

# Analysis of Water Quality Parameters of Channels Discharging into Narmada River at Budhni, Madhya Pradesh, India

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**ABSTRACT:** In order to evaluate the extent of pollution of river Narmada from Budhni tehsil region (Dist. Sehore, M.P), the channels directly discharging into the river are identified and analysed. The monitoring of water quality of these three channels identified in the region namely Gadariya, Gulzari, and Pipaliya was carried out during year 2015-16 in five month duration. The water samples were collected and analysed, with respect to 6 physiochemical parameters (BOD, COD, TDS, Turbidity, Chloride and pH) as per standard methods. The results revealed that of the three channels studied, water quality in Gadariya and Gulzari channel is considerably good, thus these two channels does not have any considerable impact on the health of Narmada river ecosystem, but Pipaliya channel can be considered a mild source of contamination for river ecosystem.

**KEYWORDS:** Gadariya, Gulzari, Pipaliya, Physicochemical Parameters, Narmada River

## I. INTRODUCTION

Rivers have been vital for the sustenance of civilization from the ancient of times. Even in contemporary civilizations, many major cities are based or dependent, on major rivers, since, they play a vital role in economy of nation's agriculture, industry, trade and hydro-electricity. Narmada is the largest west flowing river in India which originates from Amarkantak at an elevation of 900m in the Maikal range of Shahdol district Madhya Pradesh<sup>1</sup>. It is the seventh largest among the fourteen major river basins in the country<sup>2</sup>. It has a total course of 1312 km and total basin of 9879680 sqkm<sup>1</sup>. It flows 1300 km west to states of Madhya Pradesh and Gujarat in terms of its catchment area<sup>2</sup>. It is not only a vital natural resource but also a centre for religious rituals in the area. Notably the river also has a rich diversity of aquatic flora and fauna. The area of study is Tehsil Budhni (District Sehore, Madhya Pradesh, India) situated at 22.7765° N, 77.6819° E on the bank of river Narmada. It has a population of 16,808 (as per Indian census 2011). Inhabitants of this region are totally dependent on Narmada River for drinking water as well as for other household works. Also, it is a source of water for all the industries present in the area (some textile manufacturing plants like Trident and Vardhaman textile plants are situated in this region). Thus, it is intended to analyse the physiochemical parameters of water of the channels discharging into river Narmada in this region in order to study their impact on the quality of river water. Also Statistical analysis is carried out to evaluate Average values (AV), Standard Deviation (SD), Standard Variance (SV), Standard Error (SE) and 95% Confidence Limit (CL) to assess the pollution load assessment.

## II. MATERIALS AND METHODS

In order to evaluate the extent of pollution of river from this region, channels discharging into the river were identified and analysed in terms of various physiochemical parameters. First a survey was conducted in order to identify channels and to decide sampling points. Survey of the desired area was conducted using MP Land records and Google Maps. Three major river channels were identified namely Gadariya (22.769943N, 77.699307E), Gulzari (22.768637N, 77.713383E) and Pipaliya (22.750380N, 77.637055E) which are directly discharging into river Narmada (in the area

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under study). From each of these three channels, three samples were collected at a distance of approximately 10, 20 and 30 meter from the point of sink. The Samples were collected in pre-cleaned 1 Litre plastic bottles and transported in ice box, as per standard method APHA<sup>3</sup>, parameters like pH and D.O (for BOD test) were estimated onsite immediately while other parameters were tested in laboratory within 4 to 8 hours of sample collection. Sampling was done at 15<sup>th</sup> of each month in the duration of September 2015 to January 2016 between 7:00AM and 9:00AM. These samples were analysed as per standard parameters such as TDS (using water analysis kit), Turbidity (by Nephelometer), pH (using Universal indicator), Chloride content (by Mohr’s argentometric method using Potassium chromate as indicator), BOD (by incubating diluted samples at 27° C for 3 days), COD (by dichromate reflux method using a ferroin indicator), and the mean value of the results of the three sample (from each channel) was recorded for each parameter. Finally the results were compared to BIS drinking water standards and inland surface water discharge parameters to study the probable impact of these water channels on quality of river water in the vicinity of the area.

