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STUDY ON THE SOURCE OF WATER SUPPLY OF SATNA CITY (M.P.)

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ABSTRACT

Water is the life line for all the creatures. The drinking water supply has a primary objective of protecting human health, including ensuring access to adequate quantities of safe water. A good quality, unpolluted and safe drinking water is the right of citizen, which will ensure better quality of was life for the citizens of Satna, M.P. The water supply sources of Satna city was studied from four sampling stations 3-Ground water (Pannilal chowk, Gahira nala, Dali baba Housing board colony) and PHE one water supply were assessed for water quality. Various quality parameters were measured including pH, suspended solid, total dissolved solids, total hardness, calcium hardness, magnesium hardness, total alkalinity, chloride DO, BOD and COD. The ground water quality TDS, Total hardness, Ca hardness, Mg Hardness and alkalinity in the investigated stations was found beyond the desirable limit prescribed by WHO at all sampling station. Satna is a limestone belts of India.

Keywords: Ground water, physicochemical, pollution.

INTRODUCTION

In Satna City, rivers and ground water constitute major sources of water supply with growing urbanization, industrialization and a civilization associated with higher standards of living. Our water resources, particularly the rivers and ground water are continuously getting more and more polluted every day. The blame goes to none but to main himself who is polluting the water courses without realizing the dangers and implication.

Water supply systems get water from a variety of locations after appropriate treatment, including groundwater, surface water. Apart from the scarcity of water, there are many other challenges in providing a safe, adequate and reliable water supply in many parts of the world.

The quality of water deals with the physical, chemical and biological characteristics in relation to all other hydrological properties. Any characteristics of water that effects the survival, reproduction growth and production of aquaculture species, influences management decisions, causes and safety can be considered a water quality variable. Other factors being the same, aquaculture species will be healthier and production will be more, environmental impacts will be less and quality better in culture systems with good water quality than in those with poor water quality.

Groundwater pollution, also referred to as groundwater contamination, is not as easily classified as surface water pollution. By its very nature, groundwater is susceptible to contamination from sources that may not directly affect surface water bodies, and the distinction of point vs. non point source may be irrelevant. A spill or ongoing release of chemical or radionuclide contaminants into soil (located away from a surface water body) may not create point or non-point source pollution but can contaminate the aquifer below, creating a toxic plume (Chaurasia et al, 2015).

The groundwater quality, however in recent time has got deteriorated due to the percolation of polluted water in to the soils from the wastewater drains, polluted rivers and ponds. Polluted ground water is less visible, but more difficult to clean up, than pollution in rivers and lakes. Ground water pollution most often results from improper disposal of wastes on land. Major sources include industrial and household chemicals and garbage landfills, industrial waste lagoons, tailings and process wastewater from mines, oil field brine pits, leaking underground oil storage tanks and pipelines, sewage sludge and septic systems.

Ground water is one of the most important natural resources required for human consumption, domestic purposes, irrigation industrialization, urbanization, etc. (Rao et al. 2012)**.** Rain water or melted snow infiltrated in to the ground and its movement below the ground is called percolation**.** Ground water is generally clear, colorless and free from bacteria or other organisms as they are filtrated out during percolation through sub-soil. Underground water are springs, well, infiltration well and infiltration galleries. Groundwater is an important water resource in both the urban and rural areas of India. When rain falls to the ground, the water does not stop moving. Some of it flows along the land surface to streams or lakes, some is used by plants. Some evaporates and returns to the atmosphere and some seeps underground, into pores between sand, clay and rock formations called aquifers. Water moves through aquifers much like a glass of water poured onto a pile of sand. Ground water may contain dissolved minerals and gases that give it the tangy taste enjoyed by many people.

The quality of water is usually determined by its physico-chemical characteristics. It is a well-established fact that domestic-sewage and industrial effluent discharged into natural water result in deterioration of water quality and cultural eutrophication **(**Shaw et al., 1991). The other important sources of water pollution include mass bathing, disposal of dead bodies, rural and urban waste matters, agricultural run-off and solid waste disposal (Tiwari, 1992).

The groundwater depends on a large number of individual hydrological, physical, chemical and biological factors. Generally higher proportions of dissolved constituents are found in groundwater than in surface water because of greater interaction of ground water with various materials in geologic strata. The contamination of groundwater by heavy metals has assumed great significance during recent years due to their toxicity and accumulative behavior. These elements, contrary to most pollutants, are not biodegradable and undergo a global eco-biological cycle in which natural waters are the main pathways (Ahmad and Mishra 2014).

