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Physico-chemical Study of Gangi River Water at Ara, Bhojpur District, Bihar

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ABSTRACT

In the present study the water samples of Gangi river consisting four sampling sites namely Site I (Lauhar), Site II (Pharna), Site III (Panditpur) and Site IV (Karja) have been investigated for their physico-chemical parameters such as pH, Turbidity, TDS, Total Hardness, Magnesium hardness, Calcium Hardness, DO, BOD, COD, Iron, Chloride, Nitrate and Sulphate. The water samples were collected and analysed during Pre-monsoon period (from March to May), Monsoon period from (June to September) and Post-monsoon period (from October to February). All the water samples of Gangi river have been found lower than the WHO permissible limit.

Keywords: Gangi River Water at Ara, Physico-chemical Study.

INTRODUCTION

Safe water is a basic need for every human being despite of any socio economic status. The contamination of water is one of the major concerns due to unplanned urbanization[1], industrialization[2], over exploitation of the natural resources and discharge of hazardous wastes into water bodies without treatment[3]. Water sustains life while contaminated water causes several health hazards [4,5]. Most of the communicable diseases are water borne [6,7] and are considered root cause of morbidity and mortality, especially in under developed and developing countries. Despite of high mortality rate, particularly in the infants, no attention is being given to the drinking water quality. The fact is that neither the public nor the policy decision-makers are well aware of the gravity of the situation.

The crisis about water resources arises firstly because most of the water on the earth is not suitable [8] for human use and secondly unavailability of water due to its highly uneven geographical distribution. Some countries have adequate fresh water while others face scarcity. Even within a country different regions have varying extent of availability of fresh water. Keeping in view the prime importance of drinking water for sustaining human health needed to keep this planet alive, productive and prosperous; special attention has been focused on potential viability and drinking water quality of Ara town. The present paper compiles the studies of the water quality parameters such as pH, Turbidity, TDS, Total Hardness, Magnesium hardness, Calcium Hardness, DO, BOD, COD, Iron, Chloride, Nitrate and Sulphate.

MATERIALS AND METHODS

Study area: Ara is a city and administrative headquarters of Bhojpur district in the state of Bihar, India. It is located near the confluence of the Ganges and Sone rivers and about 50 km from Patna, the state capital. It belongs to Indo-Gangatic-Brahmaputra alluvial plains and situated in the middle part of Gangatic plain. Gangi river and Sahabad canal, the branches of Ganga and Sone river respectively are passing through the town. The study area spreads in an area of 40 sq. km and is situated between 25° 30′ N to 25° 45′ N latitude and 85° 30′ E to 85° 30′ E longitude. The Gangi river is the most important water resource for domestic and irrigation use in this region. The Gangi river takes its origin from the Ganga near Keshavpur at Barahara Block of Bhojpur distict, which about 10 km distance from Ara town. Again it meets in the Ganga river near Buxar district of Bihar. Run off in the river depends on rain fall in catchments. The sites in river Gangi were located under Ara town. Four sampling sites namely, Site I (Lauhar), Site II (Pharna), Site III (Panditpur) and Site IV (Karja) were selected for present study based on varying human activities, sewage discharge and other activities. The study was carried out in pre-monsoon, monsoon and post-monsoon period.

Methods: Water samples were collected from four different sites of Gangi River for the physico-chemical analysis from four sites of Gangi River, Ara. Water samples were collected in2L capacity of polythene bottle from selected sampling station in early hours of day. Water quality testing for pH, turbidity, TDS, Total Hardness, Magnesium hardness, Calcium Hardness, DO, BOD, COD, Iron, Chloride, Nitrate and Sulphate are conducted in the water testing laboratory. The water samples were analyzed as per the method [9,10] described by ISI (2004), WHO.

RESULTS AND DISCUSSION

Present study was carried out in pre-monsoon, monsoon and post-monsoon period of the year 2009. Four different sampling sites of the river, selected on the basis of the magnitudes of activities and disturbances. Show marked seasonally variation of physico-chemical [11] characteristics of water investigation as given in table 1.

pH: The pH of the water of Gangi river has been found in the range of 7.25 to 8.20 during pre-monsoon, monsoon and post-monsoon period. There has been higher pH of water in post-monsoon at the site I and lower in pre-monsoon at site IV. The average pH value was 7.73. The water of the site I with intense human activities [12] has shown comparatively higher pH than those with lesser human activities. The variation of pH with different sampling sites is shown in fig 1.

