

# **Comparative Assessment of Physico-Chemical Parameters of surface Water and Ground Water of Dravyavati River of Jaipur (Rajasthan, India)**

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**ABSTRACT:** In this study, various physico-chemical and biological analysis studies were performed to check the surface water quality of Dravyavati River and ground water quality of nearby area of this river. Surface water was found to be highly contaminated by the effluents released by the industries and sewage which is added by the human settlements. Surface water quality surely has an impact on ground water quality in a longer run. Thus, the present study was conducted to evaluate water pollution status of Dravyavati River by comparing various physico-chemical parameters such as Temperature, pH, Turbidity, Biological Oxygen Demand (BOD), Total Hardness, TDS of surface water and ground water at selected sites. The results revealed that the water quality was severely polluted in monsoon and moderately polluted in winter season.

**KEYWORDS:** River Dravyavati, physico-chemical properties, hardness, winter season.

## I. INTRODUCTION

Water is an essential component of life. It is a unique liquid in the sense that without it no life is possible. Groundwater forms a major source of drinking water and irrigation. Ground water moves through varied geological environments and during its flow many chemical compounds get dissolved in it. The modern civilization, industrialisation, urbanisation and increase in population have lead to fast degradation of our surface water quality. This contaminated surface water will have negative impact on ground water and as water is the most important component of our ecosystem, any imbalance created in it due to the presence of various contaminants can have an adverse effect on the entire eco-system.

## II. RELATED WORK

Malviya et. al. Reported<sup>[1]</sup> many physicochemical parameters and characteristic behaviour of river water samples in different seasons and different sampling stations. It was found that the water quality of river is deteriorated due to domestic, industrial effluents direct discharge into river and various human activities along the banks of the river.

Kesalkar et. al. (2012) revealed<sup>[2]</sup> that the paper mill is growing fast and produces different varieties of paper. The physico-chemical characteristics of effluent from this mill revealed that the effluent is light brown in colour and alkaline in nature and SS, BOD, COD of the treated effluent are high in concentration as compared to the Indian standards.

Kavitha et. al. Reported<sup>[3]</sup> the studies on the pharmaceutical wastewater treatment plant. As per available 4 months data, behavioural pattern of existing effluent treatment plant appears to be capable of withstanding the shock loads without affecting the efficiency of the plant. The individual units are also performing well and their removal efficiencies are satisfactory. TSS removal efficiencies for the primary clarifiers is 97.8 %, The maximum BOD removal

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efficiency achieved was 76% & TDS of 45.31% using reverse osmosis process. Aerobic treatment showed 59% COD removal whereas anaerobic phase has poor TDS removal capacity (9%-12%). The overall performance of the effluent treatment plant was satisfactory. This treatment plant is highly potential for BOD, TSS and TDS removal. Thus this treatment technology can be considered as a potential plant for industrial wastewater treatment.

Pratiksha et. al. Reported<sup>[4]</sup> that the pH of Wardha river water samples in pre-monsoon season was found to be in the range 7.5 to 8.0, for monsoon season in the range of 8.2 to 8.9 and for post monsoon 7.4 to 8.3. Standard for chloride is 250mg/l. The concentration of chloride in Wardha river water sample in pre monsoon, monsoon and post monsoon was found to be in the range of 248-255, 116-350, 155-182 mg/l respectively. The amount of total hardness in the Wardha river water samples in pre-monsoon, monsoon and post-monsoon season was found to be in the range of 230-360, 196-305, 348-400 mg/l.

Wastewater irrigation is actively practiced in various parts of the world, specially in developing countries. Study showed that edible vegetables grown in wastewater-irrigated soil have significant accumulation of heavy metals in their edible parts<sup>[5]</sup>.

