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Study of Physico Chemical Parameters of Basantar River and Impact of Industrial Waste on Groundwater Quality in Vicinity of Dumping Site in Samba Town, Jammu & Kashmir, India

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***Abstract*: Most of the rivers take delivery of millions of industrial and domestic waste matter containing fluctuating quantity of undemanding nutrient and exceedingly contaminated materials as a result of improper disposal of waste. Impact of industrial waste on river Basantar and ground water quality in vicinity of the dumping site in Samba town (J&K) were studied and then compared with the standard set by BIS (Bureau of Indian Standard) for few important parameters like TDS, Electrical Conductivity, pH, Total Alkalinity, Chloride, Total Hardness, Nitrate, Sulphate , BOD, COD, E- Coli bacteria. During analysis of River Basantar, the range of parameters was found to be maximum during August that is during monsoons and was generally on the higher sides. As far as groundwater is concerned it was found that the pollution was more near the area where industrial waste is dumped that is 45 m east. The most affected sampling station was WS 4 where all the parameters were exceeding the limits set by BIS and least affected station was WS 1. As the distance from dumping site of waste increases the pollution level of water was decreasing. Hence before use sources from where water is used should either be well treated and tested or the wells from where the water is used should be digged at greater height or located at greater distance from the dumping site.**

Keywords: Basantar River, Groundwater quality, Industrial Waste, Physico- Chemical Parameters. Samba

I. INTRODUCTION

Water is regarded as the most important source on earth. More than 70% of the part of earth is covered with water. Water used by human beings is mainly divided into two parts one is groundwater and other is surface water. Ground water is generally regarded as safest form used for drinking purposes if it is not contaminated (Dharaskar, 2015). On the other hand surface water may be used for farming and industrialized tasks (Wang et al., 2013). But it gets polluted in no time (Pathak et.al, 2015).Most of the rivers take delivery of millions of industrial and domestic waste matter containing fluctuating quantity of undemanding nutrient and exceedingly contaminated materials. Wastewater is actually the water embroidered physically, chemically as well as biologically. Wastewater discharged from domestic sources includes sputter, festering tank liberation and grey water (Husain et.al, 2014). Wastewater from industries and marketable chattels on the whole contains profound metals, colossal quantity of untreated substances, nitrate, detergents, lifeless salt, oil etc (Rathore et al, 2014) In recent years, rising industrialization, urbanization and developmental activities with the population detonation leads to creation of huge quantity of wastewater from domestic, commercial, industrial and other sources (Singare, et.al, 2014). Water quality of the Indian rivers has worsened due to unremitting release of industrial and domestic waste in last two to three decades (Krishnan et al 2007). It is now common and well known fact that more or less each and every river is contaminated by industries (Modak et al, 1996). The prime example of water pollution has been as a result of waste discharged from industries and factories (Ma et al, 2015) and that's too in an unsatisfactory way and the waste also remains untreated (Chatterjee, 2010). But raw waste has been considered as useful for soil and if it is within the tolerable limit or well treated, it can be used for agricultural purposes. Study done by (Sadasivam et al, 2015) revealed that soil treated with untreated waste matter has drastically soaring lushness.

Industrial pollution is found in large amount in some industrial areas. The type of waste present in water depends normally upon the type of industry from where the waste is discharged. Wastewater consists of suspended solids, eco-friendly and non eco- friendly untreated compounds; oils and greases; profound metal; liquefied lifeless acids and bases. The waste also consists of detergents that generate accumulation of pallid bubbles in the river. Without treatment and proper management the waste can cause several health problems to humans and also the aquatic life (Chakravarty et.al 1959). Fishes have been affected the most as a result of the waste discharged from industries (Kumar, 1996). Beside this waste organization ways implemented in India have not really helped out in growth of industries which have resulted in increase in toxic waste ultimately polluting water. The effluents which are not treated have increased the level of surface water contamination by nearly twenty times in India. The present circumstances if bungled can lead to irreversible

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environmental destruction in the longer as well as shorter run and ultimately effecting economy of the country (Lokhande et al, 2011). To know the pollution level of water, physical, chemical and bacteriological characteristics are analyzed. The important being TDS, Electrical Conductivity, pH, Total Alkalinity, Chloride, Total Hardness**,** Nitrate**,**, Sulphate , BOD, COD, E- Coli bacteria. The study holds more importance because in India especially in Jammu and Kashmir state most of the waste is dumped near water bodies or into the rivers, whichever type of waste it is (Raina & Anjum 2015). This makes river more liable to pollution. The water if analysed can be treated accordingly and then be used for several household works and other works which includes irrigation and vegetation purposes (Raina & Alam, 2014).

