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**Research paper**

# Study on physico-chemical and heavy metal analysis of water in Umrar Dam on Umrar River in Umaria district, Shahdol division in central India

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**Abstracts**: This Paper deals with the Physico-chemical Parameters and heavy metal analysis of Umrar dam in Umaria district, Madhyapradesh. Monthly Changes in Physical and Chemical Parameters Such as Water Temperature, Turbidity, Total Dissolved Solids, pH, Dissolved Oxygen, Free Carbon dioxide and Total Hardness, Chlorides, Alkalinity, Phosphate and Nitrates were analyzed for a period of one year from 2016 to 2017 simultaneously, heavy metal analysis also done in three seasons (summer, Rainy and winter) of the year. All Parameters were within the permissible limits but result related to heavy metals are not satisfactory. Copper is not found in dam water whereas Copper (Cu) is one of the metal, which are essential to human health as well as aquatic life and the concentrations of Fe, Hg and Pb are higher than prescribed limits of WHO and Indian Standard which is responsible for many health hazards related to polluted water. So, the results indicate that the Dam is polluted and cannot be used for Domestic, Irrigation and Fisheries without treatment.

**Keywords**: Umrar Dam, Heavy metals; Physico-Chemical Parameters, Pollution, Health hazards, Fisheries, Irrigation.

## INTRODUCTION

Umrar Dam is constructed in Ufri; Umaria district on the Umrar River in 1990.Water capacity of the dam is 18.9 million m3. Irrigation was the main purpose for constructing this Dam but now it is being used for fish culture by fisheries department of Umaria and irrigation too. Water of this dam is also used by the villagers living around this dam for domestic purposes. This is also known as Kaari Maati (Black Soil) Dam. This is one of the most beautiful places around Umaria Town, Coordinates, 23°29'2"N

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80°49'25"E. As water is one of the most important compounds of the ecosystem, but due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity, the natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to pollute water quality and depletion of aquatic biota. It is therefore necessary that the quality of drinking water should be checked at regular time of interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. It is difficult to understand the biological phenomena fully because the chemistry of water revels much about the metabolism of the ecosystem and explain the general hydro-biological relationship.

The quality of water is described by its physical, chemical and microbial characteristics. But, if some correlations were possible among these parameters, then significant ones would be fairly useful to indicate the quality of water. This study is important, because fluctuation in the water quality has an influence on the biotic communities (Aher and Mane, 2007). This information is important to be communicated to the general public and the Government in order to develop policies for the conservation of the precious fresh water resources (Ali et al., 2000). The aims of this study were designed to monitor monthly variation in water quality parameter of Bansagar dam so as to assess its status and suitability through the portability and aquaculture point of view and to compare observed levels of studied parameters with the corresponding WHO and IS:10500,1992 guidelines values for drinking-water quality.

## MATERIAL AND METHODS

The water samples from this site were collected in polythene bottle regularly for every month. The Water samples were immediately brought in to Laboratory for the Estimation of various Physico - chemical parameters, like water temperature and pH, TDS were recorded at the time of sample collection by using Thermometer and Pocket Digital pH & TDS Meter. While other Parameters Such as DO, Free $CO_2$, Total Hardness, Chlorides, Alkalinity, Phosphate and Nitrates were estimated in the laboratory using Indian standard procedures. For the estimation of DO, Free $CO_2$, Total Hardness, Chlorides, Alkalinity, Phosphate and Nitrates, titration methods were used while pH, TDS and Turbidity estimated by digital devices, simultaneously heavy metals Cu, Zn, Pb, Fe and Hg concentration also measured using the Atomic Absorption Spectrophotometer (AAS model ELICO, SL-168) the obtained results were expressed as ppm.

## RESULT AND DISCUSSION

Results are summarized in table.

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**Table 1. Chemical parameters of Umrar Dam, Umaria district**

| Water Quality Test | Requirement/Acceptable limit | | Results of study site |
|---|---|---|---|
| | IS 10500:2012 (Indian Standard) | WHO (2017) | |
| pH | 6.5-8.5 | NAL | Under Acceptable Limit |
| Turbidity(NTU) | 01 | 1.5 | Under Acceptable Limit |
| Dissolve Oxygen (DO) | NAL | NAL | |
| Carbon dioxide (CO2) | NAL | NAL | |
| Total Hardness (as CaCo3) | 200 mg/l | NAL | Under Acceptable Limit |
| Total Alkalinity | 200 mg/l | | Under Acceptable Limit |
| Chlorides | 250 mg/l | NAL | Under Acceptable Limit |
| TDS | 500 mg/l | NAL | Under Acceptable Limit |
| Calcium (Ca ++) | 75 mg/l | | Under Acceptable Limit |
| Magnesium (as Mg++) | 30 mg/l | | Under Acceptable Limit |
| Mercury | 0.001 mg/l | 0.006 mg/l | Above Acceptable Limit |
| Lead | 0.01 mg/l | 0.01 | Above Acceptable Limit |
| Iron | 0.3 mg/l | NAL | Above Acceptable Limit |
| Copper | 0.05 mg/l | 02 | ND |
| Zinc | 5 mg/l | NAL | Under Acceptable Limit |

