GROUNDWATER QUALITY DETERIORATION DUE TO UNPLANNED INDUSTRIALIZATION: A CASE STUDY OF DISTRICT SAMBA, J&K, INDIA

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Abstract* — Water is one of the most important natural resource which supports both human needs and economic development. Out of 2.5% global fresh water, only 1% is available for human consumption. Groundwater is an important source of drinking water for people around the world, especially in rural areas. There are about one million people, who are directly dependent upon the groundwater resources in Asia and almost 90% of the rural population of India depend on groundwater for drinking, domestic and agricultural purposes. Groundwater pollution has been reported in many areas. The main groundwater pollutants are heavy metals nitrate and organic compounds such as pesticides etc. An attempt was made in this study to evaluate the impact of unplanned industrial setup and untreated dumping of waste on physico-chemical characteristics of ground water in Samba district of Jammu division.

***Keywords*— Physico-chemical Characteristics, Basanter, pH, TSS, TDS.**

I. INTRODUCTION

The groundwater consumption rate is increasing day by day in the areas where surface water sources are not enough to meet the demands. The reason behind such reliability on groundwater is that it has been considered as safe and clean, compared to the surface water. Although, groundwater is a renewable natural resource and a valuable component of the ecosystem but it is highly vulnerable to pollution from natural and human activities (Prasanth et al. 2012). Drinking of polluted groundwater can cause serious health risk to humans which have been widely reported by many researchers. Geology and its response to different climatic conditions of the area have been considered as a basic determinant factor affecting groundwater quality. Anthropogenic factors also play a vital role in deterioration of water quality. Anthropogenic activities includes, disposal of untreated sewage, effluents, and indiscriminate use of agrochemicals has rendered the groundwater unfit for drinking/agriculture or both. Continuous increase in the agricultural, industrial and domestic activities in the last couple of years has increased the demand for good quality water to meet the growing demands.

The fast pace of industrialization and urbanization that has now become the need of the time for a country like India has turned into a major source of groundwater contamination. Heavy dumping of pollutants has been taking the pollutants' levels beyond the absorptive capacity of the environment. The industries that induce the pollutants into the groundwater resources from their manufacturing do not treat their waste to safe limit before discharge. Groundwater of rural Maharashtra, surrounding sugar industries has been highly polluted due to dumping of untreated effluent and domestic sewage (Pawar et al. 1998). The untreated effluents from the tanneries Kodaganar river basin, Tamil Nadu have considerably affected the quality of groundwater (Mondal, et. al 2005). Groundwater pollution not only deteriorates water quality but also possess threats to human health, economic development, and social prosperity.

Few years back the ground water quality of different villages of Samba district was good and is successfully used for different domestic purposes but unfortunately due to setup of industries on the bank of river Basanter the ground water quality gets deteriorated. Ground water is considered to be pure and fit for drinking but in Samba during survey it was observed that the ground water appears to be turbid. In this study an attempt was to check suitability of groundwater for agricultural, municipal, industrial and domestic water uses was determined by evaluating physico-chemical parameters.

II. LITERATURE SURVEY

A number of works on groundwater quality with respect to drinking and irrigation purposes have been carried out in many parts of India. Ground water is used as a source of drinking water in many areas especially in rural areas. Karnchanawong et al. (1993) evaluated physical, chemical and biological characteristics of about 40 shallow well, near the Mae-Hia waste disposal site. Comparison with the drinking water standards/guidelines showed that well water in the study area was not suitable for drinking due to the high contamination of total and fecal coliforms and moderate contamination by nitrate and manganese. It was also reported that wells water located adjacent to disposal site had higher concentration of conductivity, total solids, color, chloride, chemical oxygen demand, sodium, copper, and lead than in other areas.

In a seasonal study groundwater parameters like conductivity, TDS, chloride, DO, pH, hardness, phosphate, temperature etc. of Paithan city of Aurangabad district, Maharashtra were analysed by Abed et al. (2011) Most of the parameters were observed to be within permissible limits as described by various agencies.