Study Area: - Satna is a city in the Satna District of Madhya Pradesh in India, which shares a border with neighboring Uttar Pradesh. The city of Satna is known as the commercial capital of Baghelkhand. It is is located at 24.34^0 N 80.55^0 E with an average elevation of 317 meters (1033

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feet). As per provisional report of Census India, population of Satna in 2011 is 280, 222; of which male and female are 147,874 and 132,348 respectively. Although Satna city has population of 280,222; it's Urban and Metropolitan population is 282,977 of which 149,415 are males and 133,562 female. Satna is in the limestone belts of India. Satna has a literacy rate of 63.8% according to the 2011 Census. The location is renowned for dolomite mines and limestone.

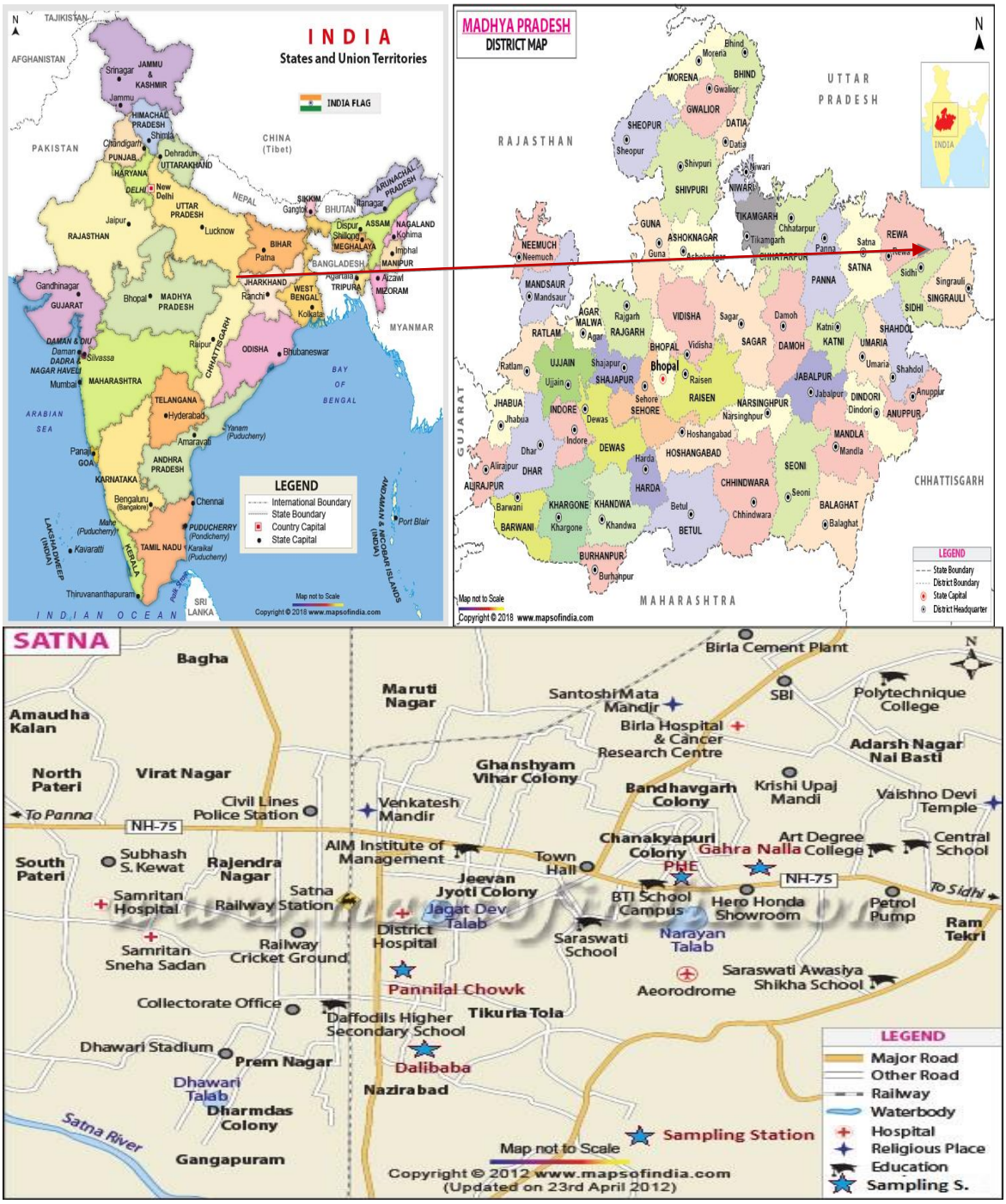

Fig. 1. Map Show sampling station of Selected Ground water of Satna City.

MATERIALS AND METHOD

To study the sources of water supply of Satna city following sampling stations were selected -

Table. 1. Sampling station of different location at Satna City.

Sr. No.	Water source	Sampling Station
1.	**Hand Pump**	Pannilal chowk
2.	**Hand Pump**	Gahira nala
3.	**Hand Pump**	Dali baba

The water samples from different sources and different stations were collected in different month of year 2016. The methods for analysis were followed as per APHA AWWA WPCF (2005).

