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A Comparative Study of Pre-Monsoon and Post-Monsoon Status of Different Physicochemical Parameters of Water Samples Collected from the Different Sources of Water in Shujalpur Tehsil (M.P.) India

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Abstract
Water quality assessment is crucial for maintaining public health and environmental sustainability. This study focuses on analyzing the changes in physical and chemical parameters of water samples collected from different surface water sources in Shujalpur, Madhya Pradesh, before and after the monsoon season. The parameters examined include pH, turbidity, dissolved oxygen (DO), total dissolved solids (TDS), hardness, alkalinity and biological oxygen demand (BOD), Chemical Oxygen Demand (COD). The findings highlight seasonal variations in water quality and their potential impact on human consumption and agricultural use.

Keywords: pre-monsoon, post-monsoon, concentration of ions, water quality parameters.

1. Introduction

Water is an essential natural resource that supports life and economic activities. Its quality varies due to natural processes and anthropogenic influences. In India, monsoons play a significant role in altering water quality by introducing contaminants and diluting existing pollutants. This study aims to compare the pre-monsoon and post-monsoon status of various water quality parameters in the Shujalpur region, Madhya Pradesh. Understanding these changes can help in water resource management and pollution control strategies.

Shujalpur, located in the Shajapur district of Madhya Pradesh, India, exhibits specific characteristics in terms of geology, climate, biological processes, and atmospheric interactions that influence its environmental conditions.

Geology: Madhya Pradesh is rich in mineral resources, ranking fourth in India for mineral wealth. The state leads in the production of diamonds and manganese ore, is second in limestone and rock phosphate production, and fourth in coal production. The Shajapur district, where Shujalpur is situated, primarily features alluvial plains with fertile soils, making it suitable for agriculture. The region's subsurface geology

consists of basaltic rock formations from the Deccan Traps, influencing soil composition and groundwater characteristics.

Climate Shujalpur experiences a subtropical climate characterized by three distinct seasons:

- **Summer (March to June):** Hot and dry conditions with temperatures often exceeding 40°C.
- **Monsoon (July to September):** Receives moderate to heavy rainfall due to the southwest monsoon, contributing significantly to the annual precipitation.
- **Winter (October to February):** Mild and dry with temperatures ranging between 10°C and 25°C.

This climatic pattern influences agricultural cycles, water resource availability, and local biodiversity.

Biological Processes: The state's diverse ecosystems include valuable teak forests and rich biodiversity. The region supports various flora and fauna, contributing to ecological balance and offering ecosystem services such as soil fertility and water regulation. The presence of medicinal plants also highlights the area's biological significance.

Atmospheric Interactions

The region's air quality is influenced by vehicular emissions, industrial activities, and agricultural practices. During the monsoon season, increased humidity and precipitation can lead to atmospheric cleansing, reducing airborne pollutants. However, post-monsoon periods may see a rise in particulate matter due to agricultural residue burning and other anthropogenic activities.

Understanding these environmental factors is crucial for effective resource management, sustainable development, and maintaining ecological balance in Shujalpur and its surrounding areas.

2. Materials and Methods

Water samples were collected from different surface water sources, including rivers, lakes, ponds, in Shujalpur area before the monsoon (April-May) and after the monsoon (October-November). Standard procedures were followed for sample collection, preservation, and analysis based on guidelines from the Bureau of Indian Standards (BIS) and the World Health Organization (WHO). The parameters analyzed included:

pH: Measured using a digital pH meter.

Turbidity: Determined using a Nephelometric turbidity meter.

Total Dissolved Solids (TDS): Measured using a conductivity meter.

Hardness: Measured using EDTA titration.

Alkalinity: Determined by acid titration method.

Dissolved Oxygen (DO): Estimated using the Winkler method.

Biological Oxygen Demand (BOD): Measured using a 5-day BOD test.

Chemical Oxygen Demand (COD) (mg/L): is a measure of the amount of oxygen required to oxidize organic and inorganic matter in water.

The water quality standards set by the Bureau of Indian Standards (BIS)**,** the World Health Organization (WHO)**,** and the Indian Council of Medical Research (ICMR) for drinking water.

Water Quality Standards (BIS, WHO, ICMR)

Parameter	BIS (IS 10500:2012)	WHO Guidelines	ICMR Standards
pH	6.5 – 8.5	6.5 – 8.5	7.0 – 8.5
Turbidity (NTU)	1 (desirable), 5 (max)	5	2

Total Dissolved Solids (TDS) (mg/L)	500 (desirable), 2000 (max)	1000	500
Hardness (mg/L as $CaCO_3$)	200 (desirable), 600 (max)	500	300
Total Alkalinity (mg/L as $CaCO_3$)	200 (desirable), 600 (max)	No specific limit	120
Dissolved Oxygen (DO) (mg/L)	≥ 6	≥ 6	≥ 5
Biological Oxygen Demand (BOD) (mg/L)	3	3	3
Chemical Oxygen Demand (COD) (mg/L)	10 (for surface water)	No specific limit	10