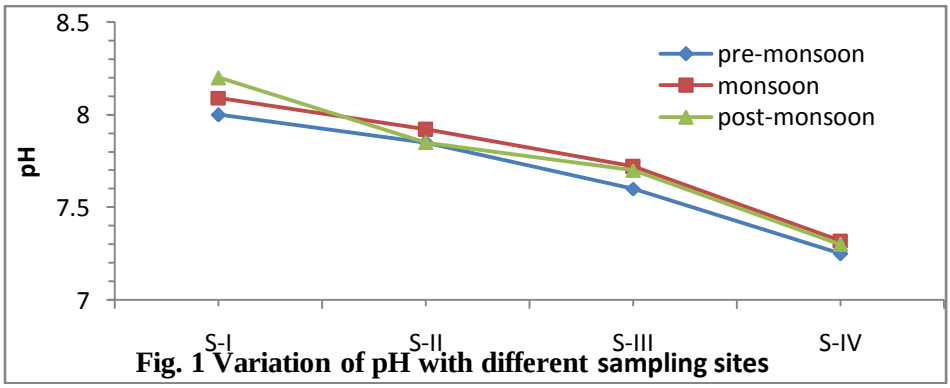

Fig. 1 Variation of pH with different sampling sites

Turbidity: It has been inferred that over permissible limit it plays several effect on cardiovascular disease [13]. The variation of turbidity with different sampling sites is shown in fig 2. The turbidity of Gangi River

have been observed in 0.70 to 1.80, 0.90 to 1.80 and 0.70 to 1.70 mg L^{-1} during pre-monsoon, monsoon and post-monsoon period respectively. The average value of turbidity was 1.29 mg L^{-1}.

Table 1: Water quality of Gangi river at different sites in different periods

Parameter	Periods	Sites			
		I	II	III	IV
pH	Pre-monsoon	8.00	7.85	7.60	7.25
	Monsoon	8.09	7.92	7.72	7.32
	Post-monsoon	8.20	7.85	7.70	7.30
Turbidity	Pre-monsoon	1.80	1.60	0.90	0.70
	Monsoon	1.80	1.65	1.20	0.90
	Post-monsoon	1.70	1.60	0.70	0.92
TDS	Pre-monsoon	640	595	150	200
	Monsoon	600	490	125	180
	Post-monsoon	600	480	125	200
Total Hardness	Pre-monsoon	288	225	203	210
	Monsoon	272	215	195	206
	Post-monsoon	260	218	205	210
Mg Hardness	Pre-monsoon	27	26	30	32
	Monsoon	30	27	33	21
	Post-monsoon	33	26	34	22
Ca-Hardness	Pre-monsoon	35	45	48	55
	Monsoon	30	42	51	52
	Post-monsoon	28	40	54	50
DO	Pre-monsoon	7.95	7.25	7.10	7.00
	Monsoon	8.15	7.40	7.20	7.21
	Post-monsoon	7.90	7.35	7.15	7.00
BOD	Pre-monsoon	4.30	4.70	3.90	2.90
	Monsoon	4.45	4.95	4.10	3.05
	Post-monsoon	4.25	4.85	4.05	3.10
COD	Pre-monsoon	16.80	16.20	17.10	16.90
	Monsoon	17.20	16.35	17.35	17.10
	Post-monsoon	17.05	16.30	17.20	16.95
Iron	Pre-monsoon	0.26	0.26	0.35	0.22
	Monsoon	0.25	0.30	0.25	0.27
	Post-monsoon	0.28	0.27	0.30	0.23
Chloride	Pre-monsoon	20.98	22.40	15.50	18.55
	Monsoon	21.00	23.60	16.20	22.00
	Post-monsoon	22.00	24.00	19.00	26.00
Nitrate	Pre-monsoon	1.40	1.20	1.50	1.95
	Monsoon	1.80	1.70	1.75	2.15
	Post-monsoon	1.97	1.43	1.63	2.05
Sulphate	Pre-monsoon	18	12	14	15
	Monsoon	15	12	15	15
	Post-monsoon	12	17	18	19