The main objective of the paper is to study impact of industrial waste on river basantar and ground water quality in Samba town (J&K) by analyzing the physico-chemical parameters and then comparing it with the standard set by BIS. The study holds more importance because there used to be a time when Samba was known for its vegetation. Vegetables and crops were exported from Samba to its neighboring areas and also to other States. But now Unfortunately due to unbalanced and unplanned Industrialization in Samba the Vegetables and fodder was imported for the Survival of life in Samba. This study will go a long way in improving the quality of river which is getting polluted day by day as a result of industries located on its bank by making awareness among people because the river serve as a source of supply to people in samba town.

A. Study Area

Samba has a very old origin. District Samba lies on south-western part of the J&K State and falls on survey of India topo sheet 43 P/L situated at 32.55' to 32.58' latitude and 75.09' to 75.12' longitude having population of 44,562 as per census of 2011. Samba is situated on range of Shivalik hills at an elevation of 384m above MSL alongside the Jammu-Pathankote National Highway NH-44 on the bank of river Basantar at a distance and at 40 km from Jammu city covering an area of 1002 km^2. District Samba is bordered by Udhampur Kathua in the East, Jammu and Bishnah of District Jammu on northern, eastern and western side respectively. On the southern side it is bordered by Pakistan. Nearly 67% of the area is rainy. Ravi Tawi Irrigation canal network contributes a lot towards the growth of crops on the southern downstream side of the area. The temperature of the area is searing and parched in summer and freezing in winter. The temperature lies in the range of 2°Cand 42 °C

B. Site Discription

Basantar River flowing in Samba has been chosen for analysis. It instigates from one of the main branch of the Ravi river, in close proximity to Kharai Dhar at an elevation of 1300 m above MSL curving on or after the southern gradients of Bani. The catchment area is 6300sq. m. Its discharge is maximum during monsoon seasons. Downstream river flows through series of shallow gorges and has produced asymmetrical valleys from its source to Chak Chavalan, the river passes through deeply carved channel and downstream area i.e. after Nud, the valley widens out and makes a knee bend before entering flood plains in Samba and finally joins in Pakistan. It is a resource of water supply to the samba town

Industrial complex in the vicinity to the bank of river Basantar known as Industrial Growth Center has been set up by State industrial development corporation (SIDCO). Quite a few small & medium scale industrial elements nearly equal to 250 in numbers have been set up and most of them mainly concerned with perilous elements are petro based and waste of these factories is thrown into or near river basantar. Figure 1 shows Map of samba district

II. MATERIAL AND METHODS

Several anthropogenic doings like sand removal, dredging, bathing, dumping of solid wastes and sewage from human residents are the main causes of river pollution. Among them industrial waste is prodominent

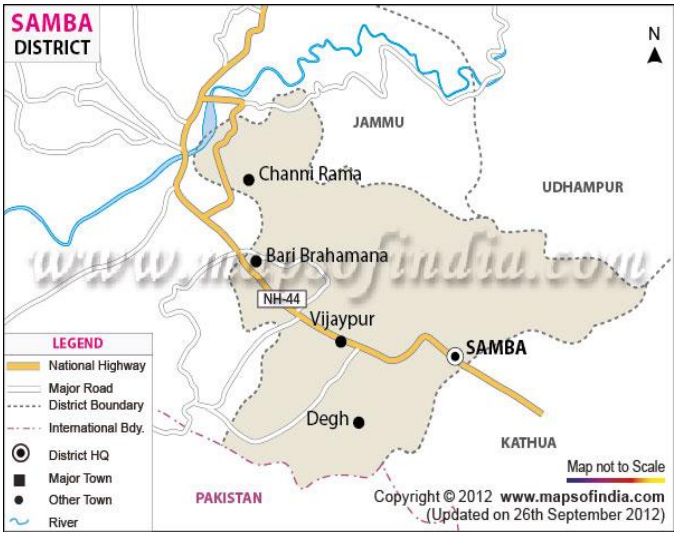

Figure 1: Map of Samba District, Jammu & Kashmir, India (Source: Maps of India)