Jasrotia et al. (2007) worked on hydrochemistry and groundwater quality around Devak-Rui watersheds to generate the baseline information of groundwater resources in developing rural as well as urban area of Jammu region.

Patel et al (1994) analyzed groundwater samples from rural areas of Rourkela Industrial Complex for 21 physico-chemical parameters and concluded in their studies that all the rural areas groundwater resources are perfectly fit for drinking purposes.

Sohani et al. (2001) done study on 16 groundwater samples collected from the bore wells of different colonies of Nandurbar Town (Maharashtra) and analysed for 15 physico-chemical parameters, which were found within the permissible limit and some are beyond the permissible limit of drinking water standards of Iron content (0.0 to 5.80 mg/1) as per Bureau of Indian Standard for drinking water.

III. Study Area

Jammu and Kashmir is northern state of India, has Srinagar as a capital in summer and Jammu as a capital in winter. The state has 22 districts and the is situated at 33.20 to 34.15 North Latitude and 74.30 to 75.35 East Longitude and Samba District is located at 32.46 to 32.75 latitude and 74.90 to 75.26 Longitude.

District Samba lies on south-western part of the Jammu and Kashmir. The Samba town is located on range of Shivalik hills alongside the Jammu-Pathankote National Highway 1A (NH 1A) on the bank of river Basantar and at a distance of 40 km from Jammu city. District Samba is bound by District Udhampur in the North, District Kathua in the East, Tehsils Jammu and Bishnah of District Jammu in the west, while on the southern side it has International Border with Pakistan. The Samba Industrial area is situated at 32.55 to 32.58 latitude and 75.09 to 75.12 longitude on the bank of River Basantar. The study area i.e. Samba district, has Village Doghur, village Supwal, Village Daboh, village Samlah, village Katli, village Madhera, village Chak Manga whose ground water quality had been analyzed in this study.

Figure 1 shows the location of District Samba

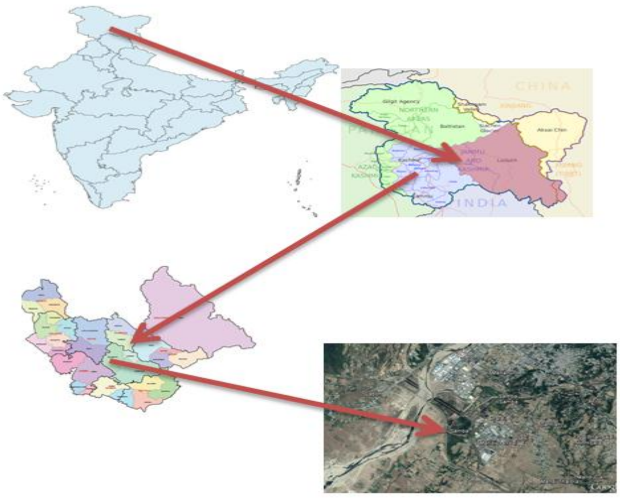

Figure 1 Location of Study Area

IV. Sampling

Groundwater samples of dug wells, tube wells and hand pumps were collected from 9 pre-defined sites viz Village Doghur, village Supwal, Chichi Mata, village Daboh, village Samlah, village Katli, village Madhera, village Chak Manga and Chak Manga Hand pump during summer, monsoon, autumn, winter and spring season of 2016 and 2017 from study area and ground water samples were analyzed for Physcio-Chemical parameters such as (pH), Electrical conductivity (EC), Turbidity, total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), Calcium (Ca^{++}), Magnesium (Mg^{++}), Sodium (Na^{+}), Potassium (K^{+}), Carbonate (CO_3^{2-}), Bicarbonate (HCO_3^{-}), Chloride (Cl^{-}), Flouride (F), Sulphate (SO_4^{2-}), Phosphate (PO_4^{-}), Nitrite (NO_2^{-}), Silicate (SiO_2).