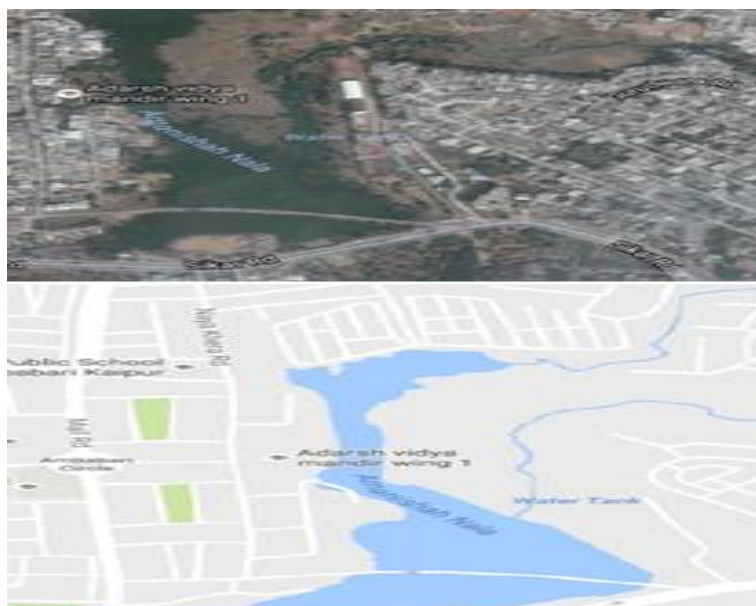
Trivedi et. al. carried out studies<sup>[6]</sup>, which revealed that one of the most important causes of water pollution is unplanned urban development without adequate attention to suitable management of sewage and waste material.

Mukhopadhyay and Mukherjee reported<sup>[7]</sup> that it is necessary to apply strong preventions immediately to save groundwater from deterioration in the study area.

Today, due to various anthropogenic activities, the river water usually receives untreated sewage, domestic waste, industrial and agricultural effluents that results in pollution of several rivers in India and abroad. During the last several decades the water quality of Indian Rivers have been deteriorating due to continuous discharge of industrial waste and domestic sewage<sup>[8-10]</sup> directly into the rivers. Industries are dumping their effluents into the rivers, thereby polluting them severely<sup>[11-12]</sup>.

### III. EXPERIMENTAL

Dravyavati River is located at 26°52'34"N 75°46'14"E within the pink city Jaipur, Rajasthan. This river is 47.5 kilometers long, which has the width ranging from 150 to 210 meters. This river is surrounded by dense urbanization and in recent years small scale industries have grown in its vicinity at a rapid speed.



Source: <https://www.google.co.in/maps/@26.9451449,75.7828388,1266m/data=!3m1!1e3>

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The surface and ground water samples were collected and analyzed for various physio-chemical parameters in the laboratory of Environmental Engineering, NIET, NIMS University, Jaipur, Rajasthan. Various physical and chemical parameters like Temperature, pH, Turbidity, Total Dissolved Solids (TDS), Hardness, Biochemical Oxygen Demand (BOD), etc. have been monitored for different locations.

Surface water was collected monthly from 5 fixed points from the surface of Dravyavati river and ground water was collected from 5 bore wells from nearby area of Dravyavati river in Jaipur, Rajasthan. Ground water samples were collected to analyze the impact of surface water quality on ground water quality.

Plastic bottles of 1.5 liter capacity with stopper were used for collecting pre samples. Each bottle was washed with 2% Nitric acid and then rinsed three times with distilled water. The bottles were then preserved in a clean place. The bottles were filled leaving no air space, and then the bottle was sealed to prevent any leakage. Each container was clearly marked with the name and date of sampling.

## IV. RESULTS AND DISCUSSION

The water quality of Ground water and Surface water of Dravyavati river of Jaipur, Rajasthan has been analyzed to evaluate the suitability of water for various domestic and industrial purposes.

### 1. TEMPERATURE

Figure 1.1: Average monthly temperature of surface and ground water quality

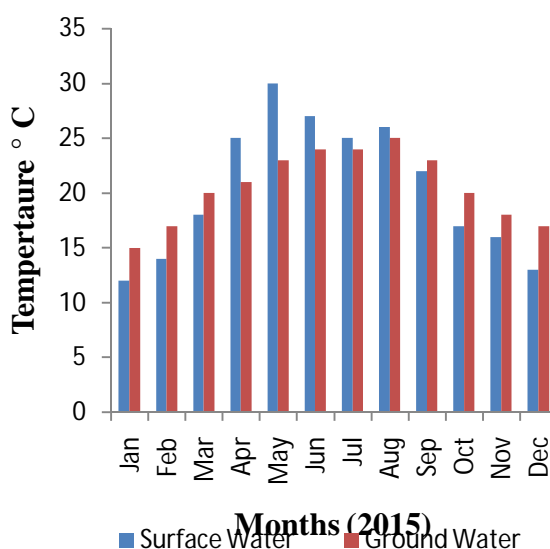


Table 1.2 Average monthly temperature of surface and ground water quality

Month	Surface Water	Ground Water
Jan	12	15
Feb	14	17
Mar	18	20
Apr	25	21
May	30	23
Jun	27	24
Jul	25	24
Aug	26	25
Sep	22	23
Oct	17	20
Nov	16	18