A. Sampling and Data Analysis

(a) Basantar River

A total of 5 samples were collected one in January second one in March third in May fourth in August and the final one in November. All the samples were collected in the year 2014. The sampling location was at downstream of mixing point at a distance of 1.5 km near Railway Bridge. Sample water was taken from the station at a depth of about 15-30 cm from the surface in previously dried glass bottle containers of 2 liters capacity using grab sampling. After collection the samples were then analysed in the lab for various parameters like pH, Electrical Conductivity, BOD_5, COD, Hardness, Alkalinity, Total Dissolved Solid (TDS), Chloride, Sulphate, Nitrate and Iron and coliform bacteria according to methods set by (American Public Health Association(APHA-AWWA-WPCF,1994) for Examination of Water and Wastewater

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(b)Groundwater

Groundwater is largely considered as a source for drinking at samba. The samples after collection were hoarded at 4° C in Environmental Engineering Laboratory. The analysis was then carried out for total dissolved solids (TDS), pH, electrical conductivity, alkalinity, chloride, sulphate, nitrate, BOD_5, COD, iron, coliform organisms and hardness in a similar way as those of study of industrial effluents for Basantar River. The locations of ground water samples are described in Table. 1. The distance of shown in the table 1 is the distance from the site where the industrial waste is dumped in unsatisfactory manner.

Table 1: Locations of ground water samples at Gazipur landfill site

Sample No.	Source	Location	Distance from site where industrial waste is thrown (m)
WS 1	Tube Well	Near Chachi Mata	185 (West)
WS 2	Hand Pump	Near the Degree College Samba	225 (West)
WS 3	Hand Pump	Near Residential Colony	325 (North)
WS 4	Tube Well	Near the Samba industrial area near Basantar River	45 (East)
WS 5	Hand Pump	Jammu-Pathankote National Highway at Samba	155 (South)

III. RESULTS AND DISCUSSIONS

A. Features of Basantar River

Dissolved materials present were found of the order of (944.52-1397.39 mg/l) mainly due to high conductivity which was ranging from 523.44 MHO/cm - 697.23 MHO/cm as shown in figure 2. Conductivity is prone to the digressions in dissolved materials, with which it has more or less straight mathematical association and mineral substance. The pH values were lying in between 6.2 to 8.2 and were found due to water being alkaline (figure 3). The alkalinity of the sample was found to be in between 212.13 to 315.5 mg/l. Hardness of water sample was on higher side as well of the order of 431.05-562.13 mg/l showing the summation of the calcium and magnesium in attendance in water. Throughout rainy season during July and August the hardness was found to be on the higher side. Chloride was utmost in August and least in May i.e. (236.2 mg/l), (168.44 mg/l).. The variation of hardness, alkalinity and chloride is shown in Fig 5. BOD_5 (15.2 mg/ltr-15.5 mg/ltr) and COD (40.2 mg/ltr-44.3 mg/ltr) were also found to be high as shown in Fig. 5, which indicates that water is affected as a result of industrial effluents

A brief of various parameters of collected samples from the river basantar are shown in table 2. Despite having luxury of self purification the water is polluted and is deemed unfit for various purposes. Ultimately this water is supplied to town and polluted water can cause many dangers to human beings besides affecting the aquatic life .So before supplying this water to general public a treatment plant should be necessarily constructed where this water can be treated (Aslam et.al, 2015).