Labeling of groundwater samples were done for every sample and the ground water was brought to the laboratory for the psychochemical analysis.

V. Experimental Result And Discussion

Ground water is the largest available natural source of fresh water present beneath the ground; it has become important not only for targeting of groundwater potential zones, but also monitoring and conserving this important resource. Groundwater is a major source of irrigation, drinking and other uses of water requirements in many parts of India. In India more than 90% of rural and about 30% of urban population depend on groundwater for drinking water resource (NRSA 2008). Groundwater is one of most preferred fresh water source to meet the increasing water demand because of its lower level of contamination and wider distribution. Monitoring of water quality is one of the important steps in water resources management. Water quality monitoring has been given the highest preference in health protection by World Health Organization (WHO 2006) and in environmental protection policies.

The groundwater quality parameters of Samba for the year 2016 and 2017 are shown in table 2 and table 3 respectively and are discussed below-

5.1. pH

It is a measure of hydrogen ion concentration. The pH value of water is used for assessment of acidic or basic nature of the water on the scale of 0 to 14. There no health-based guideline value is proposed for pH. pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters, with the optimum pH required often being in the range of 6.5–9.5 (WHO 2004). The pH of the groundwater samples in the study area of Samba ranges from 7.28 to 7.59 and 7.32 to 8.02 during 2016-2017, respectively. This indicates that groundwater pH in the study area is slightly alkaline but all the samples during study period were found to be within the prescribed limit set by WHO (1993) and BIS (2012). Alkalinity in groundwater because of influx of HCO_3^{-} ions in the aquifer, which is due to percolation of rain water through soil as stated by various authors.

5.2 Electrical Conductivity

It is a measure of water's capacity to conduct electric current (Nag and Ghosh 2013). Majority of the salts are present in the water in the ionic form, the higher the salt content, greater will be the flow of electrical current. Generally, groundwater tends to have high electrical conductivity due to high amount of dissolved salts present in it. So, it is an indicator of salinity and also gives the amount of TDS (Alaya et al. 2014). EC is found varying from 291.82 to 688.560 µS/cm and 261.2-351.2 µS/cm during study period of 2016-2017. Therefore, observed values of electric conductivity were well within permissible limit of given by WHO (1993) and BIS (2012) for drinking water.

5.3 Turbidity:

It is due to suspended matters derived from inorganic, organic and microbial substances. Turbidity of groundwater, particularly in shallow water could be due to loose soil around the sources. This a reason, suspended matters and microbial constituents enter into groundwater by leaching through soil pores and cause turbidity. Comparatively, tube well and deep-tube wells, it is less than that of shallow wells. Low turbidity of groundwater sources due to properly covered top and more depth of groundwater table. Turbidity of groundwater study ranges from 2.71-5.67 NTU and 2.811-5.823 NTU during study period 2016-2017.

5.4 Total Dissolved Solids:

Total dissolved solids (TDS) chiefly consists of inorganic salts like carbonates, bicarbonates, chlorides, Sulphate, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron etc. and small amount of organic matter. TDS in water may come from natural sources and sewage discharges (Ramkumar et al. 2013). Low TDS due to influence of rock weathering and high TDS is a result of domestic sewage, septic tanks and agriculture activities (Kumar et al. 2014). TDS levels less than 600 mg/l is considered to be good and concentration greater than 1000 mg/l decreases the palatability of the drinking water (WHO 2008). In this study TDS values vary from 311.8 – 502.23 mg/l (2016) and 281.80 – 493.80 mg/l (2017), respectively. The Groundwater was reclassified using a TDS (after Todd 1980), very fresh (0–250 mg/l), fresh (250–1,000 mg/l), brackish (1,000–10,000 mg/l) and saline (10,000–100,000 mg/l). Using this categorization, groundwater of study area falls under fresh category; indicating water is fit for drinking and other domestic purposes.