The results from analyses of water temperature from surface and ground water as presented in figure 1.1 and table 1.2 reveals that the temperature of the surface and ground water samples are within the permissible limit as per IS:10500. The results reveals that in months of October to March the temperature vary from 10°C to 20°C whereas in the months of May to September the temperature of surface and ground water samples vary from 20°C to 30°C. It is clear from the graph that temperature is low in month of January, slight rise is observed in each months and the highest temperature is observed in month of May to August after which decreasing trend is observed. The observed trend of rise and fall of temperature in water samples is due to change in atmospheric temperature or seasonal temperature change.

Increased water temperature is an important consideration when toxic substances are present in water. Many substances (i.e. cyanides, phenol, xylene, zinc) exhibit increased toxicity at elevated temperatures. These toxicities and other physiological interactions are also influenced by temperature acclimation or history of the species.

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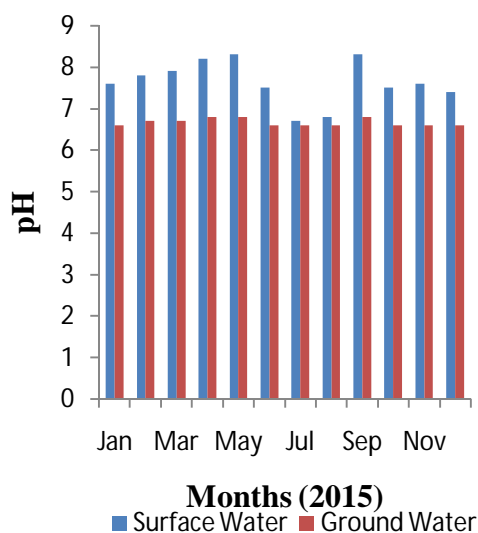
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## 2. pH VALUE

The pH is a measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water. It has no direct adverse affect on health, however, a low value, below 5.0 will produce sour taste and higher value above 8.5 shows alkaline taste. A pH range of 6.5 – 8.5 is normally acceptable as per guidelines suggested by IS: 10500. The results of the analyses for the collected surface and ground water samples are presented in figure 2.1 and table 2.2 which reveal that pH values for surface water samples are comparatively high as compared to the ground water samples except for the months of July and August. The fluctuation in the months of July and August may be due to precipitation. However result reveals that the surface water samples are close enough to alkaline which is due to the contamination in the surface water.

The increase in pH level of the surface water will have adverse impact on the aquatic life too directly and if aquatic life or aquatic process is hampered the self purification mechanism of water will also be hampered.

**Figure 2.1: Average monthly pH values of the surface and ground water samples**



**Table 2.2: Average monthly pH values of the surface and ground water samples**

Month	Surface Water	Ground Water
Jan	7.6	6.6
Feb	7.8	6.7
Mar	7.9	6.7
Apr	8.2	6.8
May	8.3	6.8
Jun	7.5	6.6
Jul	6.7	6.6
Aug	6.8	6.6
Sep	8.3	6.8
Oct	7.5	6.6
Nov	7.6	6.6
Dec	7.4	6.6

## 3. TURBIDITY

The analysis results for turbidity are presented in figure 3.1 and table 3.2 Measurement of Turbidity reflects the transparency in water. It is caused by the substances present in water in suspension. In natural water, it is caused by clay, silt, organic matter and other microscopic organisms.

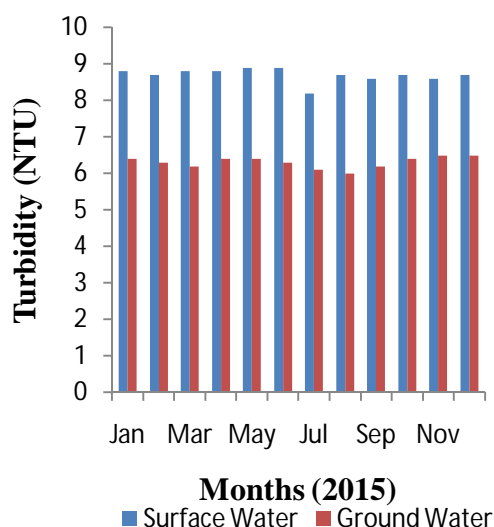
The prescribed limit of Turbidity for drinking water is 5-10 NTU (IS: 10500). Turbidity was found within the permissible limit in all the water samples. However for case of surface water samples turbidity was high whereas turbidity was found low in ground water samples. The result reveals that in ground water samples turbidity varied from 6 to 6.5 that is permissible limit for drinking water whereas in surface water samples turbidity varied from 8 to 9. Thus surface water is unlike to be suitable for drinking purpose. The reason behind the high level of turbidity is due to contamination in the surface water. Additional domestic and industrial waste dumping along with stream flow and runoff from the neighbouring area are major source of high turbidity in surface water.