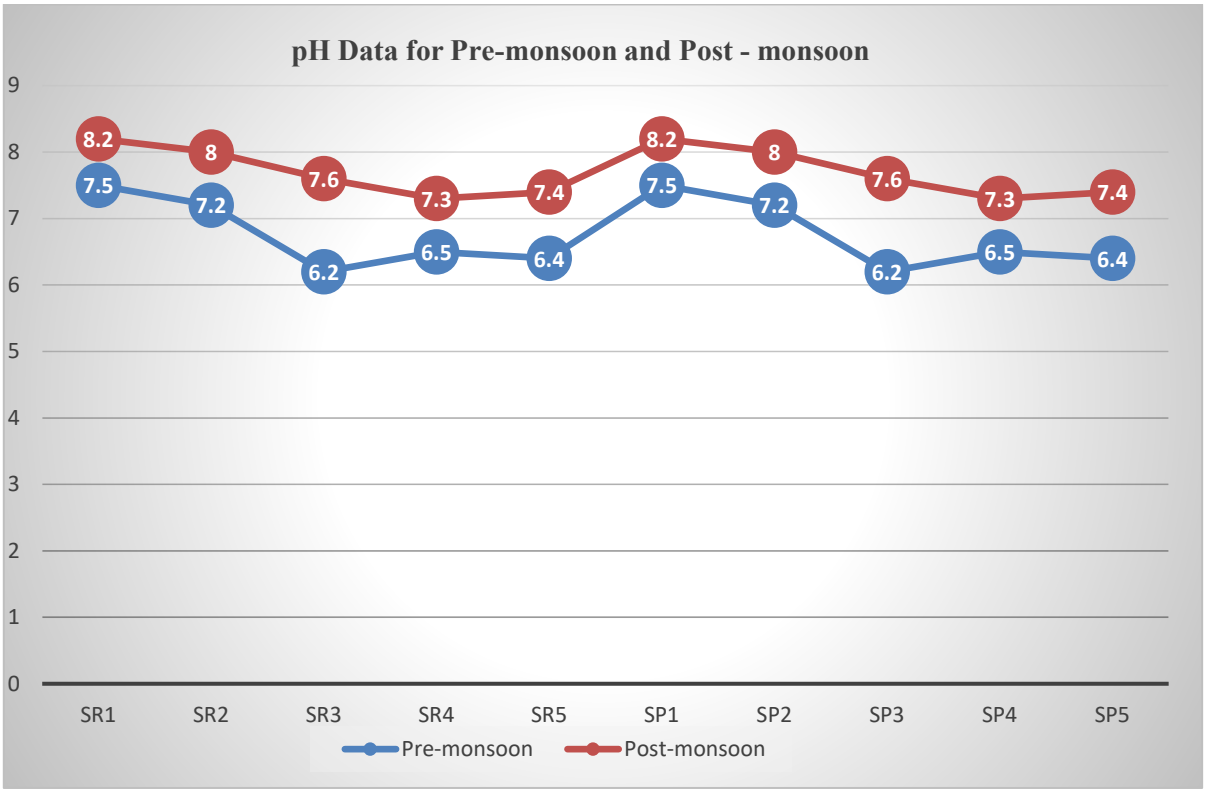
3. Results and Discussions

i. pH: Here pH was found in the range of 6.2to 8.2, high value of pH due to waste discharge, microbial decomposition of organic matter in water body and sewage discharge by surrounding human population. higher pH value recorded during post-monsoon than pre- monsoon be due to dilution of water as a result of precipitation.

Data of pH in study area (Pre-monsoon and post-monsoon)

Surface Water	Sample Station		Pre-monsoon	Post-monsoon
River	SR_1	Jatashankar Mahadev, Jamdhad River	7.5	8.2
	SR_2	Baman ghat (Newaj River)	7.2	8
	SR_3	Nandasura (Newaj River)	6.2	7.6
	SR_4	Ranoganj (Newaj River)	6.5	7.3
	SR_5	Kathiya maharaj mandir (Jamdhad River)	6.4	7.4
Pond	SP_1	Kamliya pond	7.5	8.2
	SP_2	Narola Hirapur pond	7.2	8
	SP_3	Bhyana pond	6.2	7.6
	SP_4	Simrol pond	6.5	7.3
	SP_5	Polay khurd pond	6.4	7.4