5.5 Total Alkalinity:

It is a measure of HCO_3^- and CO_3^{2-} ions. Maximum alkalinity in shallow water is probably due to infiltration of sewage from safety tank and also due to agricultural runoff, in addition to natural sources. The groundwater alkalinity decreased in tube well and deep-tube wells. The alkalinity values of study area vary from 122 to 466 mg/l and 144 to 378.23mg/l, during 2016 and 2017, respectively. Samlah (2016), Katli (2016), Chichi Mata Bore Well (2016), Chak Maga (2017), village Supwal (2017) showed higher value of Total Alkalinity. About Seventy percent of the groundwater samples showed high alkalinity with values ranging above 200 mg/L which may be due to decay of organic matter and weathering of rocks and minerals. The high alkalinity in groundwater may be due to the action of carbonates upon the basic material in the soil.

5.6 Total Hardness:

It is mainly due to HCO^{3-}, CO_3^{2-}, $SO_4^{2-}$and Cl^- of Ca^{2+} and Mg^{2+} in groundwater (BIS 1991). The BIS (2012) and WHO (1995) have set 300 mg/l desirable limit and 600 mg/l maximum permissible limit. Depending on the interaction with other factors like pH and alkalinity, water with hardness above 200 mg/l may cause scale deposition in the water distribution systems and soft water with hardness less than 100 mg/l can cause corrosion of pipes due to presence of heavy metals, such as Pb, Zn, Cu and Cd in it. General acceptability of the degree of hardness for human consumption may vary considerably from one community to another depending on local conditions. The taste of groundwater with hardness in exceeding 500 mg/l is tolerated by consumers in some cases. Hardness in water has no known adverse effects; however, it causes more consumption of detergents at the time of cleaning and evidence even indicates its role in heart disease (Schroeder, 1960)

The total hardness values of the groundwater samples of Samba ranged from 199.4-489 mg/l and 189-474.70 mg/l during 2016-2017.

World Health Organization (WHO 2004) classified hardness in drinking water in terms of its equivalent $CaCO_3$ concentration (Table 1) and accordingly, both years (2016-17) studied groundwater samples of Samba fall under category of hard to very hard.

Table 1 Classification of water depending upon the hardness (WHO 2004)

Classification	Hardness range (mg/l)
Soft	0-75
Medium Hard	75-150
Hard	150-300
Very Hard	Above 300

5.7 Calcium and Magnesium:

The Ca^{2+} in the groundwater samples studied ranged from Magnesium was measured from year to 13.120 to 52.40 mg/l (2016) and 11.1 to 48.1 mg/l (2017). Calcium of groundwater at few monitoring stations were found above the maximum permissible among this Chici Mata where calcium was recorded Samlah (hand pump) 327 mg/l (2017), Chichi Mata Bore Well 302 mg/l (2016) and Chak Maga (hand pump) 201.17 mg/l (2016) and 240.12 (2017).

Calcium is one of the important constituent of different types of rocks. Presence of Ca and Mg in the groundwater is due to leaching of weathered Ca^{2+}–Mg^{2+} silicates chiefly calcite and plagioclase feldspars (Wen et al. 2008). Ca^{2+} and Mg^{2+} are cause for hardness in water. Due to increase in hardness of water, its suitability decreases for cooking, cleaning and laundry jobs and if the concentration of magnesium is more than 300 mg/l, it is toxic (Venkateswarlu, 1999). Calcium is the most common metal, but is never found in nature uncombined. Calcium is found in almost all natural waters, soils, plant tissues and animal bones. In the high rainfall and humid regions calcium deficiency is common. Calcium In normal potable groundwater calcium has concentration between 10 and 100 mg/l (Ghosh and Nag 2013). Calcium concentration in groundwater of the study area varies from 49.8 to 283.4 mg/l and 45.50 to 308.80 mg/l during 2016 – 2017 respectively. In case of drinking water, Ca^{2+} concentration should not exceed 75 mg/l (McNeely et al. 1979). WHO (2004) and BIS (2012) maximum permissible limit of calcium in drinking water is 200 mg/l and there are only three stations which exceeds maximum permissible of limit of calcium, Hand Pump Samalah , Chichi Mata Bore Well and Chak Manga Hand Pump