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**Figure 3.1: Average monthly turbidity for surface and ground water samples**



**Table 3.2: Average monthly turbidity for surface and ground water samples**

Month	Surface Water	Ground Water
Jan	8.8	6.4
Feb	8.7	6.3
Mar	8.8	6.2
Apr	8.8	6.4
May	8.9	6.4
Jun	8.9	6.3
Jul	8.2	6.1
Aug	8.7	6.0
Sep	8.6	6.2
Oct	8.7	6.4
Nov	8.6	6.5
Dec	8.7	6.5

The direct runoff from the agricultural field in the catchment area of the river carries the organic and chemical wastes with the water and adds to the contribution of contaminations in the surface water and finally through deep percolation it reaches to the ground water.

The excess of turbidity has less impact on elders but it has a notable health issues on infants. Various breathing disorders have been identified in the areas of having high turbidity in the drinking water. However water application of high turbidity in agricultural fields does not have instant negative impact but in long term it has adverse impact on soil health.

#### 4. TOTAL DISSOLVED SOLIDS

Total Dissolved Solids may be considered as salinity indicator for classification of surface and groundwater. The TDS in groundwater is due to the presence of Calcium, Magnesium, Sodium, Potassium, Bicarbonate, Chloride and Sulphate ions. The results of the analyses are presented in figure 4.1.

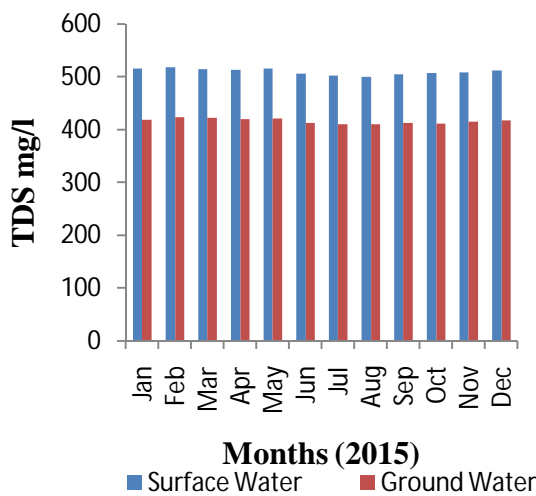
Analysis results for TDS in surface and ground water samples shown in figure 4.1 and table 4.2 reveals that the ground water samples are found to be appropriate but near to the permissible limit. TDS in surface water samples were found on end limit. TDS for surface water samples varied from 580 to 510 mg/l. Highest TDS were found for the surface water samples in the month of January and February. Domestic waste disposal is the main reason of high TDS in the surface water samples. As prescribed limit of TDS for drinking water is 500 mg/l. However TDS were almost same in ground water samples throughout the year and varied from 510 to 515 mg/l.

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**Figure 4.1:- Average monthly Total Dissolved Solids in surface and ground water samples**



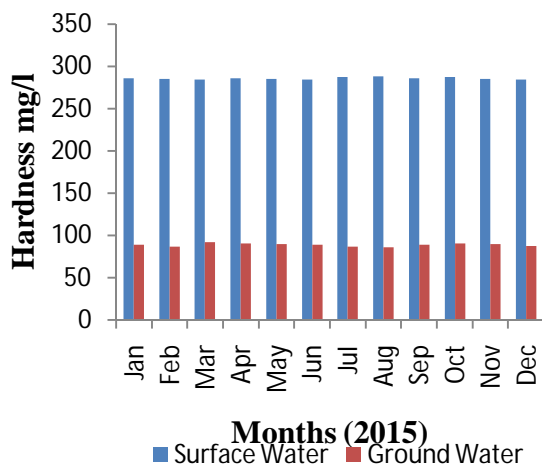
**Table 4.2:- Average monthly Total Dissolved Solids in surface and ground water samples**

Month	Surface Water	Ground Water
Jan	515	419
Feb	518	423
Mar	514	422
Apr	513	420
May	515	421
Jun	506	412
Jul	502	410
Aug	500	410
Sep	505	412
Oct	507	411
Nov	508	415
Dec	512	417

### 5. HARDNESS

Hardness of water is objectionable from the view point of water use for laundry and domestic purposes since it consumes a large quantity of soap. However the permissible limit of Hardness for drinking water is 300 mg/l (IS 10500).