Graph 1: pH Comparison in pre and post monsoon

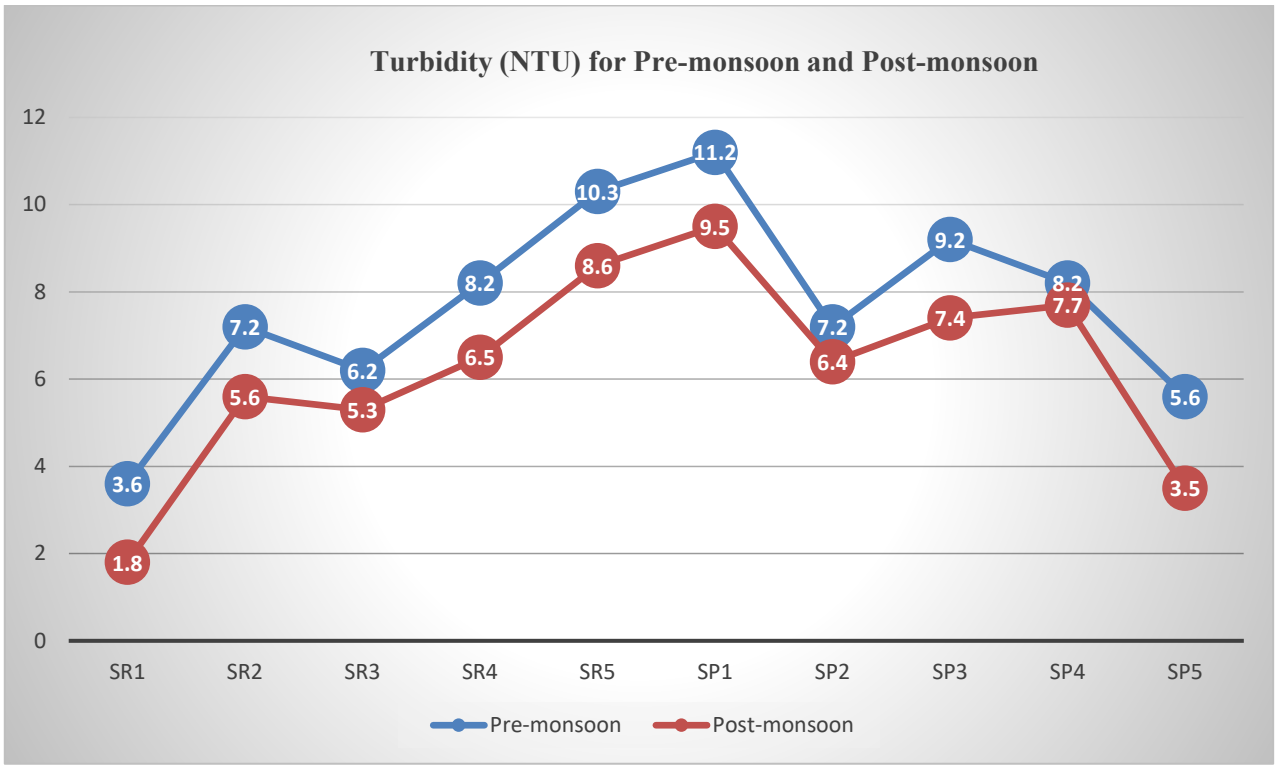


ii. Turbidity: Turbidity is due to presence of dissolved and suspended matter such as salts, clay, silt, sediments, organic and inorganic matter, plankton and other microscopic organisms in water. Turbidity in Shujalpur surface water samples shows from 3.5 to 11.2 NTU. Turbidity increases in Pre-monsoon and decreases in Post-monsoon. Decreased rainfall and runoff lower the turbidity levels in post-monsoon.

Data of Turbidity (NTU) for Pre-monsoon and Post-monsoon

Surface Water	Sample Station		Pre-monsoon	Post-monsoon
River	SR_1	Jatashankar Mahadev, Jamdhad River	3.6	1.8
	SR_2	Baman ghat (Newaj River)	7.2	5.6
	SR_3	Nandasura (Newaj River)	6.2	5.3
	SR_4	Ranoganj (Newaj River)	8.2	6.5
	SR_5	Kathiya maharaj mandir (Jamdhad River)	10.3	8.6
Pond	SP_1	Kamliya pond	11.2	9.5
	SP_2	Narola Hirapur pond	7.2	6.4
	SP_3	Bhyana pond	9.2	7.4
	SP_4	Simrol pond	8.2	7.7
	SP_5	Polay khurd pond	5.6	3.5