**Table 2. Physical parameters of Umrar Dam, Umaria district**

| Month | Taste | Odour | Temperature (ºC) | Turbidity (NTU) | TDS (mg/l) | pH |
|---|---|---|---|---|---|---|
| Jan | Agreeable | Unobjectionable | 14 | 002 | 149 | 8.0 |
| Feb | Agreeable | Unobjectionable | 15 | 002 | 149 | 8.2 |
| Mar | Agreeable | Unobjectionable | 28 | 002 | 148 | 9.0 |
| Apr | Agreeable | Unobjectionable | 28 | 002 | 149 | 8.6 |
| May | Agreeable | Unobjectionable | 30 | 002 | 148 | 8.4 |
| Jun | Agreeable | Unobjectionable | 32 | 002 | 150 | 8.4 |
| July | Agreeable | Unobjectionable | 29 | 002 | 152 | 8.2 |
| Aug | Agreeable | Unobjectionable | 28 | 003 | 162 | 8.0 |
| Sept | Agreeable | Unobjectionable | 29 | 003 | 180 | 8.6 |
| Oct | Agreeable | Unobjectionable | 26 | 003 | 182 | 8.2 |
| Nov | Agreeable | Unobjectionable | 25 | 003 | 175 | 8.9 |
| Dec | Agreeable | Unobjectionable | 18 | 002 | 150 | 8.8 |

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**Table 3. Chemical parameters of Umrar Dam, Umaria district (values are in mg/l).**

| Month | Free $CO_2$ | Dissolved oxygen | Hardness | Alkalinity | Chloride | Calcium | magnesium |
|---|---|---|---|---|---|---|---|
| Jan | 0.1 | 12.2 | 121 | 110 | 100 | 0.269 | 12.868 |
| Feb | 0.1 | 12.5 | 120 | 120 | 100 | 0.272 | 12.286 |
| Mar | 0.2 | 12.0 | 126 | 122 | 100 | 0.277 | 13.834 |
| Apr | 0.2 | 10.6 | 122 | 112 | 100 | 0.274 | 13.260 |
| May | 0.1 | 10.2 | 122 | 120 | 100 | 0.330 | 13.350 |
| Jun | 0.2 | 9.5 | 121 | 121 | 100 | 0.310 | 13.929 |
| July | 0.2 | 9.8 | 128 | 120 | 100 | 0.306 | 12.603 |
| Aug | 0.1 | 9.3 | 126 | 115 | 100 | 0.309 | 11.477 |
| Sep | 0.1 | 9.8 | 134 | 130 | 150 | 0.274 | 12.710 |
| Oct | 0.2 | 9.9 | 130 | 132 | 100 | 0.275 | 10.434 |
| Nov | 0.1 | 10.6 | 128 | 125 | 100 | 0.292 | 12.987 |
| Dec | 0.1 | 11.7 | 132 | 120 | 150 | 0.296 | 12.462 |

**Table 4. Table showing mean (±SD) concentrations of heavy metals (ppm) in water collected from Umrar Dam, Umaria district, Shahdol division (Umrar River).**

| Heavy Metals | Cu | Zn | Fe | Pb | Hg |
|---|---|---|---|---|---|
| Summer | ND | 0.043±0.002 | 0.691±0.001 | 0.840±0.000 | 3.602±0.001 |
| Rainy | ND | 0.074±0.003 | 0.727±0.001 | 0.824±0.001 | 1.129±0.000 |
| Winter | ND | 0.071±0.010 | 0.724±0.000 | 0.827±0.001 | 3.300±0.001 |

**Climate**

This area is a semi dry zone, there is a rapid increase in temperature after the month of January and April-may is the hottest month. The climate of the year is divided into four season's viz hot season from March to May; monsoon from June to September; Post-monsoon from October to November; winter from December to February.