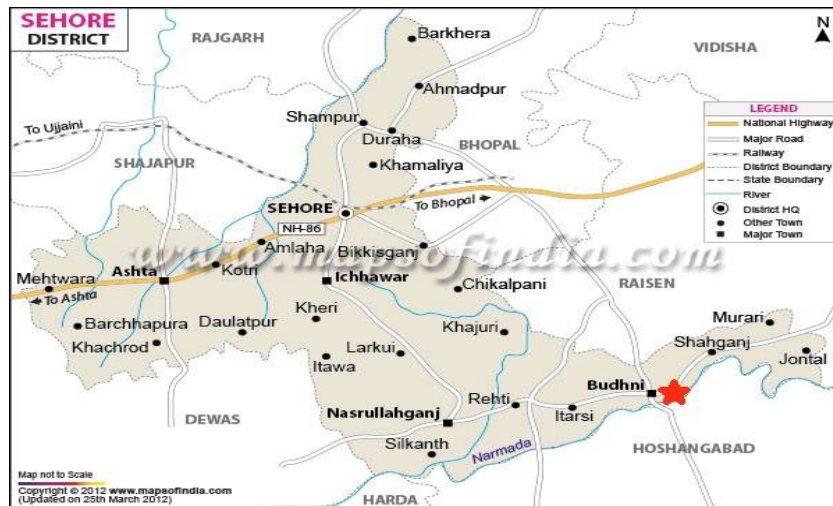


Figure 1-Map showing location of Budhni region in district Sehore (M.P). Source-www.mapsofindia.com.

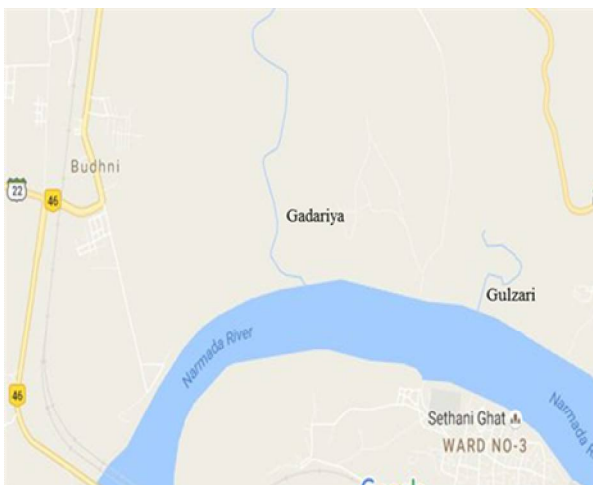


Figure 2-Location of Gadariya and Gulzari water channel\*

\*Source- Google maps

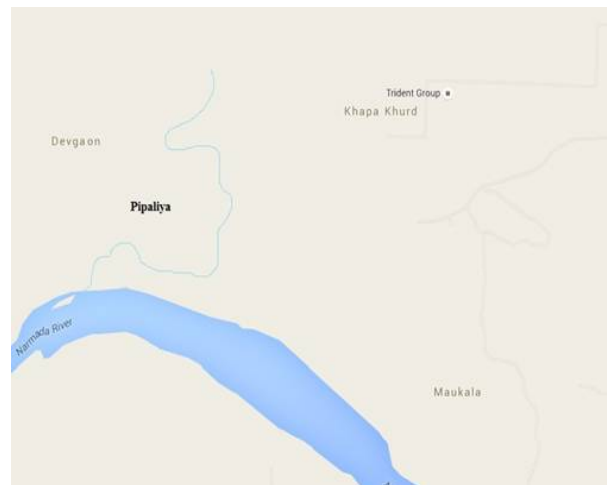


Figure 3- Location of Pipaliya water channel\*

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### III. RESULTS AND DISCUSSION

Physiochemical parameters of water in the rivers enable us to understand the suitability of the water for the aquatic life, functioning of the ecosystem and its utility for human welfare<sup>4</sup>. It is well established fact that physiochemical parameters directly influence the potable nature of water; also it directly affects the hygienic conditions of the surrounding areas. For better ecological understanding of water bodies' analysis of significant abiotic factors are important. It is known that aquatic life is affected by physicochemical status of water bodies which in turn determines the sustainability of the aquatic ecosystem. Thus, in present investigation physicochemical parameters of river channels converging into the river are analysed to study their effect on potable nature and aquatic ecosystem of river body.