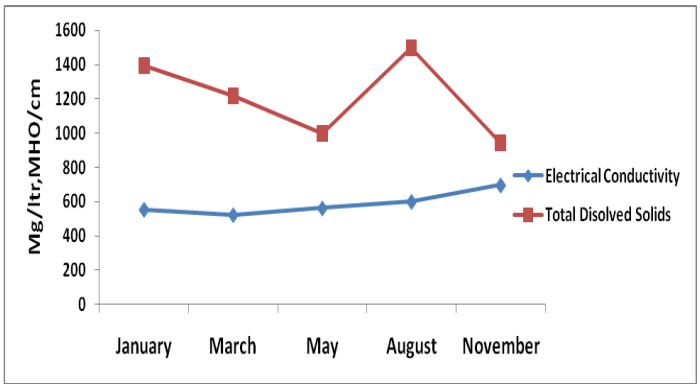

Fig 2 : Variation of TDS and Electrical Conductivity of River Basantar

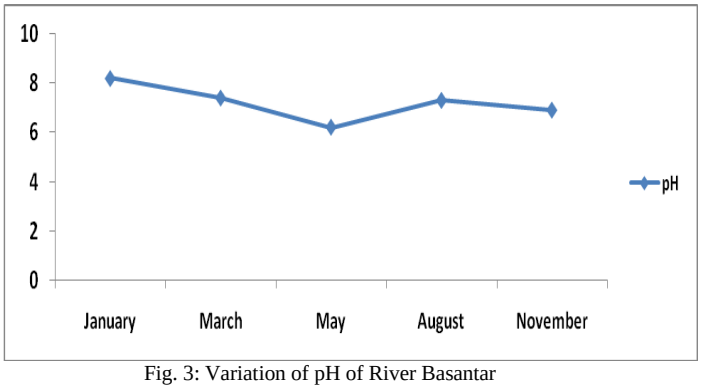

Fig. 3: Variation of pH of River Basantar

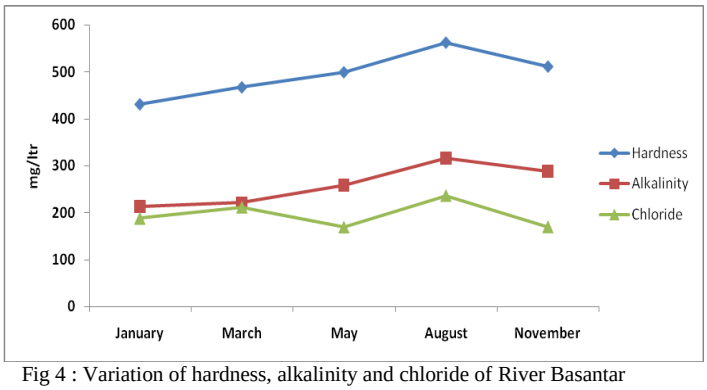

Fig 4 : Variation of hardness, alkalinity and chloride of River Basantar

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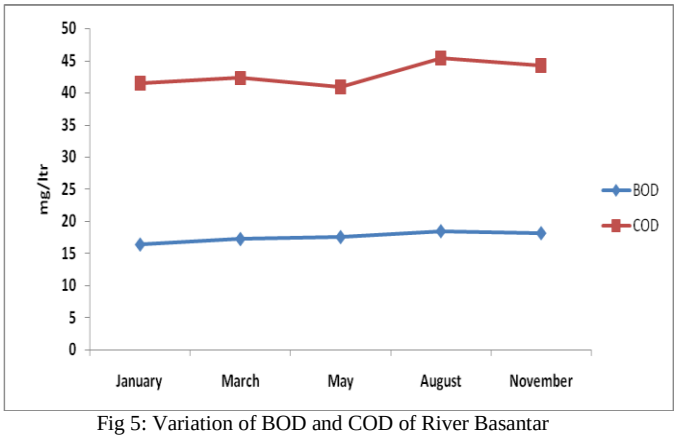

Fig 5: Variation of BOD and COD of River Basantar

Nitrate was greatest (6.1 mg/l) in the month of August and least (3.9 mg/l) in the month of January. Sulphate was varying from 6.7 to 8.5 mg/l and iron values were very high that is (4.5-6.4 mg/l) clearly showing that water is contaminated. The variation of Sulphate, nitrate and iron are shown in Fig. 6.

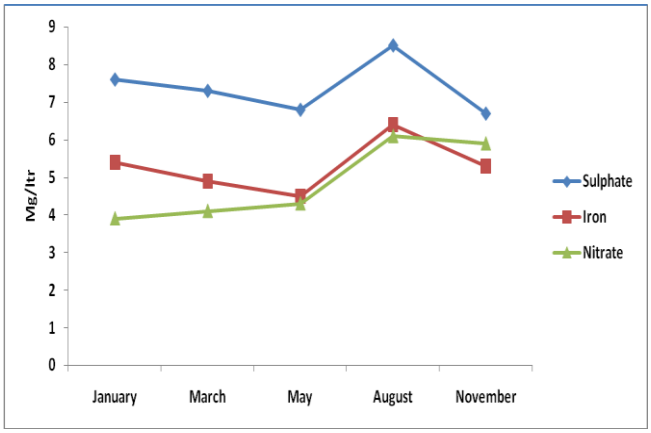

Figure 6: Variation of Sulphate, Nitrate and Iron of River Basantar

Table 2: Physico-chemical parameter's of River Basantar

Parameter	Mean Value	Range
TDS (mg/l)	1169	944.52-1397.39
pH	7.1	6.2 – 8.2
Electrical Conductivity (MHO/cm)	587	523.44 - 697.23
Alkalinity (mg/l)	254	212.13 - 315.5
Chloride (mg/l)	197	168.44-236.2
Sulphate (mg/l)	7.5	6.7 to 8.5
Nitrate (mg/l)	4.8	3.9 –6.1
BOD_5 (mg/l)	15.3	15.2 -15.5
COD (mg/l)	42.3	40.2- 44.3
Iron (mg/l)	5.10	4.5-6.4
Hardness (mg/l)	500.00	431.05-562.13