Magnesium concentration in groundwater varies from 13.20 to 51.40 mg/l and 11.41 to 48.1 mg/l (2016-2017), respectively. For drinking purposes, its value should not exceed 50 mg/l (McNeely et al. 1979). As compared to calcium, magnesium concentration was found within limit of WHO (2004) and BIS (2012). In case of irrigation water concentration of magnesium ion is more important than that of calcium ion for and their ratio serves as an index for irrigation water quality.

5.8 Sodium:

It is widely distributed and is the most abundant of the alkali metals. It is a constituent of many igneous rocks and rock salt. Many fresh water bodies contain at least a measurable concentration of this element, while in sea water the concentration may go up to 10,000 mg/l and in case of evaporite beds, it may be much higher (Nag and Ghosh 2013). Hem (1985) also related fluctuation of Na concentration is due to the adsorption processes on fine sediment in case of high evaporation. In the study area Na^+ concentration varies from 17.60 – 39.80 mg/l and 19.3 and 34.9, year 2016 and 2017 respectively. The values of sodium are within permissible limit of WHO (2004) and BIS (2012).

5.9 Potassium (K^+):

Potassium presence in groundwater due to rain water, weathering of potash silicate minerals and application of potash fertilizer. It is also present in excess in sedimentary rock and usually present in feldspar, mica and other clay minerals (Kolahchi and Jalali 2006). The potassium values in the groundwater of study area recorded between 5.30 – 17.10 mg/l and 5. 50 – 19.40 mg/l during 2016-2017. Increase in potassium in the groundwater due to presence of silicate minerals from the igneous and metamorphic rocks (Karnath 1987). It is also present because of excessive use of potassium based fertilizer for agriculture .

5.10 Carbonate and Bicarbonates:

The major source of carbonate and bicarbonate ions basically depends on the carbonate dissolution and silicate weathering (Sajil Kumar and James, 2013). The bicarbonate contributed to natural water because of natural weathering process mainly due to the reaction of calcite, plagioclase, gypsum and feldspar minerals with carbonic acid in the presence of water, which releases HCO_3^-(Drever 1997). Excess bicarbonate in water is harmful for irrigation which leads to soil damage and reduce crop yield. Water having bicarbonate less than 100 mg/l as $CaCO_3$ is desirable for domestic consumption. The recommended tolerable limit of bicarbonate in natural water is 384 mg/l (WHO 2004). However, Freeze and Cherry (1979) recommend a more conservative value of 150 mg/l for general house. Carbonate values were found in range of 12.50-25.80 mg/l and 14.10 – 28.80 mg/l for year 2016 and 2017 respectively. Similarly, bicarbonate of groundwater studied was calculated to be 183.2 - 476.92 mg/l and 148.2 to 409.2 mg/l during 2016-2017. Among studied values of bicarbonate almost all found above the recommended values for natural waters.

5.11 Chloride:

Chloride naturally found in all type of waters. The chloride ion is the most predominant natural form of the element chlorine and is highly stable in water. The chloride in groundwater may be from different sources such as weathering, leaching of sedimentary rocks and soil, domestic and municipal effluents (Sarath Prasanth et al. 2012). Chloride concentration during study period (2016-17) varies from 18.1 – 37.1 mg/l and 19.50 – 37.10 mg/l, respectively.