RESULT AND DISCUSSION

Five sampling stations were selected from water sources for analysis such as Dali baba, Panni lal Chowk, Gahra nalla and PHE. The result is given in table 2, 3, 4, 5, and fig 1-11. The result of ground water quality was compare with the WHO/BIS standard (Table-6).

Temperature-

Water temperature is a critical parameter for aquatic life and has an impact on other water quality parameters such as dissolved oxygen concentrations, and bacteria activity in water. Water temperature controls the metabolic and reproductive processes of aquatic. The temperature was found ranged from 21.58-30.80^{0}C.

pH-

pH affects many chemical and biological processes in the water. Low pH can also affect the toxicity of aquatic compounds such as ammonia and certain metals by making them more “available” for uptake by aquatic plants and animals. This can produce conditions that are toxic to aquatic life. The pH was found ranged from 7.45-7.95. The minimum pH concentration was found 7.45 at Gahra nalla in pot-monsoon and maximum pH was found 7.33 Gahira nala in summer.

Total Suspended solid (T.S.S)-

The total suspended solids were found ranged from 54.00-148.75 mg/l. The minimum TSS concentration was found 54.00 mg/l at Dali baba in winter and maximum was found 148.00 mg/l at Gahra nalla in summer.

Total dissolved Solid (T.D.S.)-

The total dissolved solids include ionized and non-ionized matter. TDS were found ranged from 433.75-689.75 mg/l. The minimum TDS was found 433.75 mg/l at Gahra nalla and maximum was 689.75 mg/l at Dali baba in summer. The highest desirable limit of WHO for TDS 500 mg/l. Maximum sampling stations were found beyond the limit. Higher TDS concentrations were indicating that water of sampling station totally unfit for drinking purpose.

Chloride-

The chlorides were found ranged from 31.26-96.15 mg/l. The minimum chloride was found 31.26 mg/l at Dali baba in summer and maximum was 96.15 mg/l at Pannilal Chowk in Post-

monsoon. The highest desirable limit of WHO for chloride is 200 mg/l. All sampling stations were found within the limit. Chlorides in natural waters can be attributed to leaching of chloride containing rock and soil , discharges of effluents from chemical industries ,ice creams plant effluents, edible oil mill operations , sewage disposal , irrigation drainage, contamination, from refuge leachates and sea water intrusion in coastal regions (Shaik et al, 2012).

Alkalinity-

The alkalinity of natural water is generally due to the presence of bicarbonates formed in reactions in the soils through which the water percolates. It is a measure of the capacity of the water to neutralize acids and it reflects its so-called *buffer capacity* (its inherent resistance to pH change). Poorly-buffered water will have a low or very low alkalinity and will be susceptible to pH reduction. Alkalinity of ground water was ranged from 195.50-286.25 mg/l. The minimum alkalinity was found 195.50 mg/l at Pannilal Chowk in summer and maximum was 286.25 mg/l at Gahra nalla in Post-monsoon session. The highest desirable limit of WHO for alkalinity 200 mg/l. All of the sampling stations were found beyond the limit except Pannilal chowk in summer.

Total Hardness

The total hardness was found ranged from 235.75-310.00 mg/l. The minimum total hardness was found 235.75 mg/l at Dalibaba in summer and maximum was 310.00 mg/l at Dalibaba in Post-monsoon. The highest desirable limit of WHO for total hardness 300 mg/l.

The hardness is more than 500 mg/l will cause the Renal Calculi formation of kidney stone. The maximum level of total hardness is due to presence of carbonate and non carbonate hardness (Tiwari et al, 2014).

Hardness value was depended on owing to presence of limestone rocks so the water gets more calcium and magnesium salt owing to their more solubility under anaerobic condition (Tripathi et al, 2016).

Calcium Hardness

The calcium hardness range was observed in the range of 188.50-257.00 mg/l. Minimum Ca hardness 188.50 mg/l was observed at Gahra Nalla in summer and maximum was 257.00 mg/l at Gahra nalla in Post-monsoon season. The highest desirable limit of WHO for Ca hardness 75 mg/l. All Sampling stations were found beyond the limit. Higher values than the permissible limit were indicating that water of these sites were unfit for drinking.

Magnesium Hardness

Magnesium is abundant and a major dietary requirement for humans (0.3-0.5 g/day). It is the second major constituent of hardness. Magnesium sulphate is used medicinally as "Epsom Salts," a laxative.

The magnesium hardness range was observed 31.00-58.50 mg/l. Minimum Mg hardness 31.00 mg/l observed at Pannilal in summer and maximum was 58.50 mg/l at Gahra nalla in Post-monsoon. The highest desirable limit of WHO for Mg hardness 30 mg/l. All Sampling stations were found beyond the limit. Higher values than the permissible limit were indicating that water of these sites were unfit for drinking.