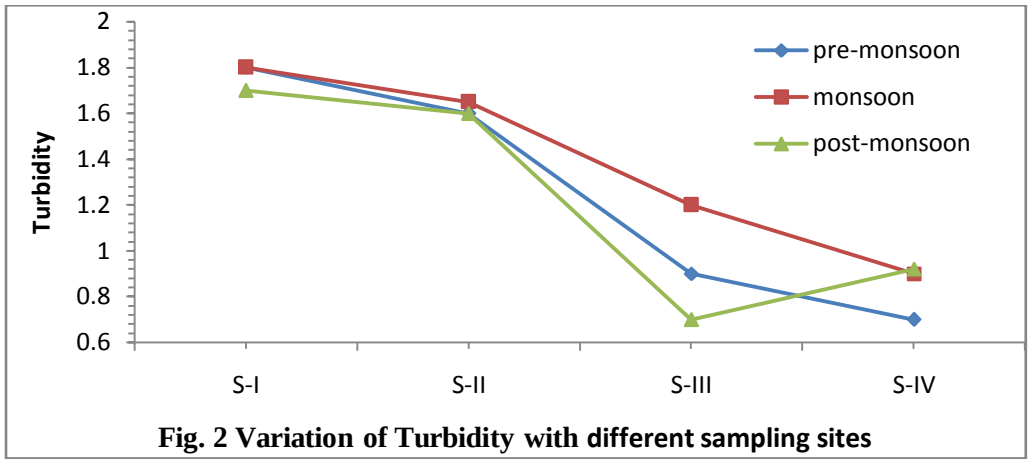

Fig. 2 Variation of Turbidity with different sampling sites

Total Dissolve Solids (TDS): The dissolved solids of the water have been found in the range of 150 to 640, 125 to 600 and 125 to 600 mg L^{-1} during pre-monsoon, monsoon and post-monsoon period respectively, of all the four sites selected. Minimum value 125 was reported in monsoon and post-monsoon at site III whereas maximum value 640 was reported in pre-monsoon at site I. The average value of TDS was 365.42 mg L^{-1}. The variation of TDS with different sampling sites is shown in fig 3.

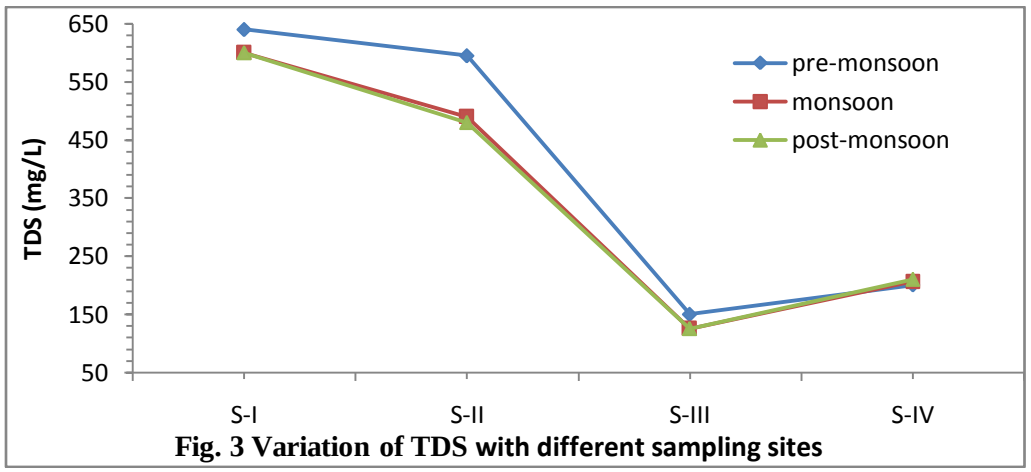

Fig. 3 Variation of TDS with different sampling sites

Total Hardness: In this study the total hardness of Gangi river water has been observed 203 to 288, 195 to 275 and 205 to 260 mg L^{-1} during pre-monsoon, monsoon and post-monsoon period respectively. The minimum value was found in monsoon at site III whereas the maximum value was reported in pre-monsoon at site I. The average value was 225.58 mg L^{-1}. Total hardness of all samples are found to be within the permissible limit 500 mg L^{-1} for drinking water by WHO. The variation of total hardness with different sampling sites is shown in fig 4.

Mg – Hardness: Mg-hardness has been observed in the range of 21 to 34 during all studied periods. The average value was 28.42 mg L^{-1}. These values fall well below the permissible limit prescribed by BIS and WHO. The hardness was comparatively higher at site III during studied period. The hardness of water at this site may be domestic waste and human activities. Magnesium tolerance by human body is lower than that of calcium. The recommend of Mg hardness is 50 mg L^{-1}. The variation of Mg-hardness with different sampling sites is shown in fig 5.