**Water Temperature**

The water temperature plays an important factor which influences the chemical, bio-chemical characteristics of water body. The maximum temperature of 32 was recorded in June and a minimum of 14 was recorded in month of January. Water temperature in summer was high due to low water level and High environmental temperature.

**Turbidity**

The turbidity of water fluctuates from 002 to 003 NTU. The maximum value of 003

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were recorded in the months of monsoon and post monsoon; It is due to the mixing of mud and other garbage with rain water and minimum value of 002 NTU was constant in the remaining months of the year.

**Total Dissolved Solids**

The total dissolved solids fluctuate from 182 mg/l to 148 mg/l. The maximum value was recorded in the month of October. It also due to rain, Heavy Rain is responsible for the soil erosion, resulting soil and mud mix with water which increases the TDS of Water bodies. The minimum value was recorded in the month of March and May.

**pH**

pH was alkaline values ranges from 9.0 to 8.0. The maximum pH value was recorded in the month of March (9.0) and minimum (8.0) in the month of January and August. Most of bio-chemical and chemical reactions are influenced by the pH. The low oxygen values coincided with high temperature during the summer.

**Hardness**

Hardness of water ranges from 134 mg/l to 120.0mg/l. The maximum value was recorded in the month of September (134 mg/l), during summer can be attributed to decrease in water volume and increase of rate of evaporation of water and minimum value was in the month of February, may be due to heavy rain and dilution of water.

**Dissolved Oxygen**

The value of DO fluctuates from 12.5 mg/l to 9.3 mg/l. The maximum value was recorded in the month February and minimum values in the month of August. The amount of oxygen that dissolves in water can vary in daily and seasonal patterns, and decreases with higher temperature, salinity, and elevation. The maximum solubility of oxygen in water at 1 atm pressure (standard air pressure at sea level) ranges from about 15 mg/L at 0ºC to 8 mg/L at 30ºC—that is, ice-cold water can hold twice as much dissolved oxygen as warm water (Wetzel 2001).

**Free Carbon Dioxide**

The value of free CO2 ranges from 0.2mg/l to 0.1mg/l.CO2 may fluctuate according to environmental condition, alkalinity and Hardness of water.

**Alkalinity**

Total alkalinity ranges from 132 mg/l to 110 mg/l the maximum value of 132 mg/l and minimum value of 110 mg/l were recorded in the month of October and January respectively. The alkalinity was maximum value in the summer and rainy due to increase in bicarbonates in water. (Hujare, 2008)

**Chlorides**

The value of chlorides ranges from 150mg/l to 100mg/l. It was about constant during year between 150-100.

**Phosphate, Nitrates, Ca and Mg**

Ca and Mg Concentration were higher in summer season whereas lowest were found during winter. Concentration were higher during summer can be attributed to decrease in water volume and increase of rate of evaporation of water and minimum value was during winter may be due to heavy rain and dilution of water. There was no phosphate and nitrates recorded in Dam water.

**Heavy Metals Analysis**

The Lead and Mercury concentrations in the water are highest in the summer season whereas lowest concentrations are found in Rainy season. Iron and Zinc are found in highest concentration in Rainy while lowest in summer. Copper (Cu) is one of the metal, which are essential to human

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health. It's presence in the aquatic environment may be due to accumulation of domestic and agricultural wastes but we did not found this metal in Dam water. The concentration of Zn in this site is under permissible limit. It is an essential mineral of importance to both plants and animals.

In this study, lead levels were above the recommended limits (0.1ppm) for water. Pb is a toxic element, which has no significant biological function and shows their carcinogenic effects on aquatic biota and humans even at low exposures. Pb exposure is known to cause musculo-skeletal, renal, ocular, neurological, immunological, reproductive and developmental effects. Mercury is a highly toxic element that is found both naturally and as an introduced contaminant in the environment. The concentration of Hg in water is highest than prescribed limits by WHO (0.006ppm), Indian Council of Medical Research (mg/l) and BIS, IS: 10500- Desirable (mg/l) (0.001ppm). In present study mining, fertilizers, domestic waste products and activities of boats are main reasons of heavy metal contamination, which is responsible for the many health hazards in population living across the Dam.

## CONCLUSION

According to results of this study, conclusion is, Dam water is not suitable without treatment for drinking and cooking because of contamination of Heavy metals.

## SUGGESSIONS

There is much human interference in respect to water degradation by which pollution are increasing as, Washing clothes, Taking bath, Worship for different spiritual purpose, immersion of statues, industrial waste, domestic waste and mining .these activities should be banned by the authority because some peoples are using its water for drinking also, which is not good for their health as well as aquatic animals.

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