Graph 2: Turbidity Comparison in pre and post monsoon

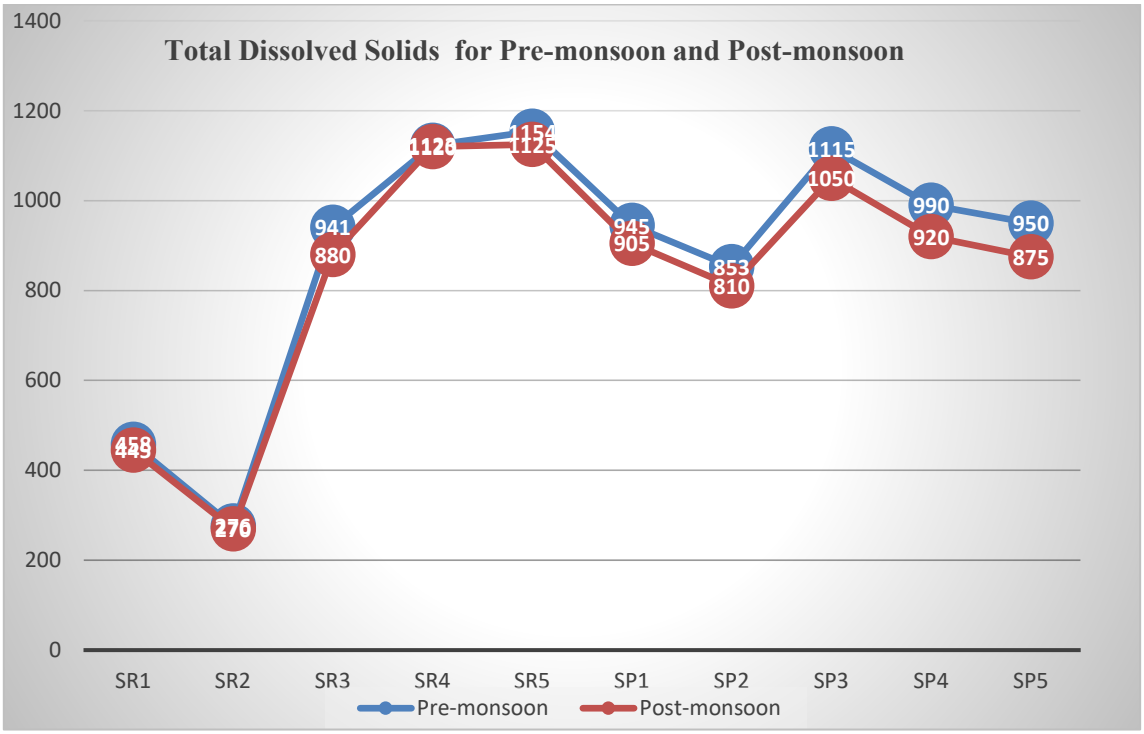


iii. Total Dissolved Solids (TDS): The TDS concentration varied from 270 mg/L to 1154mg/L in Shujalpur tehsil surface water are within the desirable limit. In present study concentration of TDS was found influenced by physical factor such as evaporation. This can be evident by the fall of TDS in post-monsoon season

Total Dissolved Solids (TDS) (mg/L) for Pre-monsoon and Post-monsoon

Surface Water	Sample Station		Pre-monsoon	Post-monsoon
River	SR_1	Jatashankar Mahadev, Jamdhad River	458	445
	SR_2	Baman ghat (Newaj River)	276	270
	SR_3	Nandasura (Newaj River)	941	880
	SR_4	Ranoganj (Newaj River)	1123	1120
	SR_5	Kathiya maharaj mandir (Jamdhad River)	1154	1125
Pond	SP_1	Kamliya pond	945	905
	SP_2	Narola Hirapur pond	853	810
	SP_3	Bhyana pond	1115	1050
	SP_4	Simrol pond	990	920
	SP_5	Polay khurd pond	950	875