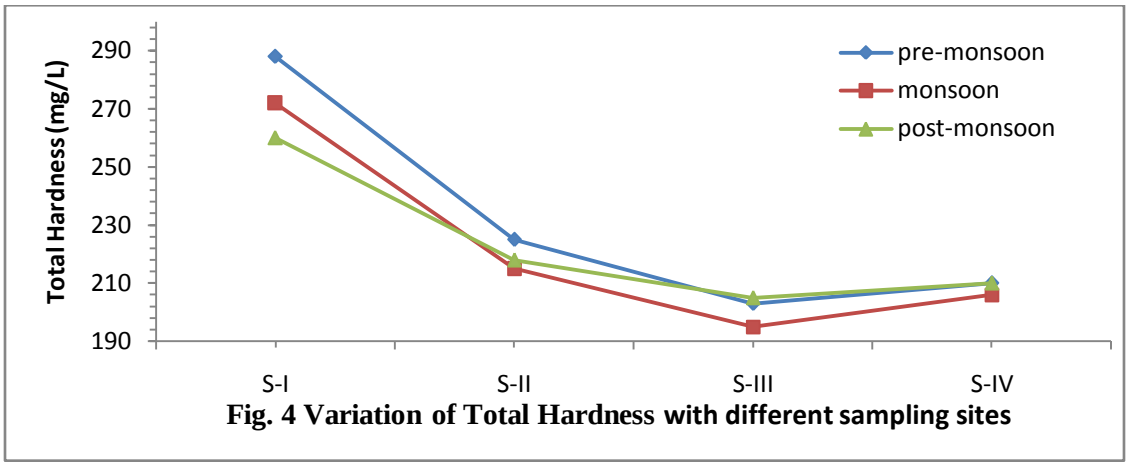

Fig. 4 Variation of Total Hardness with different sampling sites

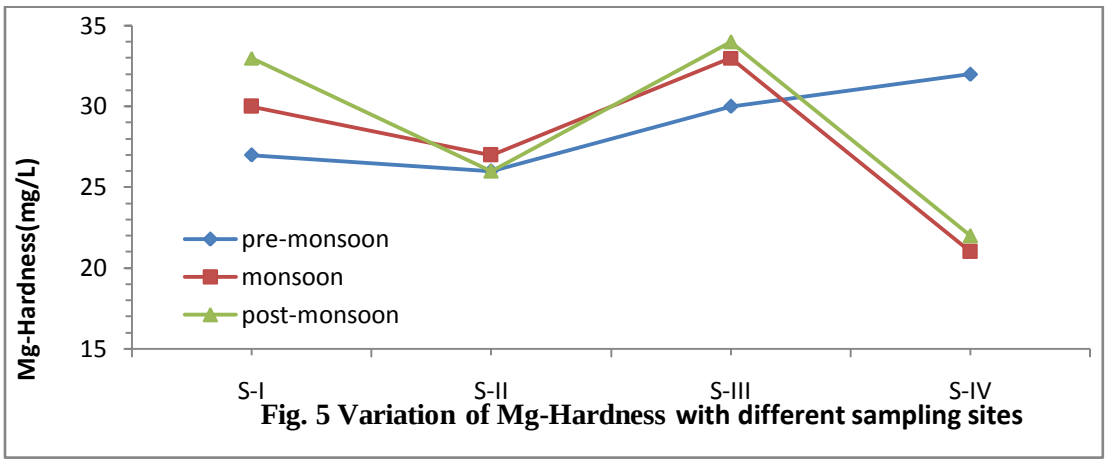

Fig. 5 Variation of Mg-Hardness with different sampling sites

Ca – Hardness*:* Similarly the calcium hardness was found to be 35 to 55, 30 to 52 and 28 to 54 during studied periods. The minimum value was found in post-monsoon at site I, whereas maximum value was reported in pre-monsoon at site IV. The average value was 44.17 mg L^{-1}. The recommended value of calcium hardness in portable water is 100 mg L^{-1}. The variation of Ca-hardness with different sampling sites is shown in fig 6.

DO, BOD and COD: DO of river water has been observed in 7.00 to 7.95, 7.20 to 8.15 and 7.00 to 7.90 mg L^{-1} during pre-monsoon, monsoon and post-monsoon period respectively. The average value was 7.39 mg L^{-1}. The variation of DO with different sampling sites is shown in fig 7. Values of dissolved oxygen obtained for the water of their sites of Gangi river support to observation [14] carried out in the past.