**TDS:** The total dissolved solid is the sum of the cations and anions concentration. A high value of TDS indicates elevation in the density of water reduces solubility of gases like oxygen and thus has a negative impact on utility of water<sup>5</sup>. In **Gadariya** channel, mean value of TDS of five sampling occasions was found to be 215.99 mg/l, max and min value found to be 286 mg/l and 163 mg/l in the month of November and September respectively. In **Gulzari** channel, mean value of TDS of five sampling occasions was found to be 265.33 mg/l, max and min value found to be 320 mg/l and 206 mg/l in the month of December and September respectively. In **Pipaliya** channel, mean value of TDS of five sampling occasions was found to be 582.65 mg/l, max and min value found to be 666 mg/l and 510 mg/l in the month of November and January respectively. The variation in concentration of TDS in the respective channels is shown graphically in Figure-4. The values of TDS in Gadariya and Gulzari indicate no harm to the aquatic ecosystem. While in Pipaliya high TDS value indicate presence of considerable concentration of soluble organic and inorganic substances.

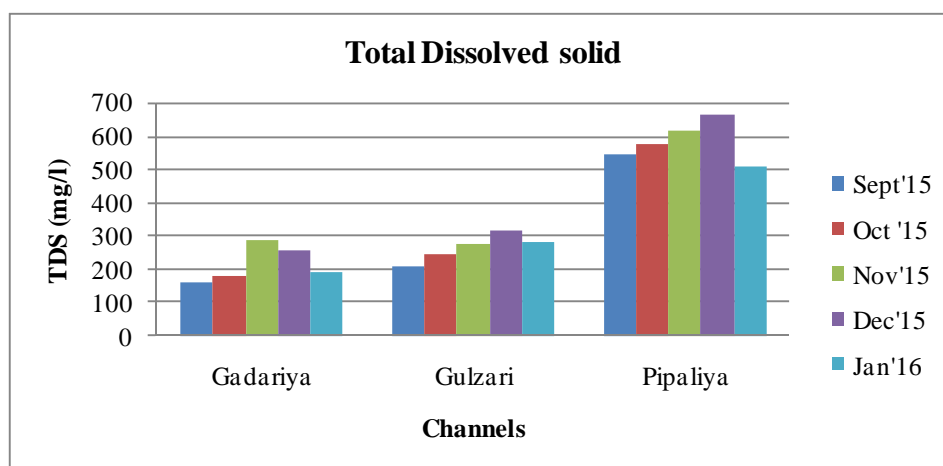


Figure - 4 Graph showing variation in TDS concentration at different channels

**Turbidity:** Turbidity, a measure of the light transmitting properties of wastewater, is a test used to indicate the quality of wastewater discharges with respect to colloidal and residual suspended matter. High levels of turbidity in industrial effluents contribute large amounts of suspended solids to receiving waters<sup>6</sup>. In **Gadariya** channel, mean value of Turbidity of five sampling occasions was found to be 5.33 NTU, max and min value found to be 8.66 NTU and 3.33 NTU in the month of December and September respectively. In **Gulzari** channel, mean value of TDS of five sampling occasions was found to be 3.13 NTU, max and min value found to be 6 NTU and 0.67 NTU in the month of January and November respectively. In **Pipaliya** channel, mean value of TDS of five sampling occasions was found to be 29.06 NTU, max and min value found to be 42.33 NTU and 18 NTU in the month of November and January respectively. The variation in turbidity in the respective channels is graphically represented in Figure-5. The turbidity value in Gadariya and Gulzari channel are low and can be attributed to presence of sand and silt due to the shallowness of the

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channels, but turbidity in Pipaliya channel is considerably high, which indicate towards the possibility of presence of contaminants.