Graph 3: Total Dissolved Solids (TDS) Comparison in pre and post monsoon

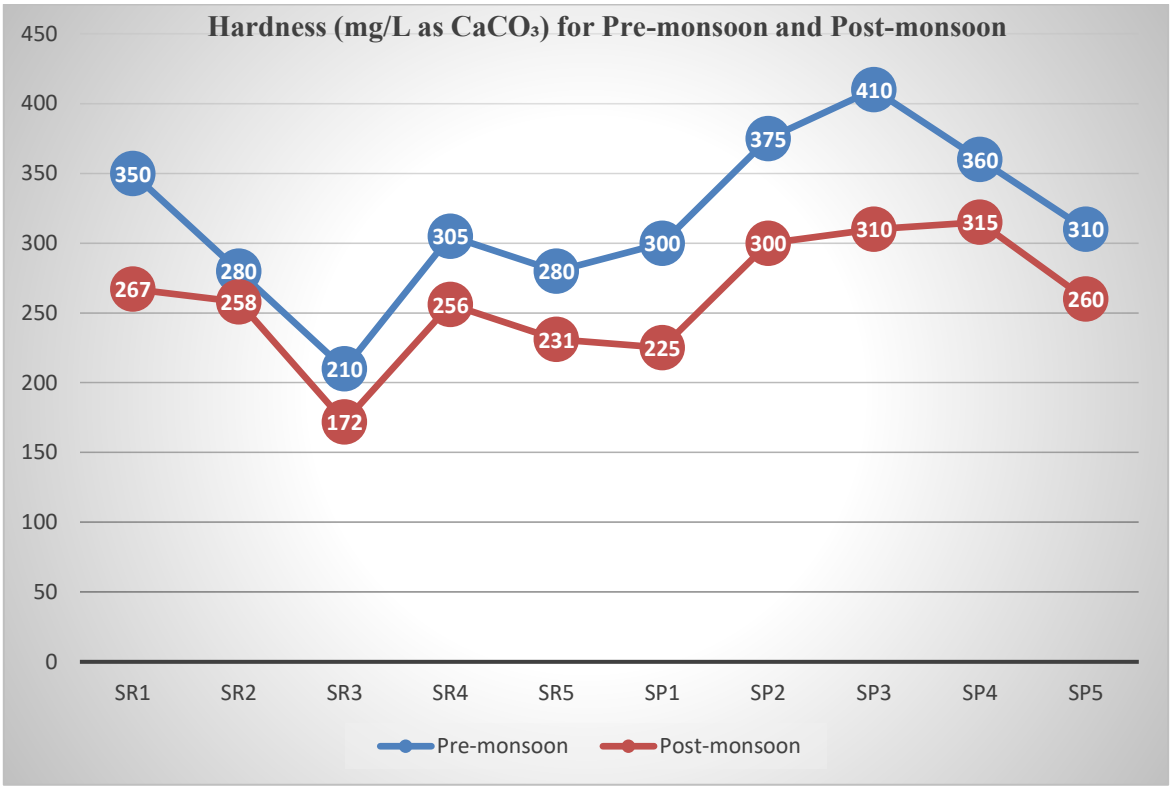


iv. Total Hardness: It was observed with minimum of 210 mg/L and maximum 410mg/L. hardness of water is mainly due to the presence of ca2+ and Mg2+ and is an important indicative of toxic effects of poisonous elements. Hardness value observed high in pre-monsoon and low in post-monsoon season.

Hardness (mg/L as $CaCO_3$) for Pre-monsoon and Post-monsoon

Surface Water	Sample Station		Pre-monsoon	Post-monsoon
River	SR_1	Jatashankar Mahadev, Jamdhad River	350	267
	SR_2	Baman ghat (Newaj River)	280	258
	SR_3	Nandasura (Newaj River)	210	172
	SR_4	Ranoganj (Newaj River)	305	256
	SR_5	Kathiya maharaj mandir (Jamdhad River)	280	231
Pond	SP_1	Kamliya pond	300	225
	SP_2	Narola Hirapur pond	375	300
	SP_3	Bhyana pond	410	310
	SP_4	Simrol pond	360	315
	SP_5	Polay khurd pond	310	260

Graph 4: Hardness Comparison in pre and post monsoon

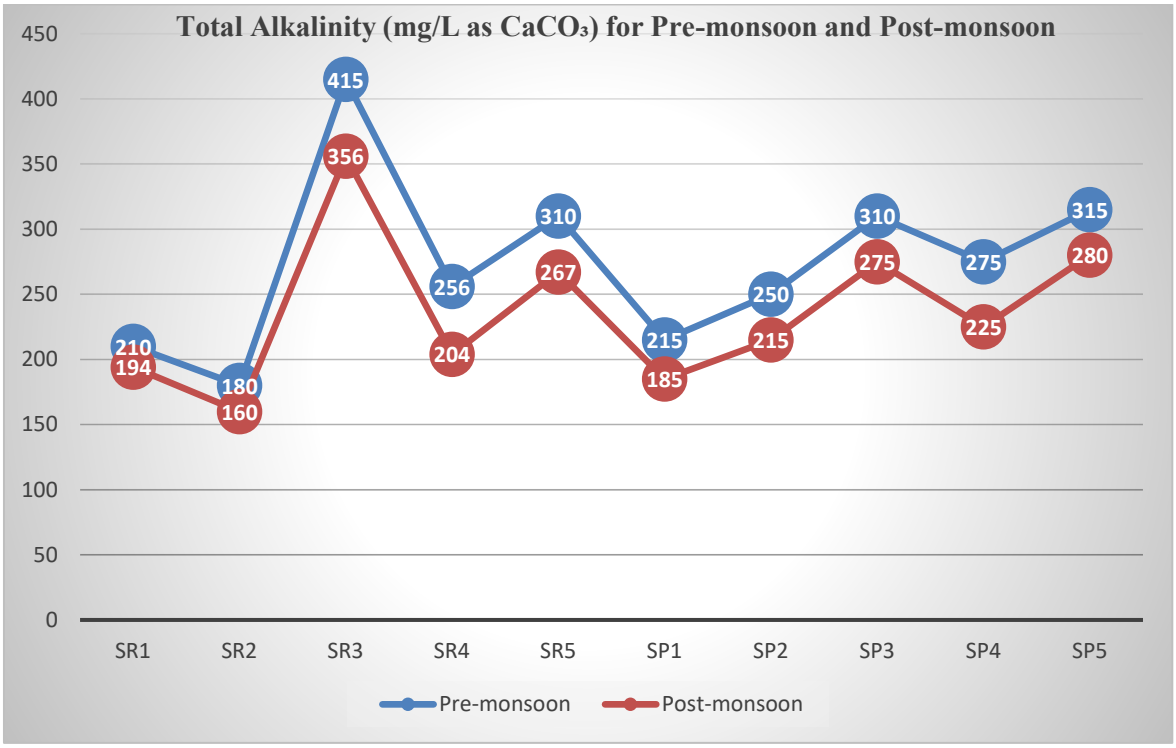


v. Total Alkalinity: Surface water 10 samples show alkalinity value fluctuates between160mg/L to 415mg/L. excess alkalinity in water is harmful for irrigation which lead to soil damage and reduce the crop yield. Increase level in pre monsoon and decrease in post monsoon may result of evaporation and the dilution of water during monsoon.