Dissolved Oxygen (D.O.)

The dissolved oxygen was found ranged from 5.23-6.33 mg/l. The minimum DO was

found 5.23 mg/l at Dalibaba in Post-monsoon and maximum was 6.33 mg/l at Gahra nalla in winter season.

Biochemical Oxygen Demand (B.O.D)

The Biochemical Oxygen Demand was found ranged from 0.60-2.75 mg/l. The minimum BOD was found 0.60 mg/l at Dalibaba & Gahra nalla in summer and maximum was 2.75 mg/l at Dali baba in Post-monsoon.

Chemical Oxygen Demand (C.O.D)

The Chemical Oxygen Demand was found ranged from 18.65-46.68 mg/l. The minimum COD was found 18.65 mg/l at Dalibaba in summer and maximum was 46.68 mg/l at Gahra nalla in Post-monsoon.

Table 2:- Physico - chemical quality of ground water at Dali baba in different season.

Sr. No.	Parameters	Units	Summer	Post-Monsoon	Winter
1.	**Temp.**	^{0}C	30.8	25.89	22.46
2.	**pH**	-	7.68	7.75	7.78
3.	**Total Solid**	mg/l	631.00	596.25	522.25
4.	**SS**	mg/l	96.25	110.00	54.00
5.	**TDS**	mg/l	689.75	452.50	495.00
6.	**Chloride**	mg/l	31.26	55.47	41.18
7.	**Alkalinity as CaCo3**	mg/l	226.00	275.00	241.50
8.	**Total Hardness**	mg/l	235.75	310.00	278.25
9.	**Ca Hardness**	mg/l	188.75	249.75	219.75
10.	**Mg Hardness**	mg/l	36.50	41.75	47.25
11.	**D.O.**	mg/l	5.80	5.23	6.13
12.	**BOD**	mg/l	0.60	2.75	1.28
13.	**COD**	mg/l	18.65	26.84	21.46

Table. 3:- Physico -chemical quality of ground water at Pannilal chowk in different season.

Sr. No.	Parameters	Units	Summer	Post-Monsoon	Winter
1.	Temp.	^{0}C	29.76	26.43	21.58
2.	pH	-	7.68	7.75	7.78
3.	Total Solid	mg/l	595.00	672.50	552.25
4.	SS	mg/l	121.25	102.50	74.25
5.	TDS	mg/l	483.75	445.00	469.50
6.	Chloride	mg/l	45.96	96.15	36.51
7.	Alkalinity as CaCo3	mg/l	195.50	278.75	237.00
8.	Total Hardness	mg/l	251.00	276.25	274.50
9.	Ca Hardness	mg/l	203.25	232.50	217.50
10.	Mg Hardness	mg/l	31.00	43.49	46.75
11.	D.O.	mg/l	5.80	5.65	5.83
12.	BOD	mg/l	0.65	2.05	1.23
13.	COD	mg/l	22.43	30.54	24.86

Table. 4: -Physico -chemical quality of ground water at **Gahra nalla in different season.**

Sr. No.	Parameters	Units	Summer	Post-Monsoon	Winter
1.	Temp.	^{0}C	30.65	28.62	21.58
2.	pH	-	7.95	7.65	7.45
3.	Total Solid	mg/l	745.75	740.00	466.75
4.	SS	mg/l	148.75	117.5	68.5
5.	TDS	mg/l	547.50	475.00	433.75
6.	Chloride	mg/l	50.21	67.10	37.91
7.	Alkalinity as CaCo3	mg/l	211.00	286.25	222.00
8.	Total Hardness	mg/l	243.00	298.00	238.75
9.	Ca Hardness	mg/l	188.50	257.00	196.00
10.	Mg Hardness	mg/l	43.5	58.50	35.50
11.	D.O.	mg/l	5.38	5.50	6.33
12.	BOD	mg/l	0.60	2.48	1.15
13.	COD	mg/l	26.42	46.68	37.46