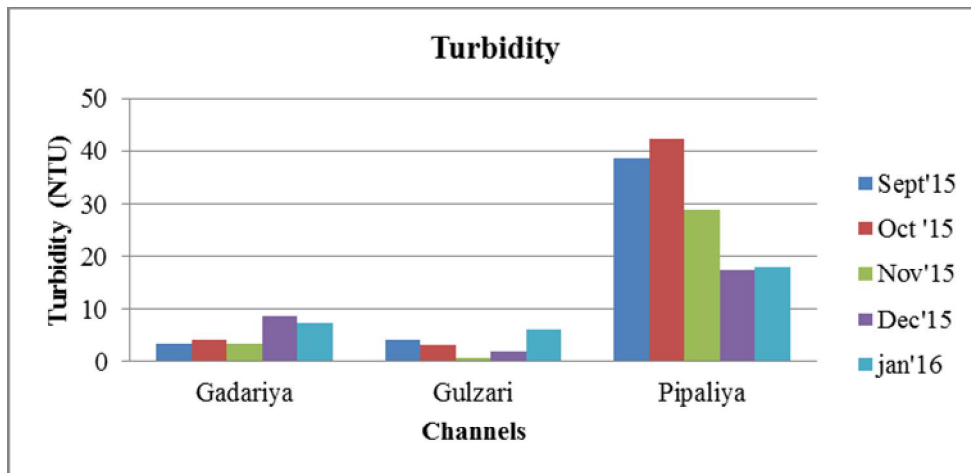


Figure - 5 Graph showing variation in Turbidity at different channels

**Chloride:** Chlorides may get into surface water from several sources such as rocks agricultural runoff, wastewater from industries, oil-well wastes, effluent wastewater from wastewater treatment plants, and road salting etc. The chloride contents indicate domestic as well as industrial pollution<sup>7</sup>. In **Gadariya** channel, mean value of Chloride of five sampling occasions was found to be 35.06 mg/l, max and min value found to be 41.27 mg/l and 28.62 mg/l in the month of October and January respectively. In **Gulzari** channel, mean value of Chloride of five sampling occasions was found to be 45.52 mg/l, max and min value found to be 72.89 mg/l and 19.3 mg/l in the month of October and January respectively. In **Pipaliya** channel, mean value of Chloride of five sampling occasions was found to be 251.81 mg/l, max and min value found to be 347.5 mg/l and 189.06 mg/l in the month of October and January respectively. Also, the variation in chloride content in the respective channels is represented graphically in Figure-6. The values in Gadariya and Gulzari are lower than the permissible limits. While, high chloride content in Pipaliya water channel indicates the effluent discharge from industries and agricultural runoff in the upstream of the sampling point.

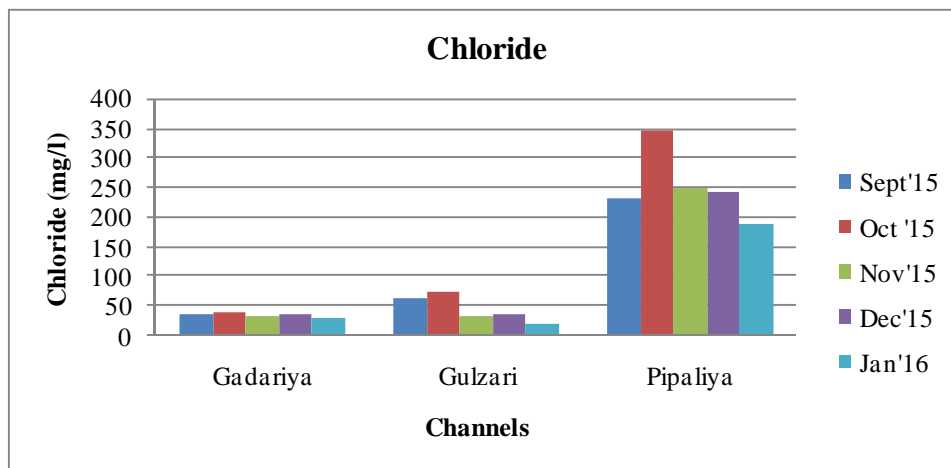


Figure - 6 Graph showing variation in Chloride content at different channels

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**pH:** Most of the chemical and biochemical reactions are influenced by the pH, it is of great practical importance. The adverse effects of most of the acids appear below pH 5 and of alkalis above pH 9.5<sup>8</sup>. In **Gadariya** channel, mean value of pH of five sampling occasions was found to be 7.24, max and min value found to be 7.75 and 6.91 in the month of November and January respectively. In **Gulzari** channel, mean value of pH of five sampling occasions was found to be 6.9, max and min value found to be 7.25 and 6.75 in the month of October and December respectively. In **Pipaliya** channel, mean value of pH of five sampling occasions was found to be 7.44, max and min value found to be 7.9 and 7.08 in the month of November and January respectively. Also, the variation in pH values in the respective channels is represented graphically in Figure-6. The analysis showed that the water is generally neutral in all the three channels.