Total Alkalinity (mg/L as $CaCO_3$) for Pre-monsoon and Post-monsoon

Surface Water	Sample Station		Pre-monsoon	Post-monsoon
River	SR_1	Jatashankar Mahadev, Jamdhad River	210	194
	SR_2	Baman ghat (Newaj River)	180	160
	SR_3	Nandasura (Newaj River)	415	356
	SR_4	Ranoganj (Newaj River)	256	204
	SR_5	Kathiya maharaj mandir (Jamdhad River)	310	267
Pond	SP_1	Kamliya pond	215	185
	SP_2	Narola Hirapur pond	250	215
	SP_3	Bhyana pond	310	275
	SP_4	Simrol pond	275	225
	SP_5	Polay khurd pond	315	280

Graph 5: Total Alkalinity Comparison in pre and post monsoon

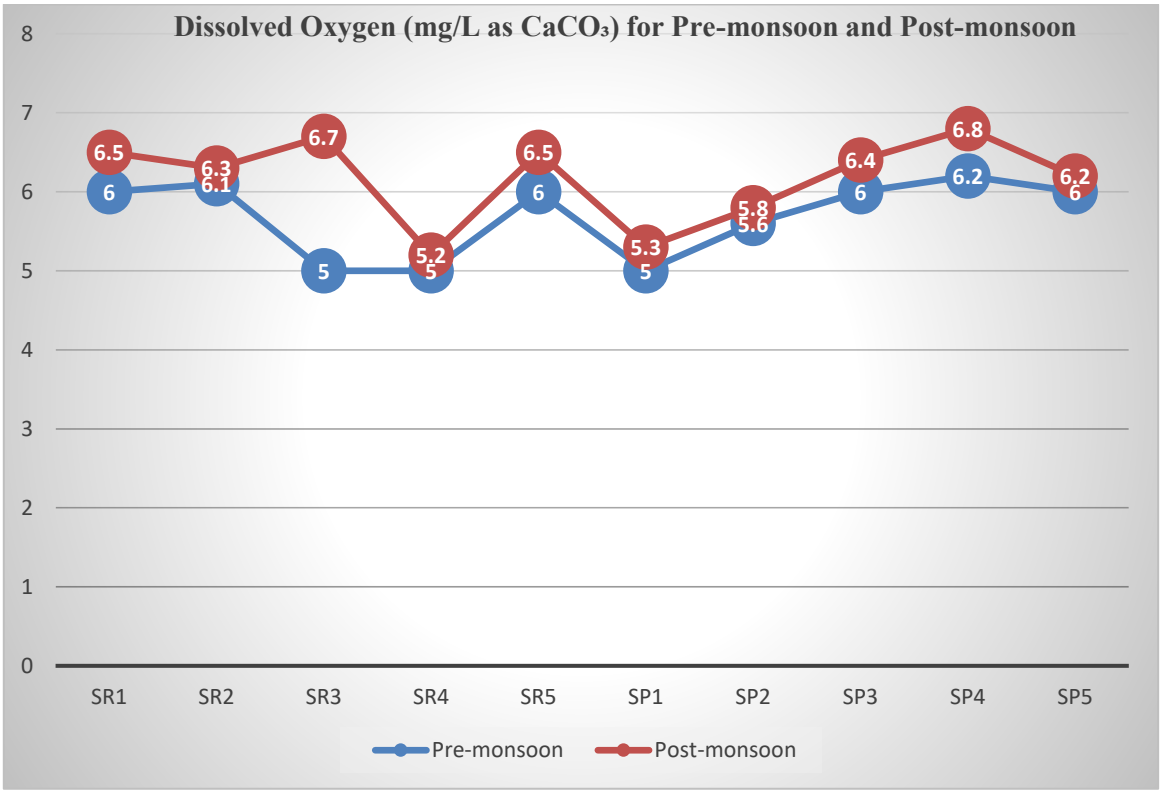


vi. Dissolved Oxygen (DO): DO is one of the most important parameters. Its gives direct and indirect information of bacterial activity, photosynthesis, availability of nutrients, stratification etc. In the progress of Pre-monsoon dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity, and in Postmonsoon due to Rainfall dilutes pollutants and organic matter in the water, DO increased .in the present study DO value fluctuates between 5 mg/L to 6.8mg/L of DO indicate water purity.