There is no bad impact of high chloride concentration in groundwater to human health reported. Though, high content of Cl^- in groundwater may give a salty taste and can corrode pipes, pumps and plumbing fixtures. Chloride is present in all water, mostly in sea water. Increase of chloride in the environment is due to mixing of sea water with ground waters, the agricultural activities, human and animal excrete and industrial wastes. Chloride's high concentration gives salty taste to water. In the human beings consumption of water with excess amount of chloride may result in heart and kidney problems. Chloride in high concentration can cause the corrosion of metals in the pipes of the water distribution system and may increase the metal amount in the drinking water (TSE 1998, WHO 2011).

5.12 Fluorides (F):

It is most commonly occurring form of fluorine, is the natural contaminant of water. Groundwater, fluoride dissolved by geological formation (Kumar et al. 2010). Fluoride is important for human health as a trace element and higher concentration of this element causes toxic effects on health. Fluoride concentration between 0.7 to 1.0 mg/l in drinking water protects tooth decay and enhances bone development (Kundu et al., 2001). World Health Organisation (WHO) and Bureau of Indian Standards (BIS) has suggested permissible limit of fluoride in drinking water at 1.0 mg/l and tolerance range is upto 1.5 mg/l. Fluoride concentration more than 1.5 mg/l cause fluorosis, dental mottling and bone diseases. In the study area, fluoride ranges between 0.037 – 0.180 mg/l 2016 and 0.037 – 0.15 mg/l 2017 which is well with prescribed limit.

5.13 SO_4^{2-}:

It is a naturally occurring ion in water bodies of different kinds and is a major contributor to total hardness. It is present in many minerals and added to water through industrial waste. However, the highest levels usually occur in groundwater and are from natural sources.SO_4^{2-} content exceeding 200 mg/l is objectionable for domestic purposes; as beyond this limit, it causes gastro-intestinal irritation. Studied samples groundwater Samba area had SO_4^{2-} contents within permissible limits, ranging from 39.40 – 129.70 mg/l 2016 and 27.1 – 149.1 mg/l 2017. No health-based guideline is proposed for Sulphate. SO_4^{2-}in drinking water, can cause a noticeable taste, and cause a laxative effect in case very high concentration.

5.14 Phosphate:

Presence of phosphate in groundwater is not commonly toxic to humans, animals and fish, but it creates taste and odour problems and cause difficulties in water treatment (Singh et al.2005). It could cause digestive problem to human and animals, when present in very high levels in the groundwater. Phosphate levels higher than 1.0mg/l may inhabit coagulation in water treatment plants and as a result, organic particles that harbor microorganisms may not be completely removed before distribution of the water (Mangukiya et al. 2012). Spatial and temporal variation of phosphate in groundwater of study area of Samba found in the range of 0.46 to 0.76 mg/l (2016) and 0.054 to 0.410 mg/l (2017) which shows that its values well within limit of 1 mg/l. Broadly, presence of phosphate in groundwater of study area is due to agricultural runoff from agriculture land in which phosphatic fertilizers were used.

5.15 Nitrite:

The presence of nitrite in the environment means biological activities and even a small amount of nitrite indicates the beginning of pollution. Nitrite formation is also related to DO and decrease in DO causes the microbiological reduction of nitrate to nitrite. The nitrite concentration ranged from 0.010-0.70 mg/l (2016) and 0.010-0.192 mg/l (2017).

Table 2 Village wise Physcio-chemical Characteristics of Study Area for the year 2016. **1)** Village Doghur **2)** Village Supwal **3)** Village Daboh **4)** Samlah **5)** Katli **6)** Madhera **7)** Chichi Mata Bore Well **8)** Chak Maga **9)** Chak Maga Hand Pump