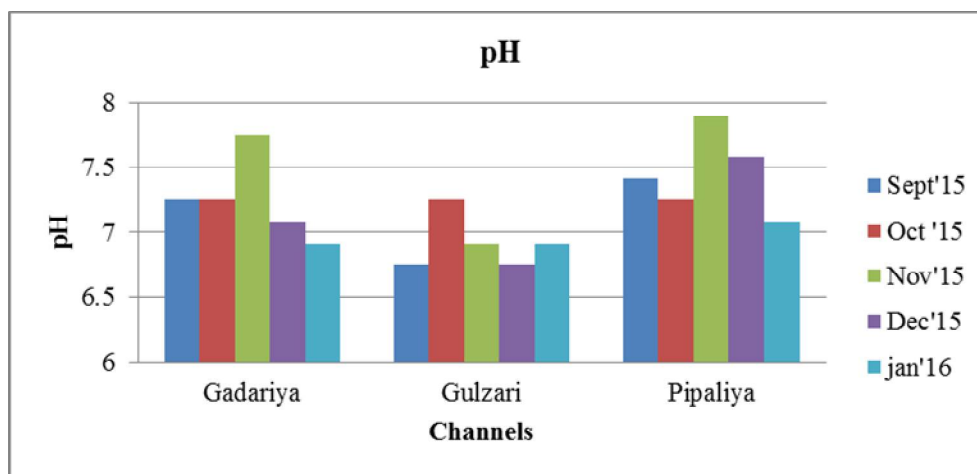


Figure - 7 Graph showing variation in pH at different channels

**BOD:** The Biochemical oxygen demand also indicates the amount of organic compounds in water as measured by the volume of oxygen required by the bacteria to metabolise it under aerobic condition. For more organic matter, more oxygen is required by bacteria for its decomposition<sup>9</sup>. This results in release of organic nutrients in water bodies resulting in death of organisms thriving on water<sup>9</sup>. In **Gadariya** channel, mean value of BOD of five sampling occasions was found to be 2.99mg/l, max and min value found to be 3.36 mg/l and 2.3 mg/l in the month of October and December respectively. In **Gulzari** channel, mean value of BOD of five sampling occasions was found to be 2.81, max and min value found to be 3.23 mg/l and 2.1 mg/l in the month of October and December respectively. In **Pipaliya** channel, mean value of BOD of five sampling occasions was found to be 14.55 mg/l, max and min value found to be 16 mg/l and 13.06 mg/l in the month of October and November respectively. The variation in BOD values in the respective channels is represented graphically in Figure-8. The BOD values in Gadariya and Gulzari indicate presence of organic matter in very small quantity, which is harmless, while increased value in Pipaliya channel indicates that there is a discharge of wastewater in the upstream of the station.

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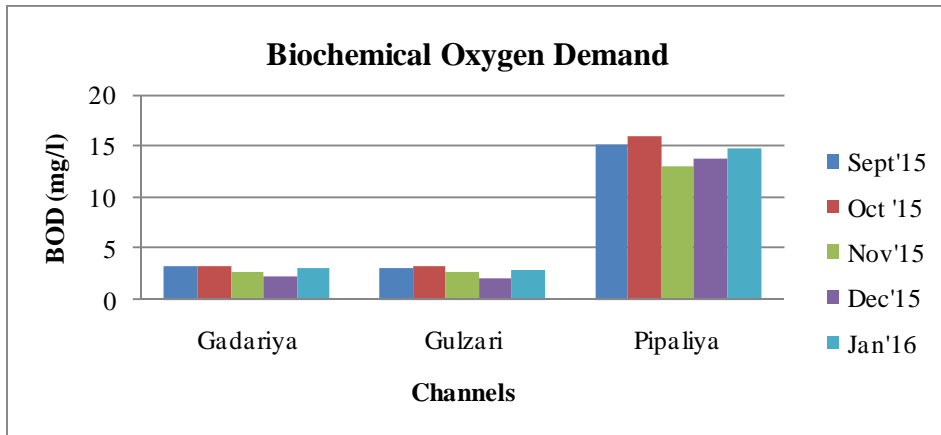


Figure - 8 Graph showing variation in BOD at different channels

**COD:** The amount of oxygen required to decompose biodegradable as well as non-biodegradable organic matter in known as chemical oxygen demand. It indicates mainly the presence of non-biodegradable organic matter. In **Gadariya** channel, mean value of COD of five sampling occasions was found to be 13.78 mg/l, max and min value found to be 15.46 mg/l and 10.56 mg/l in the month of October and December respectively. In **Gulzari** channel, mean value of COD of five sampling occasions was found to be 11.68, max and min value found to be 13.43 mg/l and 8.71 mg/l in the month of October and December respectively. In **Pipaliya** channel, mean value of COD of five sampling occasions was found to be 70.31, max and min value found to be 77.26 mg/l and 63.10 in the month of October and November respectively. The variation in COD values in the respective channels is represented graphically in Figure-9. Low chemical oxygen demand in Gadariya and Gulzari channel indicates the absence of non-biodegradable organic matter. While in Pipaliya channel, higher COD indicates the industrial pollution of channel in upstream side of sampling station.