BOD of river water has been observed 2.90 to 4.70, 3.05 to 4.95 and 3.10 to 4.85 mg L^{-1} during pre-monsoon, monsoon and post-monsoon period respectively. The minimum value was found in pre-monsoon at site IV, whereas maximum value was reported in monsoon at site II. The average value was 4.05 mg L^{-1}. The variation of BOD with different sampling sites is shown in fig 8. Site I and II with greater human activities have shown higher value of BOD. This may attributed to the additional load of organic matter at these sites as a consequence of anthropogenic activities and discharge of domestic sewage [15].

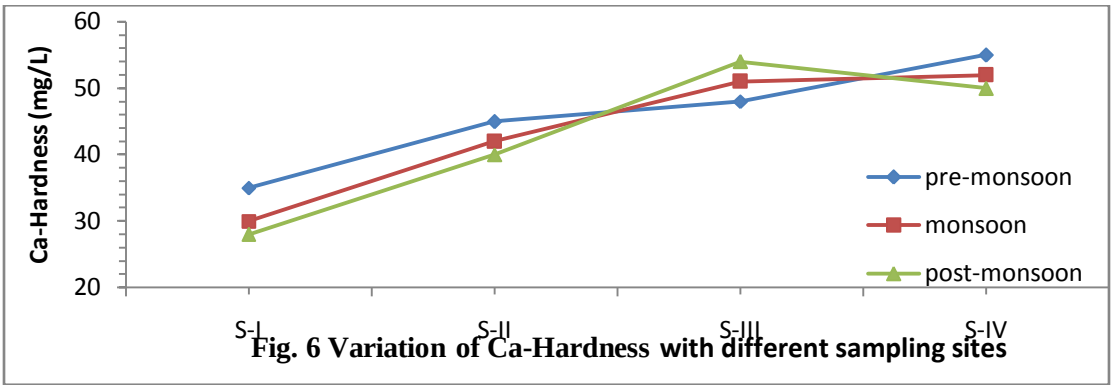

Fig. 6 Variation of Ca-Hardness with different sampling sites

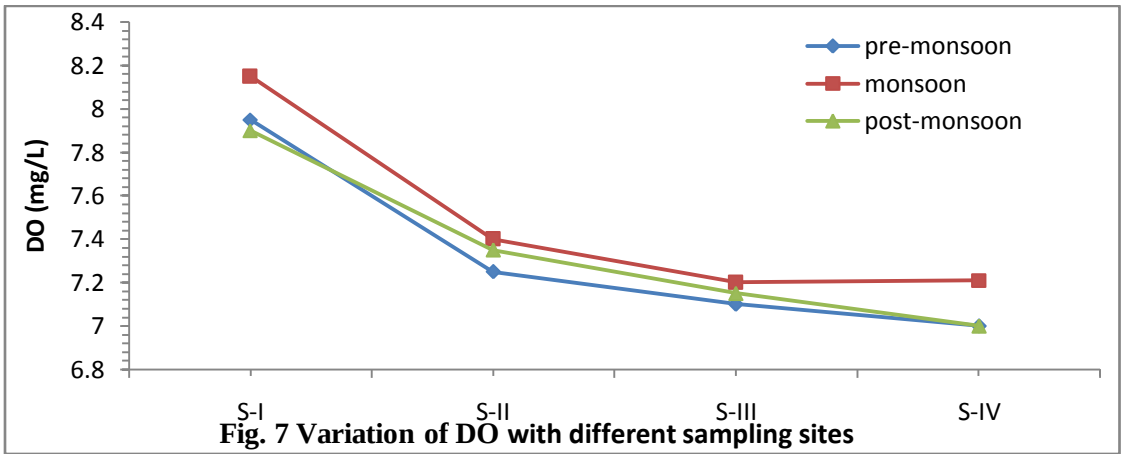

Fig. 7 Variation of DO with different sampling sites

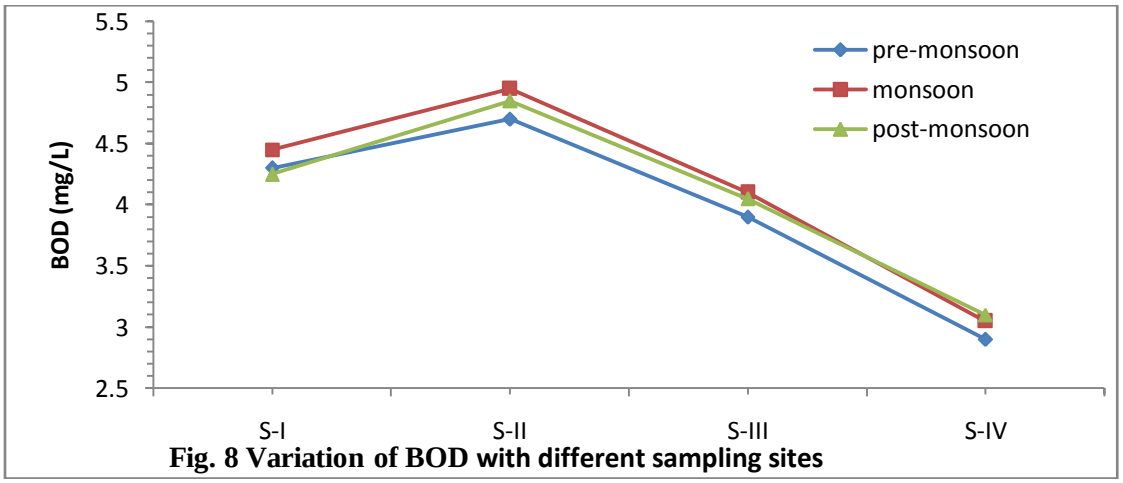

Fig. 8 Variation of BOD with different sampling sites

COD value of river water has been observed 16.20 to 17.10, 16.35 to 17.35 and 16.30 to 17.20 mg L^{-1} during pre-monsoon, monsoon and post-monsoon period respectively. The average value was 16.88 mg L^{-1}. The variation of COD with different sampling sites is shown in fig 9.

