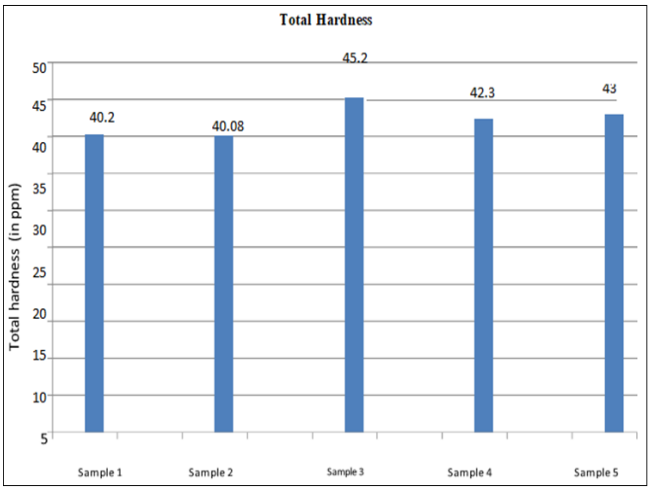

Fig 7 Average Hardness of the Water Samples from Different Areas.

➢ *Biochemical Oxygen Demand (BOD)*

BOD provides a quantitative index of degradable organic matter in water and is used as a measure of waste strength. The low BOD value of all samples indicated a good sanitary condition of the water. It is noted that all water samples are within the permitted limits (ie 3-4 mg/l)

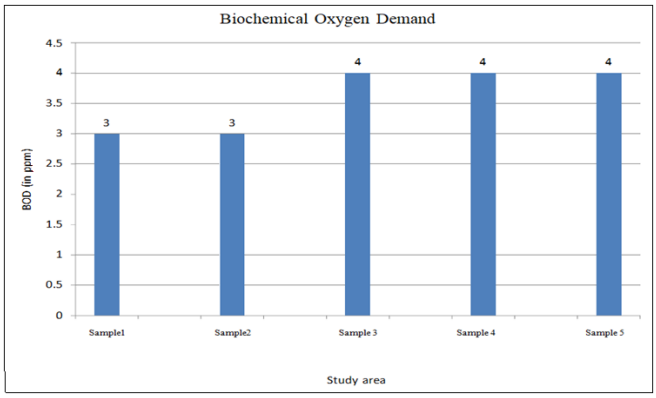

Fig 8 Average BOD of the Water Samples from Different Areas.

➢ *Dissolved Oxygen (DO)*

Water's dissolved oxygen content has been influenced by aquatic vegetation, reflecting the physicochemical processes that occur in water. Organic pollution is most likely linked to low levels of oxygen in the water. In the study area, the dose of DO is between 8.61-8.96 mg per litre, where the prescribed dose of DO is 5.0 mg per litre.

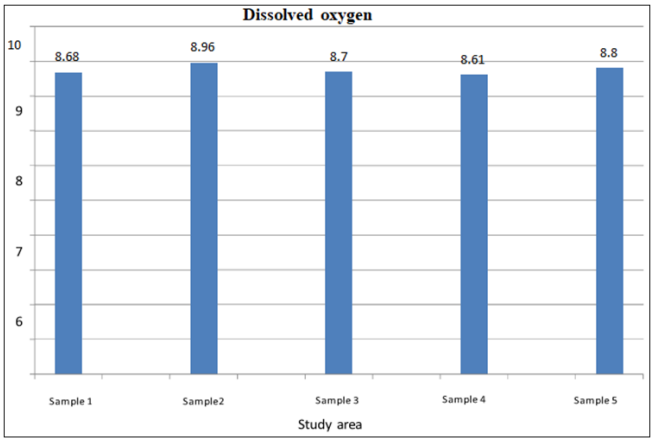

Fig 9 Average DO of the Samples from Different Area

➢ *Temperature*

It is observed that the temperature of water supplied to the hostels, canteens and institute building is within the permissible limits of IS:10500. As a result, Figure 11 shows the temperature of the water collected from the river.

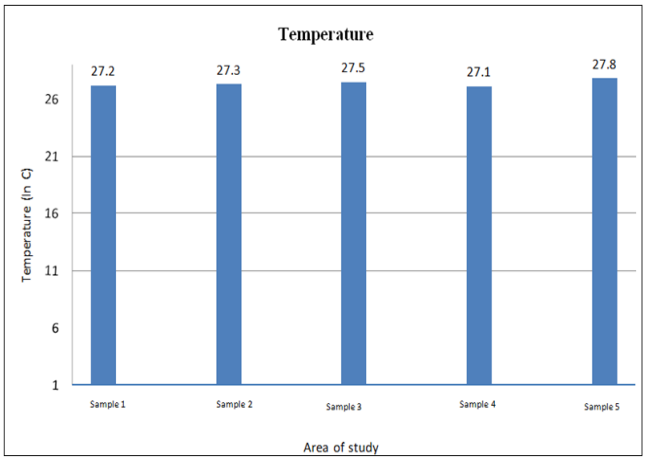

Fig 10 Average Temperature of water from different areas

IV. RESULT AND DISCUSSION

Samples were taken throughout the research period from various sampling sites, and the findings of the analysis of the hazardous and trace metals in water samples were discussed with regard to certain parameters. Copper and zinc are detected in the river waters during the study period, and all data from water quality stations of the Narmada River show that the concentration of arsenic, cadmium, chromium, copper, and zinc are within the acceptable and permissible limits of Bureau of Indian Standards (BIS) standards. Cadmium, chromium, lead, and iron concentration in the Narmada River ranges from 0.002 to 1.201 g/L, 0.080 to 26.66 ug/L, and 0.080-21.930 g/l and 0.002-1.312 mg/l in October and November, respectively.

- *Heavy Metal Concentration*

If there is a high concentration of copper, zinc and cadmium in the water sample, heavy metal pollution occurs. Asaduzzaman *et.al.* 2017. The analysed values for the copper content of water samples in these locations are set out in Annex 1. In both high and low flow conditions, the concentration of heavy metals at the sites is shown.

V. CONCLUSION

Metal concentrations and transports in the Narmada River and its tributaries largely contribute to very little heavy metal pollution to the mainstream. Further studies can be done on the heavy metal concentration of other metals such as lead (Pb), chromium (Cr), arsenic (As) and nickel (Ni) in the tributary.

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