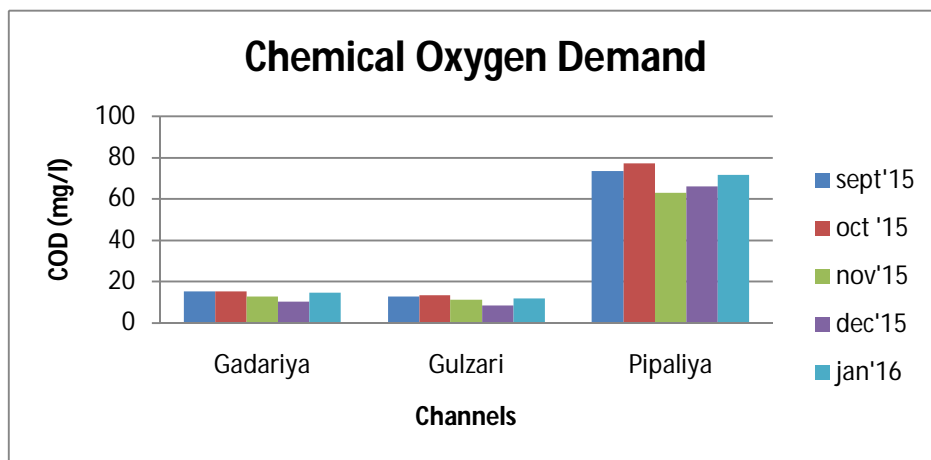


Figure - 9 Graph showing variation in COD at different channels

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### IV. EXPERIMENTAL RESULTS

Table -1 shows the results of testing of each parameter for the 3 channels studied during October 2015 to January 2016 and also records BIS drinking water standards and inland surface water discharge standards.

Table - 1: Experimental results of physiochemical parameters at different dates for all 3 channels

Parameters	Sample Collection Date	Gadariya	Gulzari	Pipaliya	BIS Drinking Water standards <sup>10</sup>	Inland Surface water Discharge limits <sup>11</sup>
Total Dissolved Solid (TDS) (mg/l)	15,September 2015	163.33	206.66	543.3	500	-
	15,October 2015	180	243.33	576.66		
	15,November 2015	286.66	273.33	616.66		
	15,December 2015	256.66	320	616.66		
	15,January 2016	193.33	283.33	510		
Turbidity (NTU)	15,September 2015	3.33	4	38.66	1	-
	15,October 2015	4	3	42.33		
	15,November 2015	3.33	0.67	29		
	15,December 2015	8.66	2	17.33		
	15,January 2016	7.33	6	18		
Chloride (mg/l)	15,September 2015	36.86	64.86	233.33	250	-
	15,October 2015	41.27	72.89	347.5		
	15,November 2015	31.95	31.95	247.64		
	15,December 2015	36.61	38.61	241.52		
	15,January 2016	28.62	19.3	189.06		
pH	15,September 2015	7.25	6.75	7.41	6.5-8.5	5.5-9
	15,October 2015	7.25	7.25	7.25		
	15,November 2015	7.75	6.91	7.9		
	15,December 2015	7.08	6.75	7.58		
	15,January 2016	6.91	6.91	7.08		
Biochemical Oxygen Demand (BOD) (mg/l)	15,September 2015	3.33	3.13	15.2	-	30
	15,October 2015	3.36	3.23	16.0		
	15,November 2015	2.8	2.7	13.06		
	15,December 2015	2.3	2.1	13.7		
	15,January 2016	3.2	2.9	14.83		
Chemical Oxygen Demand (COD) (mg/l)	15,September 2015	15.33	13.03	73.43	-	250
	15,October 2015	15.46	13.43	77.26		
	15,November 2015	12.86	11.20	63.10		
	15,December 2015	10.56	8.71	66.13		
	15,January 2016	14.7	12.06	71.63		

Note- Results of each parameter at any given date is simple mean of values of 3 samples taken.