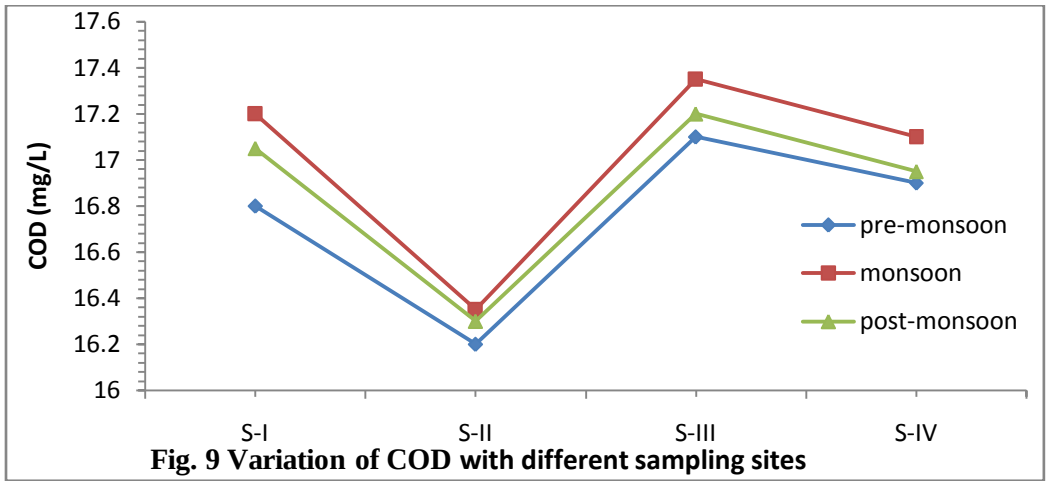

Fig. 9 Variation of COD with different sampling sites

Iron: The highest concentration of iron in ground water has been observed 49 mg L^{-1} in a hand pump at Bhuneshwar. Several states of the country have reported the contamination of water in ground water. This is due to the widely spread of both ferrous and ferric iron as minor component of most sediment. A bitter and astringent test has been found at the level above 1 mg L^{-1} in drinking water. Iron deficiency causes anemia while higher iron intake causes headache, anorexia, shortness of breath and graying colors to skin. The variation of Iron with different sampling sites is shown in fig 10. The iron contents of Gangi River have been observed in 0.22 to 0.35, 0.25 to 0.30 and 0.23 to 0.30 during pre-monsoon, monsoon and post-monsoon period respectively. The average value of iron content was 0.27 mg L^{-1}.