Fig.1:- Physico chemical water quality at Dalibaba

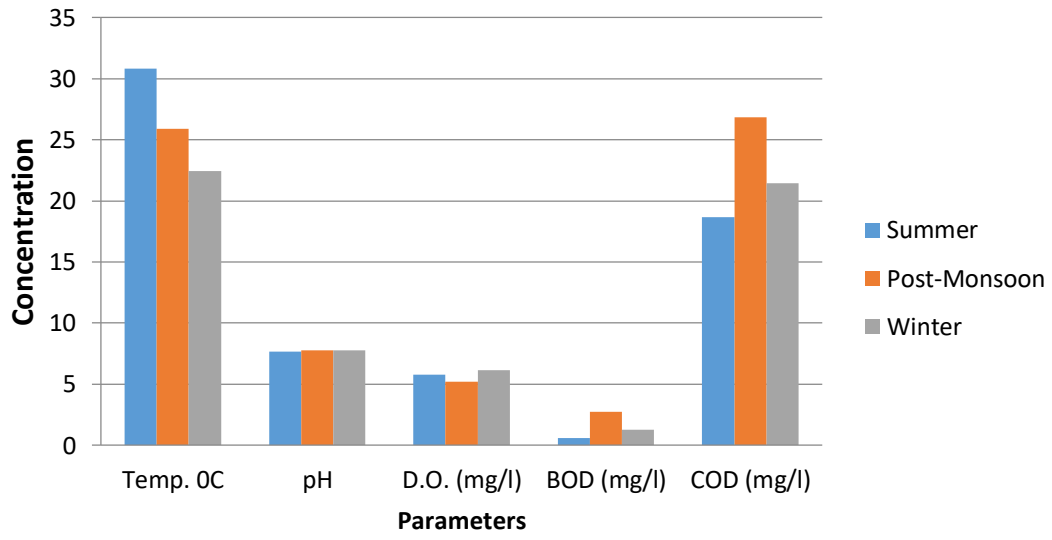

Fig.2:- Physico chemical water quality at Dalibaba

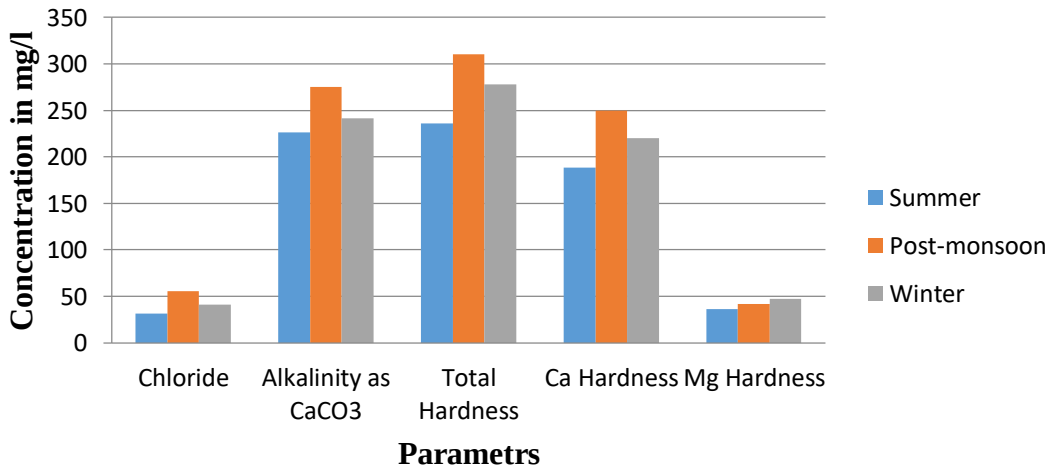

Fig.3:- Physico chemical water quality at Dalibaba

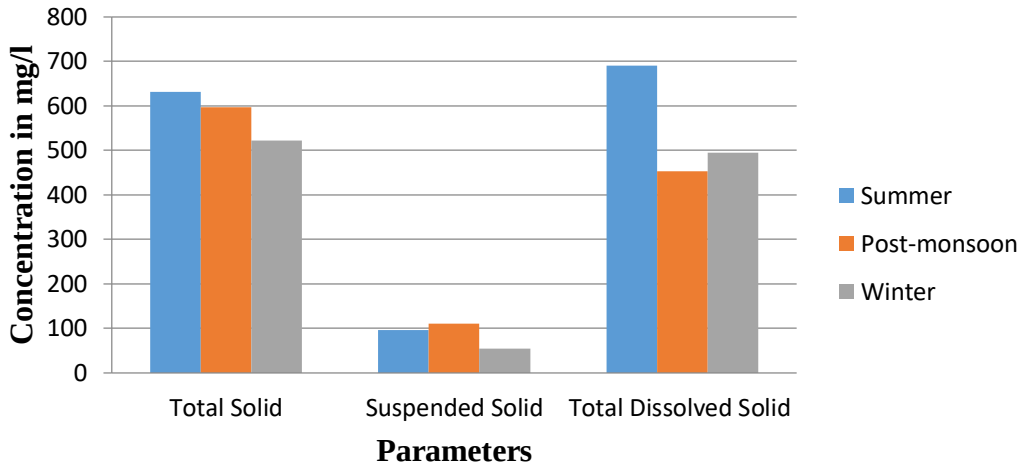

Fig.4:- Pysico-chemical water quality at Pannilal Chowk

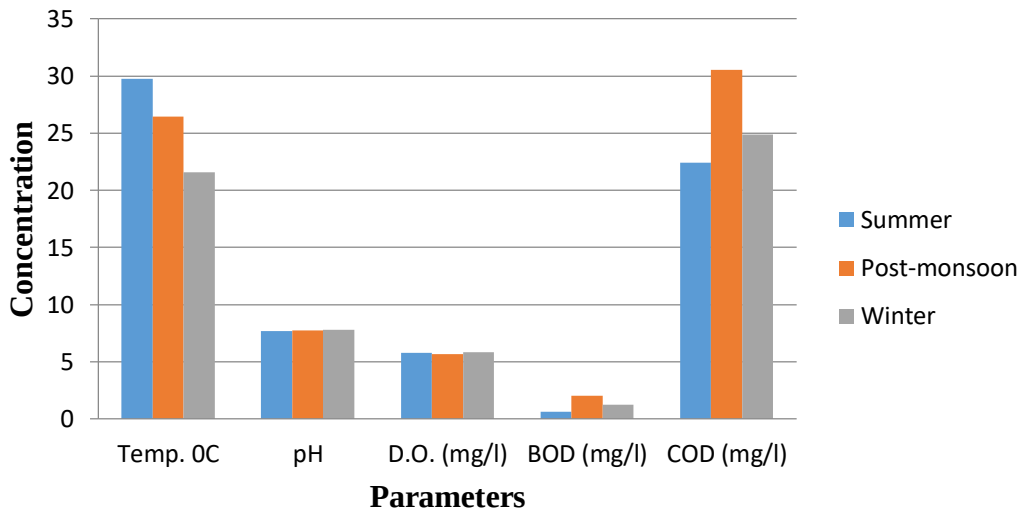

Fig.5:- Physico chemical water quality at Pannilal Chowk

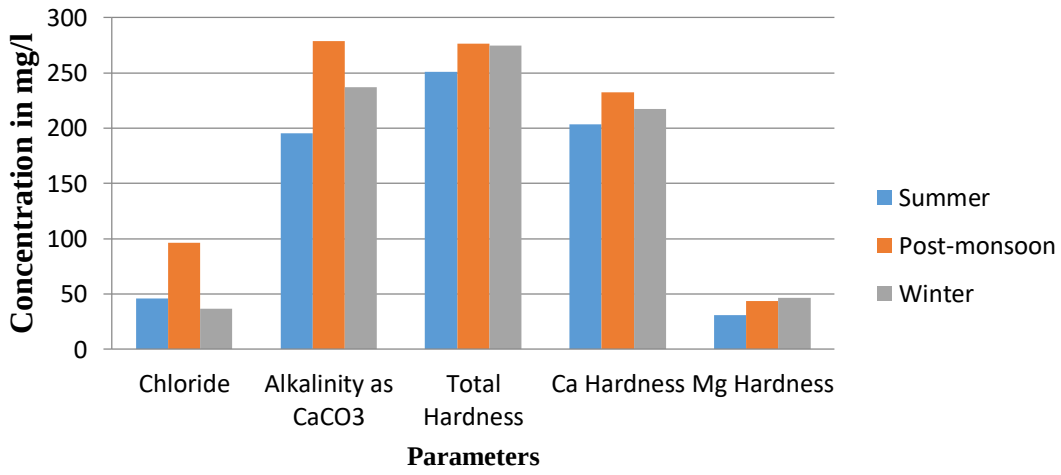

Fig.6:-Physico chemical water quality at Pannilal Chowk

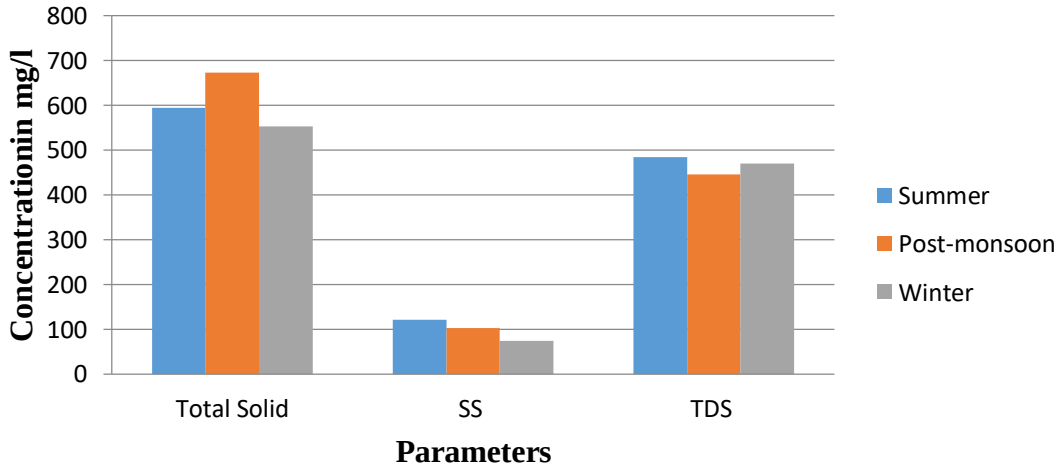

Fig.7 :- Pysico chemical water quality at Gahra Nalla

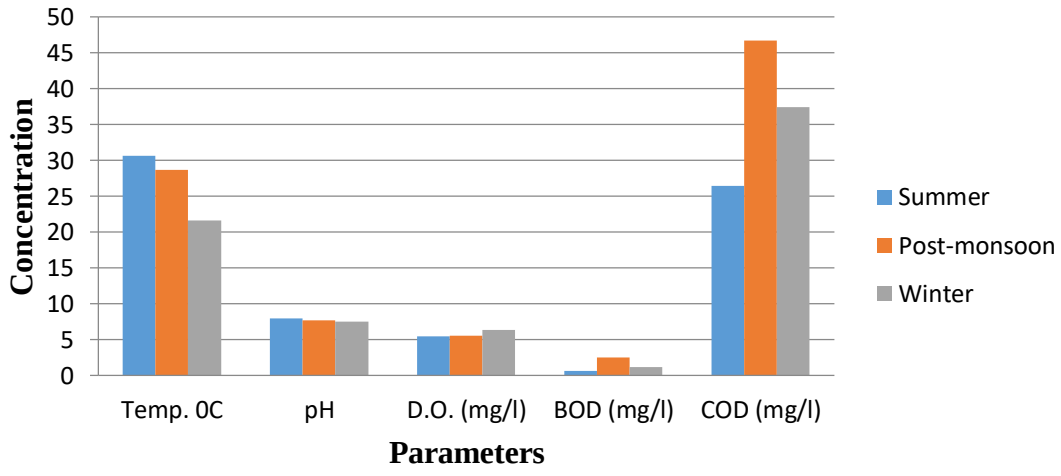

Fig.7 :- Pysico chemical water quality at Gahra Nalla

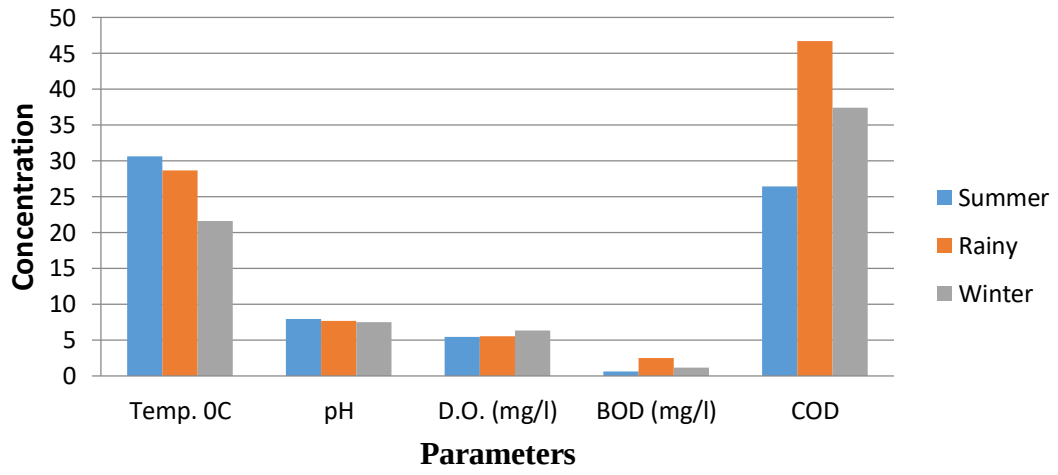