S.No	Parameter/Village	1	2	3	4	5	6	7	8	9
1	**pH**	7-7.8	7.27-8.39	7.11-8.44	7.19-8.11	7.18-7.96	6.30-7.59	7.18-8.5	6.99-7.89	7.29-8.59
2	**Conductivity (µS/cm)**	222-488	385-755	329-569	381-959	380-950	295-480	371-940	190-489	311-469
3	**Turbidity (NTU)**	2.5-6	1.6-3.5	1.5-5.1	2.6-5.7	3.6-6.8	1.9-3.8	3-7.2	3.2-7.9	2.3-6.5
4	**TDS (mg/l)**	260-440	340-450	220-409	269-699	210-529	288-435	199-612	221-484	250-512
5	**Total Alkalinity CaCO3 (mg/l)**	122-223	132-218	119-198	208.2-566.5	271.1-399.1	102.2-169.1	219.2-440.2	239.2-441.1	241.4-490.21
6	**Total Hardness CaCO3(mg/l)**	131.1-259.5	181-371.1	225-321.1	219.2-421.1	252.2-416.9	273.3-433.2	282.3-556.1	152.2-397.2	255.1-699.3
7	**Calcium as Ca(mg/l)**	29.2-79.1	73.3-107.9	29.2-111	60.1-131.3	131.2-295.8	99.1-191.5	181.2-422.2	29-77	109.8-292.7
8	**Magnisium as CaCO3 (mg/l)**	6.6-19.2	16.9-39.2	7.3-76.19	26.1-88.3	13.2-60.1	17.1-40.2	17.3-69.4	7.3-18.2	17.2-56.1
9	**Sodium (mg/l)**	10.7-22.9	14.4-31.9	10.3-69.5	12.3-37.1	10.9-26.1	25.2-42.6	13.2-27.1	16.1-23.4	11.1-22.7
10	**Potassium (mg/l)**	3.9-7.1	14.1-18.9	4.7-12.2	5.13-11.1	4.19-7.3	5.1-7.5	5.1-8.32	4.6-9.32	3.9-6.5
11	**Carbonates as CO_3,(mg/l)**	9.16-17.31	16.3-27.6	5.11-32.6	16.3-31.1	8.11-20.28	8.13-21.3	12.1-22.37	8.62-16.62	11.3-22.7
12	**Bicarbonates as HCO_3,(mg/l)**	105-309.3	216.3-289.3	141.9-401.2	290.6-599.4	199-491.4	137.3-292.3	251.2-498.2	106.3-288.3	129.2-440.8
13	**Chloride (mg/l)**	14.69-29.39	11.69-30.13	13.8-77.89	17.8-35.9	11.9-29.8	12.2-31.8	12.6-29.1	16.44-35.21	12.77-26.9
14	**Floride as F,(mg/l)**	0.02-0.08	0.050-0.089	0.04-0.082	0.022-0.31	0.008-0.29	0.039-0.41	0.04-0.68	0.02-0.09	0.02-0.089
15	**Sulphate (mg/l)**	39.3-133.6	31.3-99.3	49.7-99.1	47.44-111.99	22.2-60.1	22.2-79	14.3-69.9	33.2-145.9	55.4-130.4
16	**Phosphate-P (mg/l)**	0.011-0.080	0.052-0.99	0.023-0.6	0.023-0.22	0.019-0.201	0.019-0.71	0.029-0.181	0.020-0.30	0.042-0.191
17	**Nitrite-N (mg/l)**	0.0019-0.019	0.0039-0.080	0.031-7.80	0.030-0.077	0.003-0.06	0.0019-0.039	0.018-0.071	0.027-0.109	0.019-0.39

Table 3 Village wise Physcio-chemical Characteristics of Study Area for the year 2017. **1)** Village Doghur **2)** Village Supwal **3)** Village Daboh **4)** Samlah **5)** Katli **6)** Madhera **7)** Chichi Mata Bore Well **8)** Chak Maga **9)** Chak Maga Hand Pump