Dissolved Oxygen (DO) (mg L) for Pre-monsoon and Post-monsoon

Surface Water	Sample Station		Pre-monsoon	Post-monsoon
River	SR_1	Jatashankar Mahadev, Jamdhad River	6	6.5
	SR_2	Baman ghat (Newaj River)	6.1	6.3
	SR_3	Nandasura (Newaj River)	5	6.7
	SR_4	Ranoganj (Newaj River)	5	5.2
	SR_5	Kathiya maharaj mandir (Jamdhad River)	6	6.5
Pond	SP_1	Kamliya pond	5	5.3
	SP_2	Narola Hirapur pond	5.6	5.8
	SP_3	Bhyana pond	6	6.4
	SP_4	Simrol pond	6.2	6.8
	SP_5	Polay khurd pond	6	6.2

Graph 6: Dissolved Oxygen (DO) Comparison in pre and post monsoon

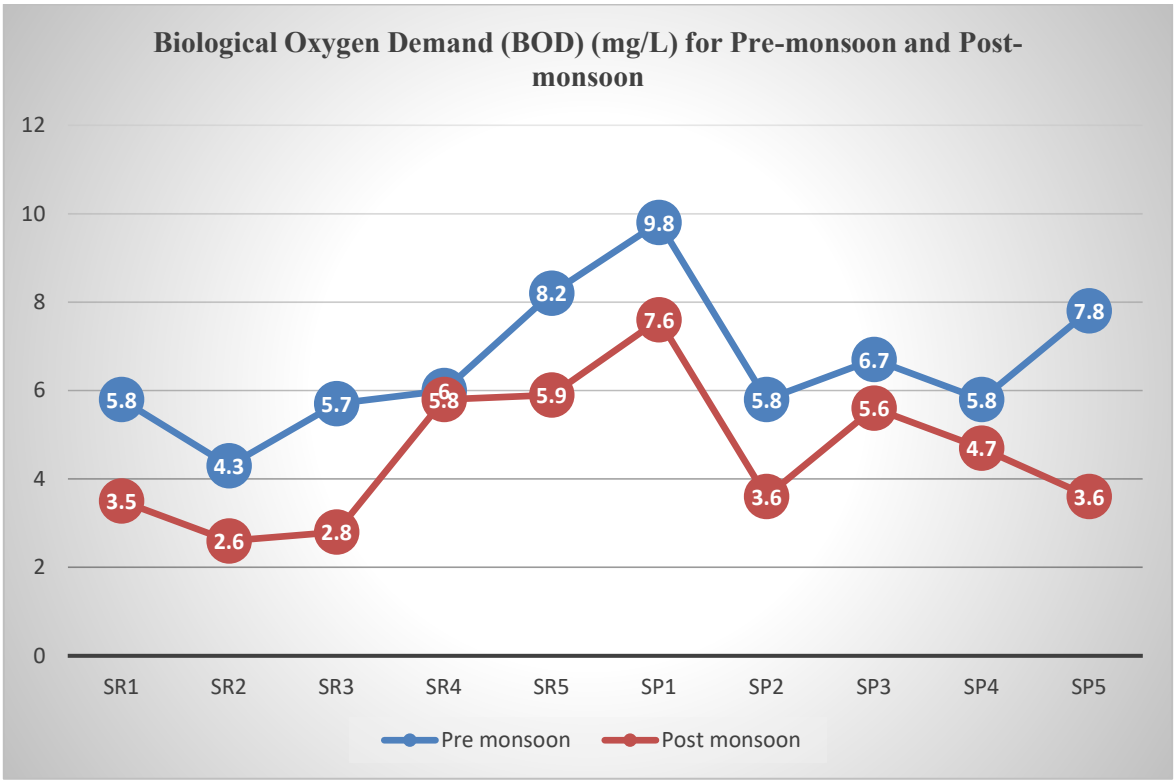


vii. Biological Oxygen Demand (BOD) : High BOD values indicate that there's a large amount of organic matter present, and microorganisms are actively consuming oxygen to decompose it. In present study BOD value fluctuates between 2.6to 9.8 mg/lBiological Oxygen Demand (BOD) (mg/L) for Pre-monsoon and post-monsoon. BOD high in Pre-monsoon and decrease in Postmonsoon.

Biological Oxygen Demand (BOD) (mg/L) for Pre-monsoon and Post-monsoon

Surface Water	Sample Station		Pre-monsoon	Post-monsoon
River	SR_1	Jatashankar Mahadev, Jamdhad River	5.8	3.5
	SR_2	Baman ghat (Newaj River)	4.3	2.6
	SR_3	Nandasura (Newaj River)	5.7	2.8
	SR_4	Ranoganj (Newaj River)	6.0	5.8
	SR_5	Kathiya maharaj mandir (Jamdhad River)	8.2	5.9
Pond	SP_1	Kamliya pond	9.8	7.6
	SP_2	Narola Hirapur pond	5.8	3.6
	SP_3	Bhyana pond	6.7	5.6
	SP_4	Simrol pond	5.8	4.7
	SP_5	Polay khurd pond	7.8	3.6