B. Variation of groundwater characteristics

Total dissolved solids (TDS) are union of waste particles in water both in melted and suspended form. TDS at various stations WS1, WS2, WS3, WS4, and WS5 was found to be 1110 mg/ ltr, 1225 mg/ltr, 1200 mg/ltr, 2650 mg/ltr and 2200 mg/ltr respectively. Samples 1, 2 and 3 were found to be safe where as WS4 and WS5 were exceeding the limits set by (BIS, 2012). TDS lessens the moistness and causes gastro-intestinal problems in human beings (WHO, 1997). Conductivity was ranging in between 700 MHO/cm to 3050 MHO/cm with maximum at sample WS4and minimum at WS2. At WS1, WS3 and WS5 it was 1000 MHO/cm, 1120 MHO/cm and 2650 MHO/cm The pH value of all the five Sampling locations was found to be lying between 7.42 and 9.6. The maximum among all was found at WS4 and WS2 was having the least pH value followed by WS 1 where it was 7.5, at WS5 it was 7.8 and at WS3 it was 7.3. Water was found to be safe for all the four samples viz WS1, WS2, WS3 and WS5 but SL4 was exceeding the permissible limit set by (BIS, 2012). So on the whole water for the town with respect to pH can be deemed as safe. The consequence of pH on hydrogen making from glucose from mixed culture was studied by (Fang and Liu, 2002) showed that assortment of germs enhances with increase in pH value. Biochemical oxygen demand (BOD) is the extent of disbanded oxygen obligatory for aerobic heritable living things in water to shatter behind alive material there in a given water sample at unambiguous warmth in a distinct eon of time. At different locations Maximum BOD5 was 1.42mg/ltr at WS4 with minimum being 0.95 mg/ltr at WS1. At WS2, WS3, WS5 BOD5 was 1.07 mg/ltr, 0.97 mg/ltr and 1.23 mg/ltr respectively. COD is value of oxygen analogous to the crude matter of the water defenseless to rust due to husky compound oxidant. The COD of all five selected samples were in between 17.3 mg/ltr to 80.5mg/ l, with sampling station SL4 having the limit intensity of COD i.e 80.5. These levels of COD show the subsistence of unrefined pollutants in water locations. Attendance of COD can be exploited as unrefined indicators to review the toxic waste. At WS 2, WS 3 and WS5 COD were 27.6 mg/ltr, 43.6 mg/ltr and 70.4 mg/ltr.

Evaluation of capability of water to disable acids is known as alkalinity. The alkalinity at the sampling locations was varying between 190 mg/ltr and 650 mg/ltr with maximum at WS 4 and minimum at WS 1 Alkalinity of additional samples WS 2, WS 3, WS 5 were found to be 212 mg/ltr, 320 mg/ltr and 515 mg/ltr. Alkaline water is considered to be destructive for drinking. Finding out divalent ions which consists of calcium and magnesium is known as Hardness (William, 1992). Hardness of water was varying in between 208 mg/ltr to 700 mg/ltr in phrase of CaCO3 at WS 1 and WS 4. At other stations the variation of hardness was 275 mg/ltr at WS2 to 425 mg/ltr at WS3 and then 525 mg/ltr at WS5. It is generally considered to be dangerous for drinking because excessive calcium and magnesium results stones in kidney and laxative problems respectively but the deficiency of these essentials may lead to utilitarian problems. Chloride content at the sampling locations was in the range of 155.21 mg/ltr to 797 mg/ltr with maximum at sampling location WS 4 and minimum at WS 1. At other locations WS 2, WS 3 and WS5, the chloride content was 269.41 mg/ltr, 486.86 mg/ltr, 593.23 mg/ltr respectively. Chloride absence is providentially less, if not looked after