S.No.	Parameter	1	2	3	4	5	6	7	8	9
1	**pH**	7.19-7.9	7.35-821	7.42-8.76	7.8-8.7	7.2-7.7	5.3-6.1	7.1-8.7	7.3-8.6	7.5-8.92
2	**Conductivity (µS/cm)**	298-560	497-878	389.6-599.3	399.54-979.3	371-877	239-493	389-879	219-488	249-679
3	**Turbidity (NTU)**	2.7-5.8	1.9-4.5	2.9-6.5	3.6-7.8	3.7-6.9	1.8-4.9	2.9-6.4\8	4.5-7.9	3.5-6.8
4	**TDS (mg/l)**	220.5-346	299-549	229.9-518.8	268.2-639	295-459	248-399	272-649	287.8-504.6	299-483
5	**Total Alkalinity CaCO3 (mg/l)**	122-209	276-469	137.25-209	259-518	228-399	112-169	199-529	217-489	198-527
6	**Total Hardness CaCO3(mg/l)**	142-239	248-429	185-388	278-577	238-483	289-492	246-590	123-389	269-619
7	**Calcium as Ca(mg/l)**	21.1-73.23	43.3-84.2	64-99.5	176-478	68-109.6	79-106	49-121	23.2-69.3	99-382
8	**Magnisium as CaCO3 (mg/l)**	7.1-18.7	18.26-58.4	14.45-16.5	13.4-83.6	14.1-58.18	19.5-39.9	21.8-69.2	6.2-19.21	18.1-51.3

9	**Sodium (mg/l)**	13.5-29.8	13.35-29.8	13.51-37.2	13.56-25.5	15.6-28.4	17.5-40.9	14.5-37.4	14.6-29.3	14.6-29.5
10	**Potassium (mg/l)**	4.3-9.6	14.2-25.7	14.6-18.3	4.5-9.2	3.4-9.4	4.7-9.91	6.1-9.5	3.1-12.4	3.4-9.3
11	**Carbonates as CO_3,(mg/l)**	9.5-18.1	9.7-29.5	13.5-34.5	12.9-28.5	12.1-25.5	10.1-41.5	13.3-28.2	8.4-16.4	10.1-24.8
12	**Bicarbonates as HCO_3,(mg/l)**	117.4-210.3	274.52-583.74	124.68-199.4	256.4-596.6	234.81-493.2	117.5-190.2	242.81-581.8	112.47-297.1	162.48-491.7
13	**Chloride (mg/l)**	12-50.1	17.2-32.1	21.9-39.4	13.5-32.5	12.23-26.1	13.5-21.4	12.8-29.3	14.9-29.7	11.3-29.6
14	**Floride as F,(mg/l)**	0.012-0.29	0.016-0.79	0.033-0.49	0.031-0.09	0.022-0.09	0.042-0.81	0.013-0.38	0.01-0.05	0.029-0.49
15	**Sulphate (mg/l)**	12.7-39	31.5-96	48.5-95.8	16.5-62.5	34-82.34	25.6-53.2	32.9-92	27.5-129.2	65.2-119
16	**Phosphate-P (mg/l)**	0.019-0.082	0.017-0.59	0.027-0.19	0.045-0.17	0.061-0.28	0.046-0.86	0.048-0.377	0.064-0.217	0.043-0.193
17	**Nitrite-N (mg/l)**	0.0029-0.099	0.0017-0.059	0.002-0.009	0.024-0.077	0.002-0.034	0.002-0.074	0.012-0.063	0.025-0.19	0.012-0.45

VI. Conclusion

The result on Physiochemical characteristics of different ground water samples of Samba district showed that indiscriminate disposal of industrial effluent into surface water, discharge of untreated chemical contaminants cause contamination of the groundwater as sources surrounding to it being hydraulically connected with them. The untreated industrial effluents discharged on the surface, discharged into river, dumbed into ground cause severe groundwater pollution in Samba. Groundwater once contaminated, may remain unusable or even hazardous for decades or even centuries.

Therefore, industrial effluents, if not treated properly can pollute and cause serious damage to the groundwater resources.

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