Graph 7: Biological Oxygen Demand (BOD) Comparison in pre and post monsoon

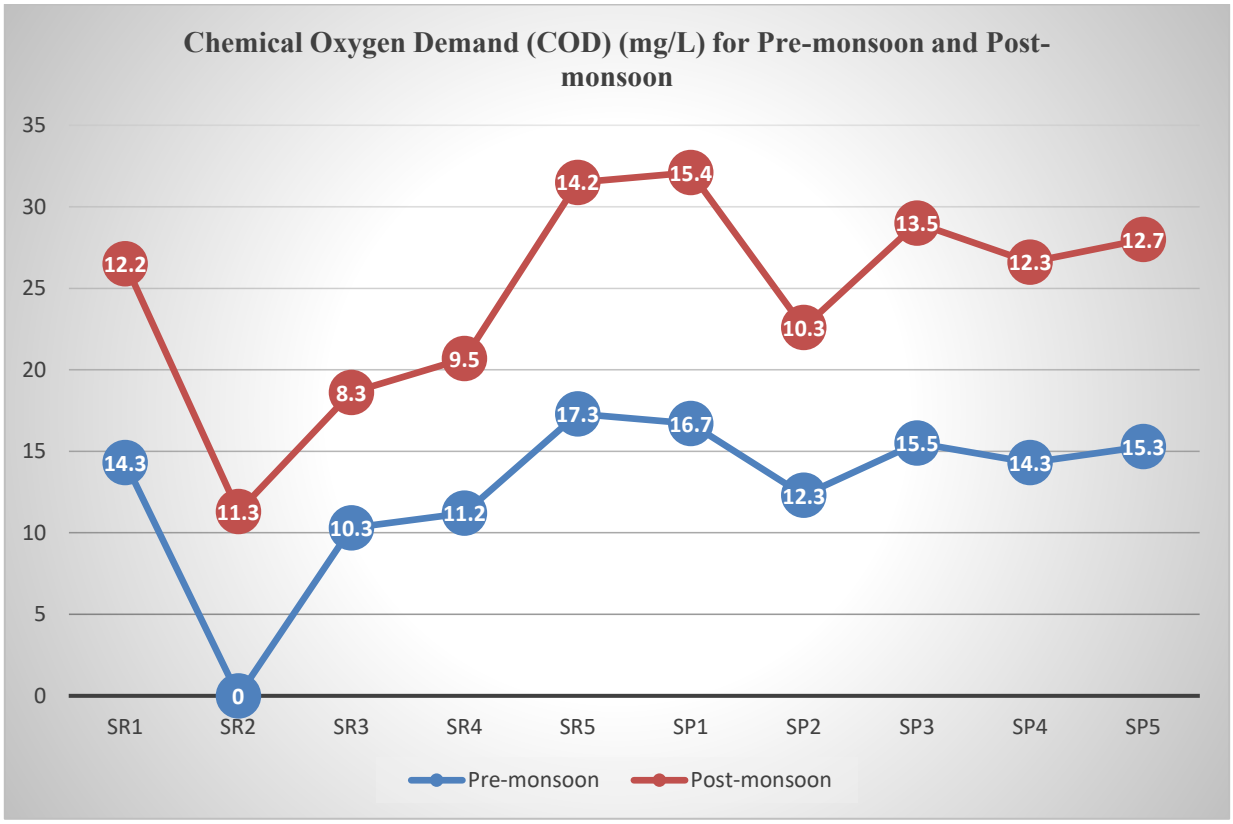


viii. Chemical Oxygen Demand (COD): COD levels tend to be lower in post-monsoon compared to pre-monsoon.COD levels are often lower due to the limited rainfall and lower water flow, which can concentrate pollutants.High COD values indicate a higher level of organic pollutants, which can negatively impact water quality. In the present study COD value fluctuates between 8.3to 17.3mg/L of COD indicate water quality.

Chemical Oxygen Demand (COD) (mg/L) for Pre-monsoon and Post-monsoon

Surface Water	Sample Station		Pre-monsoon	Post-monsoon
River	SR_1	Jatashankar Mahadev, Jamdhad River	14.3	12.2
	SR_2	Baman ghat (Newaj River)	13..4	11.3
	SR_3	Nandasura (Newaj River)	10.3	8.3
	SR_4	Ranoganj (Newaj River)	11.2	9.5
	SR_5	Kathiya maharaj mandir (Jamdhad River)	17.3	14.2
Pond	SP_1	Kamliya pond	16.7	15.4
	SP_2	Narola Hirapur pond	12.3	10.3
	SP_3	Bhyana pond	15.5	13.5
	SP_4	Simrol pond	14.3	12.3
	SP_5	Polay khurd pond	15.3	12.7

Graph 8: Chemical Oxygen Demand (COD)Comparison in pre and post monsoon



Summary of highest and lowest reading of surface water quality parameter of Shujalpur area in Shajapur District

S.No.	Parameters	L R in mg/L	H R in mg/L	Range
1	pH	6.2	8.2	2.0
2	Turbidity	3.5	11.2	7.7
3	TDS	270	1154	884
4	Hardness	210	410	200
5	Total Alkalinity	160	415	255
6	Dissolved Oxygen	5	6.8	1.8
7	BOD	2.6	9.8	7.2
8	COD	8.3	17.3	9.0

Conclusion:

In this study we have analyzed almost 10 samples from the different surface water area of the Shujalpur, Distt. Shajapur (M.P.) India, in pre-monsoon and post-monsoon periods the higher values were generally found for each parameter in the pre-monsoon period. It may be due to the evaporation of water and lowering of water table as the atmospheric temperature increases up to 42°C in the summer before monsoon.

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