Fig.8:- Physico chemical water quality at Gahra Nalla

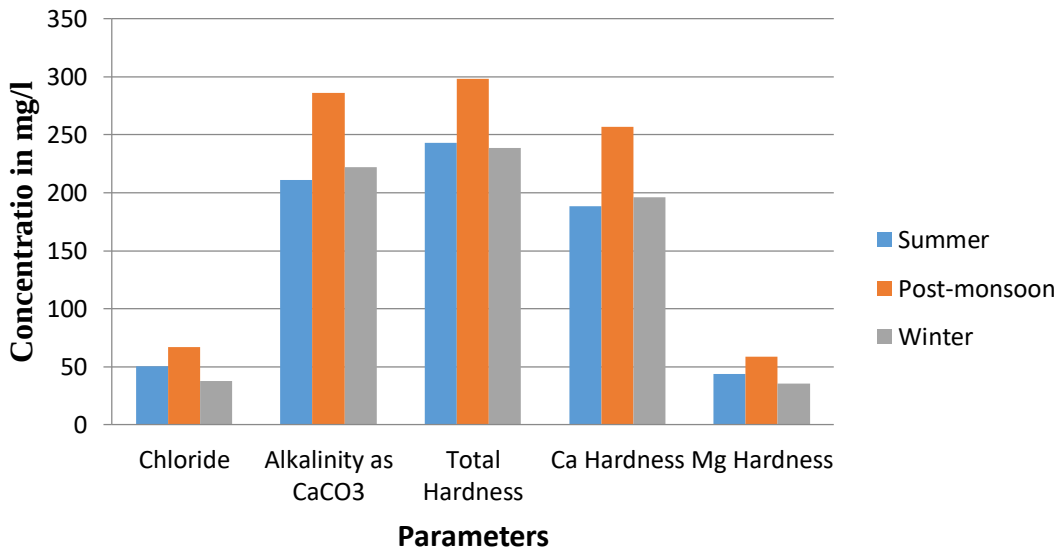

Fig.9:- Physico chemical water quality at Gahra Nalla

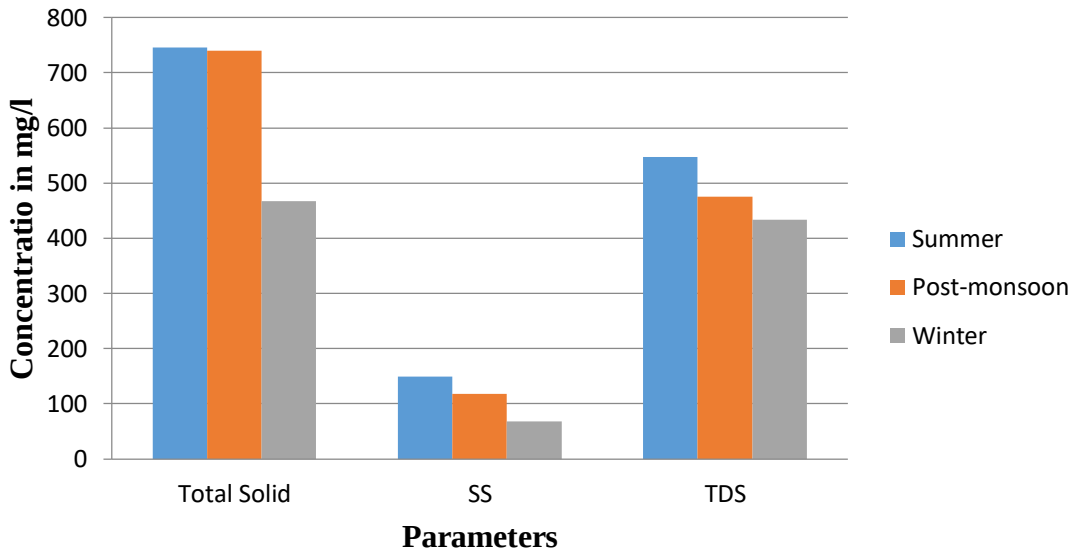

Table 6: Water quality standard for Drinking.

S.N.	Parameters	Indian Standard IS10500; 1991.	WHO	
			HDL	MPL
2.	TDS (mg/l)	2000	500	2000
3.	TSS (mg/l)	-	20	150
4.	TS (mg/l)	-	------	75
5.	pH	6.5-8.5	6.5-8.5	No relaxation
7.	Total hardness (mg/l)	600	300	600
8.	Ca^{++} hardness (mg/l)	200	75	200
9.	Mg^{++}hardness (mg/l)	100	30	150
10.	Total alkalinity (mg/l)	600	200	600
11.	Chloride		200	-

HDL= Highest Desirable Limit MPL=Maximum Permissible Limit

CONCLUSION

It is concluded that the ground water quality of Satna city was observed with higher TDS, Total hardness, Calcium hardness, Magnesium hardness at all sampling station and alkalinity were also found beyond the limit at Gahira nalla and Dali baba prescribed by WHO (highest desirable limit). The hard water, which is consider to be a significant etiological factor around the globe causing many diseases such as cardiovascular problems, diabetes, reproductive

failure, neutral disease and renal dysfunction and so on. Sources of hardness in water are dissolved polyvalent metallic ions from sedimentary rocks, seepage and runoff from soils. Calcium and magnesium, the two principal ions, are present in many sedimentary rocks, the most common being limestone and chalk.

The positive health and well being is not possible without water. There are serious concerns with reference to human health point of view.

It is suggested that the hygienic conditions of the environment in and around the hand pumps must be monitored on a periodical basis to ensure pollution free drinking water availability. The quality of drinking water depends not only as the physical and chemical characteristics of water but also depends on the contamination by heavy metal, micro organisms such as bacteria, virus, fungus etc; microbiological studies must also be carried out to ensure pathogen free quality drinking water for the citizens. The above suggested measures if adopted earnestly will go a long way to secure safety of the environment and the right of the population for clean safe, tasty and healthy drinking water.

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