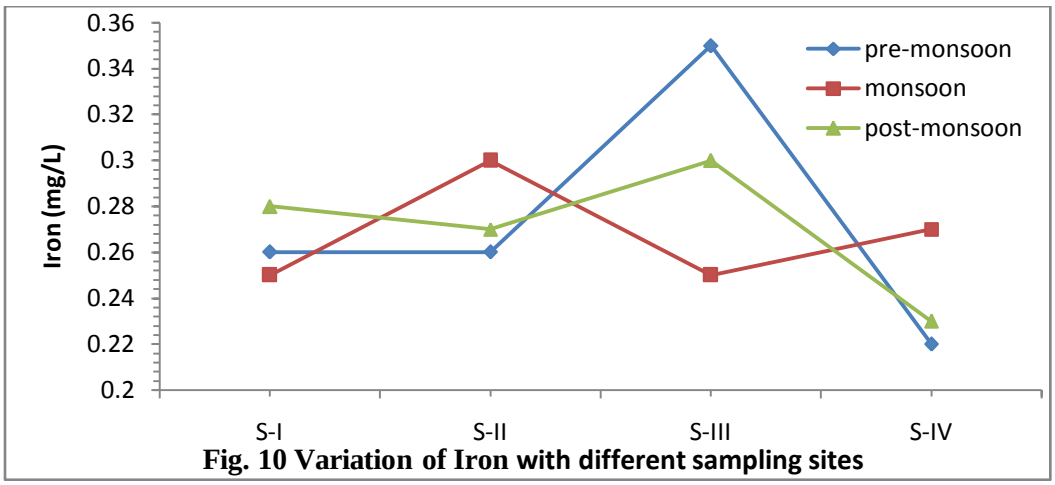

Fig. 10 Variation of Iron with different sampling sites

Chloride: Chloride has been basic parameter detecting pollution of water by sewage before the development of bacteriological procedure (Sawyer, 1960). The chloride contents of Gangi River have been observed in 15.50 to 20.98, 16.20 to 23.60 and 19.00 to 26.00 during pre-monsoon, monsoon and post-monsoon period respectively. The average value was 20.94 mg L^{-1}. The variation of chloride with different sampling sites is shown in fig 11. The chloride values were well below the standard limit set for river water by WHO (1971) and IS (1991).

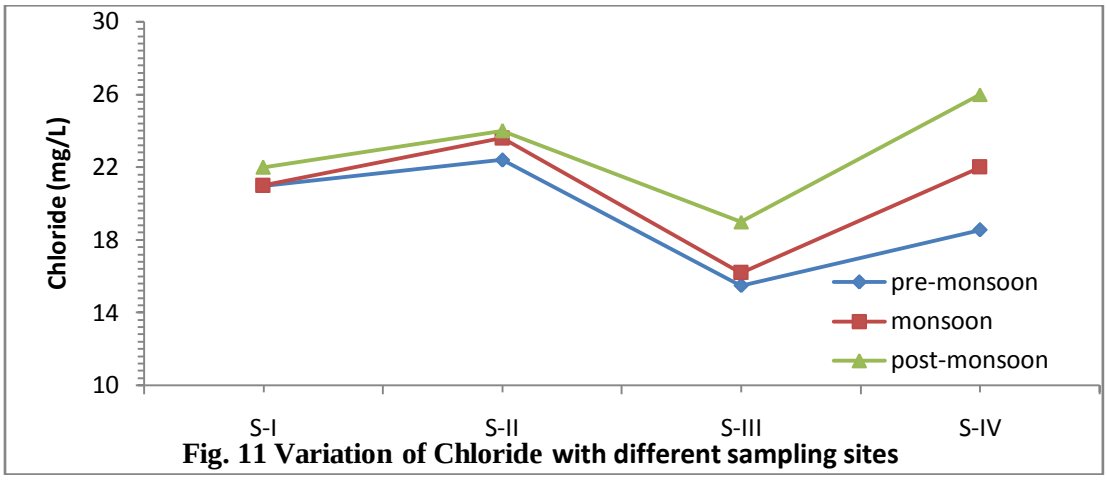

Fig. 11 Variation of Chloride with different sampling sites

Nitrate: Nitrate is very important water quality parameter for health and hygiene. It inters into water from fertilizer, decayed vegetables and animal domestic effluent, sewage sludge, farm leachiest, industrial discharges. WHO recommended 45 mg L^{-1} of nitrate in drinking water for human absorption is allowed. In the present study it has been found that maximum nitrate level is 2.15 mg L^{-1}, which is much below the permissible limit. The variation of nitrate with different sampling sites is shown in fig 12. The nitrate contents of Gangi River have been observed in 1.20 to 1.95, 1.70 to 2.15 and 1.43 to 2.05 during pre-monsoon, monsoon and post-monsoon period respectively. The average value of nitrate content was 1.71 mg L^{-1}.