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Table- 2, 3 & 4 shows result of the statistical analyses for each physicochemical parameter which evaluates Mean, Median, Range, Standard Deviation (SD), Standard Variance (SV), Standard Error (SE) and 95% Confidence Limit (CL) of Gadariya, Gulzari and Pipaliya channel respectively.

Table - 1: Statistical analysis of physicochemical parameters of Gadariya water samples

PARAMETERS	TDS	TURBIDITY	CHLORIDE	pH	BOD	COD
Mean	215.996	5.33	35.064	7.248	2.998	13.782
Standard Error	23.696127	1.1148498	2.18389927	0.1404422	0.201057	0.92968
Median	193.33	4	36.61	7.25	3.2	14.7
Standard Deviation	52.98615	2.4928799	4.88334721	0.314038	0.449578	2.078827
Sample Variance	2807.5322	6.21445	23.84708	0.09862	0.20212	4.32152
Range	123.33	5.33	12.65	0.84	1.06	4.9
Minimum	163.33	3.33	28.62	6.91	2.3	10.56
Maximum	286.66	8.66	41.27	7.75	3.36	15.46
Count	5	5	5	5	5	5
Confidence Level (95.0%)	65.79099	3.0953192	6.06347642	0.389929	0.558224	2.581204

Table - 2: Statistical analysis of physicochemical parameters of Gulzari water samples

PARAMETERS	TDS	TURBIDITY	CHLORIDE	pH	BOD	COD
Mean	265.33	3.134	45.522	6.914	2.812	11.686
Standard Error	19.10886	0.9038562	10.105775	0.091301	0.200385	0.839063
Median	273.33	3	38.61	6.91	2.9	12.06
Standard Deviation	42.72873	2.0210839	22.597200	0.204156	0.448074	1.876201
Sample Variance	1825.744	4.08478	510.63347	0.04168	0.20077	3.52013
Range	113.34	5.33	53.59	0.5	1.13	4.72
Minimum	206.66	0.67	19.3	6.75	2.1	8.71
Maximum	320	6	72.89	7.25	3.23	13.43
Count	5	5	5	5	5	5
Confidence Level (95.0%)	53.05472	2.5095071	28.058130	0.253494	0.556357	2.329611

Table - 3: Statistical analysis of physicochemical parameters of Pipaliya water samples

PARAMETERS	TDS	TURBIDITY	CHLORIDE	pH	BOD	COD
Mean	582.656	29.064	251.81	7.444	14.558	70.31
Standard Error	27.456042	5.1389343	26.0373981	0.1410177	0.526578	2.542005
Median	576.66	29	241.52	7.41	14.83	71.63
Standard Deviation	61.393577	11.491006	58.2213921	0.3153252	1.177463	5.684096
Sample Variance	3769.1713	132.04323	3389.7305	0.09943	1.38642	32.30895
Range	156.66	25	158.44	0.82	2.94	14.16
Minimum	510	17.33	189.06	7.08	13.06	63.1
Maximum	666.66	42.33	347.5	7.9	16	77.26
Count	5	5	5	5	5	5
Confidence Level (95.0%)	76.230194	14.267969	72.2914065	0.391528	1.462014	7.057738



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## V. CONCLUSION

This study is an attempt to identify the possible sources of contamination of Narmada River in Budhni region (District Sehore, M.P). The study provides informative data and helps to understand the impact of industrial and anthropogenic activities on the quality of river water (in the studied region). The results of the study reveal that of the three channels studied, 2 channels namely 'Gadariya' and 'Gulzari' have considerably good water quality as all of the parameters studied are under the standard limits, except turbidity which is due to presence of sand and silt, thus these channels have apparently no negative impact on the quality of river water. Although the 3<sup>rd</sup> channel studied namely 'Pipaliya' has poor water quality as the measurement of parameters such as chloride content, TDS and Turbidity has crossed the BIS drinking water limit and value of waste water parameter BOD is also considerably close to inland surface water discharge limits, these values indicate the discharge of industrial effluents and agricultural runoff in the upstream of the channel. Thus, discharge from 'Pipaliya' channel can be considered a mild source of contamination for river Narmada as it has a potential to cause deleterious impact on the potable nature of river water and aquatic organism present in the vicinity of point of sink as well.

## VI. ACKNOWLEDGEMENT

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## BIOGRAPHY



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