**Figure 5.1:- Average monthly Hardness of surface and ground water samples**



**Table 5.2: Average monthly Hardness in surface and ground water samples**

Month	Surface Water	Ground Water
Jan	286	89
Feb	285	87
Mar	284	92
Apr	286	91
May	285	90
Jun	284	89
Jul	287	87
Aug	288	86
Sep	286	89
Oct	287	91
Nov	285	90
Dec	284	88



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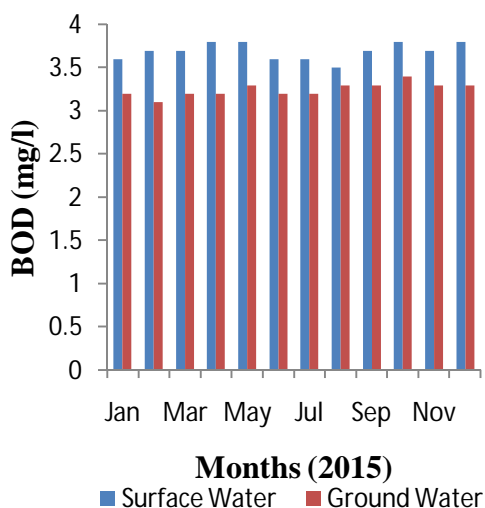
According to Hardness classification (Durfur and Backer, 1965), the no of water samples of the study area can be classified as TDS Range of 0 -60 is soft; 60-120 is moderately hard; 121-180 is hard and above 180 is very hard. The results revealed from figure 5.5 states that the surface water quality of Dravyavati River is not suitable for drinking purpose however it can be used for domestic purpose. The value of hardness for surface water samples varied from 290 to 300 mg/l throughout the year. The hardness of ground water samples were found under appropriate limit and varied from 70 to 85 mg/l. The high values of hardness in surface water will have an negative impact on ground water quality. The reasons for hardness in surface water samples are the toxic and chemical waste intrusion through sever lines additionally chemical transport through runoff from agriculture fields are major role players.

### 6. BIOLOGICAL OXYGEN DEMAND (BOD)

BOD gives a quantitative index of the degradable organic substances in water and is used as a measure of waste strength. The permissible limit of Biological Oxygen Demand is 3 to 5 mg/l. The analysis results are presented in figure 6.1 and table 6.2

The analyses results presented in figure 6.1 and table 6.2 reveals that the BOD in surface water samples varies from 3.5 to 3.8 mg/l. These values of BOD in surface water samples are close to the last permissible limit. The reason behind the high BOD in surface water is due to direct disposal of domestic and industrial waste in Dravyavati River. However the values of BOD in ground water samples varied from 3.2 to 3.5 mg/l. The BOD of ground water samples are under permissible limit. However intrusion of contamination in surface water will have negative impact on ground water too.

**Figure 6.1: Average monthly BOD of surface and ground water samples**



**Table 6.2: Average monthly BOD of surface and ground water samples**

Month	Surface Water	Ground Water
Jan	3.6	3.2
Feb	3.7	3.1
Mar	3.7	3.2
Apr	3.8	3.2
May	3.8	3.3
Jun	3.6	3.2
Jul	3.6	3.2
Aug	3.5	3.3
Sep	3.7	3.3
Oct	3.8	3.4
Nov	3.7	3.3
Dec	3.8	3.3

The highest BOD values are obtained in the months of April, May, October and December for surface water samples. The lowest values of BOD are obtained in the months of June to August for surface water samples. The fluctuation in the BOD values may be due to the precipitation occurrence in the months of June to August. However in case of ground water samples lowest values of BOD are obtained in the months of February and March.

### V. CONCLUSION

The above research work is an attempt to reveal the present comparative status of various physico – chemical parameters of surface water and ground water of Dravyavati river of Jaipur, Rajasthan. The analysis results indicate an overall increase in the temperature, pH, turbidity, TDS, Hardness, BOD more of surface water than ground water. This

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indicates a high contamination of surface water which might further increase the contamination level of ground water through deep percolation process in immediate and proper action is not taken.

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