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and treated well can cause death but if it is in excess it may lead to health risks to people going through heart related diseases and kidney problems (WHO, 1997). Nitrate at the sampling locations was varying between 2.59 mg/ltr to 12.3 mg/ltr with least at WS 1 and maximum at WS 4. At WS 2, WS3, WS 5, it was 2.78 mg/ltr, 3.74 mg/ltr, 8.5 mg/ltr respectively. In this regard water was found to be safe It is important for both plants and animals but the unnecessary nitrate content is disadvantageous to the both (WHO, 1997). like it may cause blue baby disease. Iron is normally found in water as ferrous or ferric structure. It is not dodgy to wellbeing yet it is considered for the visual intentions. Sulphate is a salt of sulphuric acid, containing the anion SO_4^{2-} or the divalent group. Sulphate was varying from 45 mg/l to 420 mg/l as WS 1 and WS 5. For samples WS 2, WS 3 and WS 4 sulphate was 100 mg/ltr, 225 mg/ltr and 370 mg/ltr . Osmotic Diarrhea results due to excess Sulphate present in ground water. Existence of iron alters the color of water [23]. Iron at the sampling locations was varying between 1.34 mg/ltr to 4.46 mg/ltr with least at WS 2 and maximum at WS 4. At WS 1, WS 3, WS 5, it was 3.66 mg/ltr, 3.82 mg/ltr, 3.78 mg/ltr respectively. All values for iron were exceeding the limits set by BIS. Since this water is having excess iron content it won't be suitable to use it for drinking. E-coli are the rod figured aerobic bacteria that instigate in the intestine of humans; they are not disparaging and are beneficial in bulldozing untreated material in biological treatment process. E-coli was ranging in between 2.5 -4.7 MPN/100 in only WS5 andWS4 samples and in rest of the water sample, E-coli bacteria was absent.

Table 3 shows the summary of chemistry of groundwater where it has clearly been mentioned which sample is exceeding the permissible limit set by BIS and for which parameter.

Table 3: Assessment of groundwater parameters by comparing with Bureau of Indian Standards (BIS)

Parameter	Range	Average ± SD	Acceptable Limit as per BIS	Water Sample No. Exceeding the Permissible Limit
TDS (mg/l)	200-1050	1677±702.42	2000	WS4, WS5
Conductivity (MHO/cm)	700-3050	1704 ± 1066.41	-	-
pH	7.42-9.6	7.92 ± 0.94	6.5-8.5	WS4
Alkalinity (mg/l)	190-650	377.4± 199.38	200	WS2, WS3, WS 4, WS 5
Chloride (mg/l)	155.21-593.23	460.34±511.13	250	WS2, WS3, WS 4, WS 5
Sulphate (mg/l)	45-420	232.00 ± 163.42	200	WS3, WS 4, WS 5
Nitrate (mg/l)	2.59-12.3	5.98 ± 4.27	45	-
BOD_5 (mg/l)	0.93-1.23	1.12 ± 0.19	-	-
COD (mg/l)	17.3-80.5	47.88 ± 27.08	-	-
Iron (mg/l)	1.34-3.78	3.41 ± 1.19	0.3	WS 1,WS2, WS3, WS 4, WS 5
Hardness (mg/l)	208-700	426.6 ± 196.97	200	WS2, WS3, WS 4, WS 5
E-Coli (MPN/100)	2.5-4.7	1.44± 2.13	Absence	Present in WS 4, WS 5.

It was found that the site which was affected the most was WS4 where all the parameters were exceeding the benchmark of permissible limits set by (BIS ,2012). The reason behind this could be the distance of this station from the dumping site of waste as it is nearest among (Nagrajan et.al,2012)

Leachate percolations into groundwater lead to this problem of contamination of water. Least affected site was WS 1 as it was the Farthest site. Industrial waste affect groundwater negatively in those areas which are nearer to dumping site of waste (Mor et.al ,2005). As a result population of that area gets affected due to several water borne diseases. Nagarajan et.al, 2012 did a research and concluded that one should not use water from the source which are located nearer to sites where wastes are dumped

IV. CONCLUSION

During analysis of River Basantar, the range of parameters was found to be maximum during August that is during monsoons and least was during summer this may be due to the fact that water gets purified as a self purification of water due to sunlight. The pollution caused to river has affected the aquatic life beside affecting the population of the area. It was found that the ground water pollution was more near the area where industrial waste is dumped that is 45 m east. The most affected sampling station was WS 4 where all the parameters were exceeding the limits set by (BIS, 2012) and least affected station was WS 1. So industrial waste affect the water negatively especially to those samples which are located nearer to dumping sites. As the distance from dumping site of waste increases the pollution level of water decreases Presence of TDS, Chloride, Sulphate, iron etc in large amount in groundwater makes it unsuitable for use and hence before use they should either be well treated, tested or the wells from where the water is used should be digged at greater height or located at greater distance from the dumping site

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