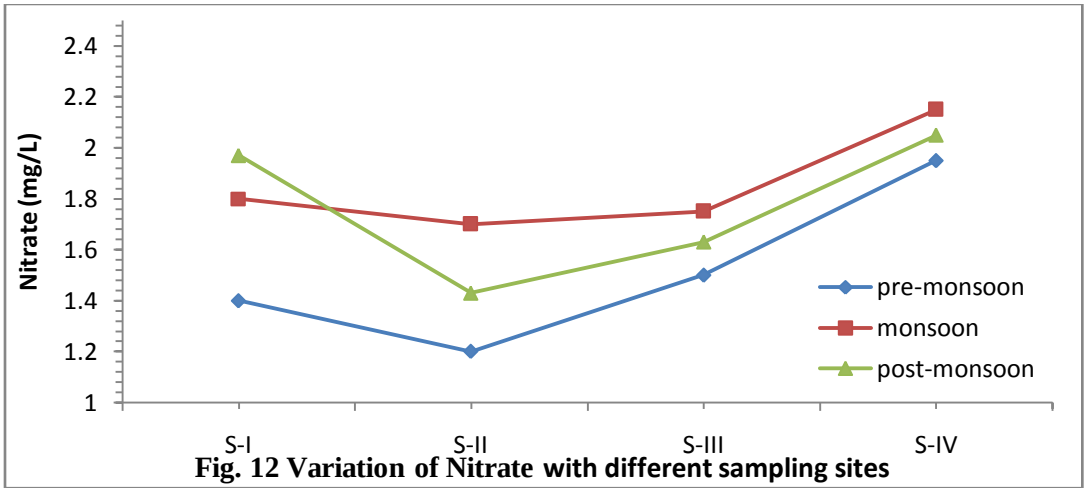

Fig. 12 Variation of Nitrate with different sampling sites

Sulphate: Dehydration is a common side effect due to the ingestion of large amounts of magnesium or sodium sulphate. No symptoms of sulphate deficiency have been suggested and reported in humans. WHO guide line prescribes the value of sulphate in drinking water would be 250 mg L^{-1} above which consumer may get salty test. The variation of sulphate with different sampling sites is shown in fig 13. The Sulphate contents of Gangi River have been observed in 12 to 18, 12 to 15 and 12 to 19 during pre-monsoon, monsoon and post-monsoon period respectively. The average value of sulphate content was 15.17 mg L^{-1}.

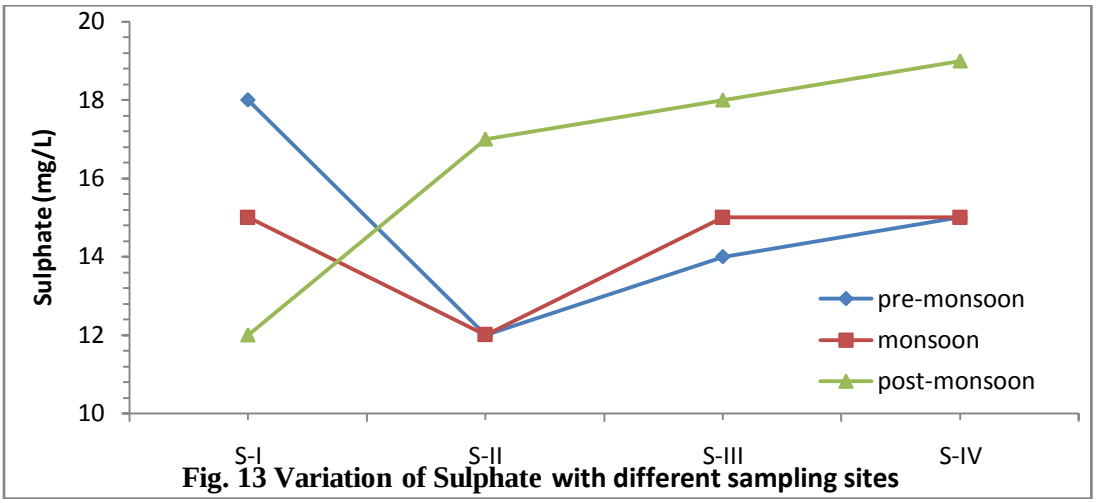

Fig. 13 Variation of Sulphate with different sampling sites

APPLICATIONS

These results are useful to Know the Quality of water and is Potable or not since Gangi river water is highly Polluted.

CONCLUSIONS

Physico-chemical studies of Gangi river water collected from four sites of periphery of Ara block shows that the water quality parameters of samples investigated are within the described limit prescribed by WHO standard. Higher human activity (washing and bathing of cattle) larger organic load as consequence of domestic and animal wash and very small urban discharges are responsible for the water quality of the Gangi River.

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