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Research Article

Seasonal variation of groundwater quality in Amethi district Uttar Pradesh India

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Keywords

Groundwater, physico-chemical properties, seasonal variations and Amethi.

Abstract

Groundwater is a primary source of fresh water in the world. Present study was carried out on seasonal variation of groundwater quality and assessment of physico-chemical parameters in Amethi district, Uttar Pradesh. In this study, results are given on seasonal variation of average winter, summer and monsoon at 15th blocks of Amethi district (Amethi, Bahadurpur, Bhadar, Chhatoh, Deeh, Gauriganj, Jagdishpur, Jamo, Musafirkhana, Salon, Sangrampur, Shahgarh, Shukul Bazar, Singhpur and Tiloi). In this study attempts have been made to investigate physico-chemical parameters in the groundwater samples collected from Shallo handpumps which distance of 10 to 20 km along all blocks of Amethi during sampling period from June 2013 to May 2014. The examination was done for suitability of groundwater status for drinking purpose. Hasty modern urbanization and industrialization which caused groundwater contamination has affected the accessibility and status of groundwater due to its over misuse and inappropriate wastes disposal on unaffected lands. In our study, the pH range in all seasons (winter, summer and monsoon) 7.64 ± 0.32, 8.42 ± 0.59, 8.06 ± 0.49; total Alkalinity varied from 305 ± 73.08, 236 ± 43.40, 276 ± 45; total Hardness varied from 302 ± 64, 224 ± 46, 260 ± 54; Chloride varied from 26 ± 10, 56 ± 13, 106 ± 30; Total dissolved solid varied from 457 ± 132, 491 ± 130, 548 ± 139; Nitrate varied from 0.74 ± 0.48, 0.89 ± 0.70, 1.42 ± 1.10; Sulphate varied from 21 ± 9.36, 13.46 ± 6.87, 15 ± 6.63; Fluoride varied from 0.34 ± 0.14, 0.46 ± 0.21 and 0.26 ± 0.10 respectively. The higher range of pH indicated that the water is alkaline. Other parameters (TDS, Alkalinity and Hardness) are in the normal range but showed variations drastically with the change in season. The effect of long term continuous extensive irrigation by underground water and application of increasing amount of municipal solid wastes and industrial wastes over years on water and soil quality on this area have been discussed.

Introduction

Amethi district is located at the latitude 26°09’14.53 N and longitude 81°48’51.26 E at an average elevation of 101 M (331 feet) from mean sea level of east India. The recharging source of groundwater is the river Gomti, which passes through the centre of the Amethi district. The land of Amethi district is usually flat surface except some regions around the Gomti river which drains almost the whole district. Amethi is the name of a district in Faizabad division of the Indian state of Uttar Pradesh. Amethi was covered in 15 blocks takes under whole Amethi district (Amethi, Bahadurpur, Bhadar, Chhatoh, Deeh, Gauriganj, Jagdispur, Jamo, Musafir khana, Salon, Sangrampur, Shahgarh, Shukul Bazar, Singhpur, Tiloi) (Figure 1). Drinking water needs of human and animals should be the first priority on any available water (NWP, 2002, Shukla et al. 2014). The World Health Organization (2002) estimate 1.7millions deaths and 54.2 millions disability adjusted life year (Days) lost world wide per year due to unsafe water hygiene and sanitation. According to United Nations World Water Development Report (2003) about two million tons of wastes per day are discharged to receiving waters human waste industrial wastes and chemicals agricultural wastes an approximate estimate of global wastewater production is about 1,500 km3 per day. Therefore now a day's fresh water has become a scare commodity due to over exploitation and pollution (Ghose and Basu, 1968; Gupta and Shukla, 2006; Patil and Tijare, 2001; Singh and Mathur, 2005). Unfortunately due to injudicious and unplanned urbanization and Industrialization for the past few decades in few parts of the country, the resource is either being depleted or degraded in quality (Murhekar, 2011; Parihar S.S, 2012; Haribhau M.G, 2012; Manimaran D., 2012; Antony R.A., 2012). The depth of water tables changes with monsoons going down to 4-6 M during pre-monsoon and rises to 0-3 M during monsoon and post monsoon period. Over the years, excessive amounts of nitrate are surfacing in groundwater in various parts of the state (Krishnan S., 2005). Groundwater will normally look clear and clean because the ground naturally filters out particulate matter. But, natural and human-induced chemicals can be found in groundwater. Ramesh et al. (1995) have explained the unequal distribution of major and trace elements in the groundwater because of anthropogenic activities (such as sewerage wastewater, industrial effluents waste dumping etc). About 80% of the diseases of the world population and more than one-third of the deaths in the developing countries are due to contamination of water (WHO, 2002).

Groundwater composition in a region depends on the natural (such as wet and dry deposition of atmospheric salts, evaporation and soil-rock-water interactions) and anthropogenic processes, which can alter or modify the natural system of hydrological cycle (Subbba et al. 2002; Rao et al. 2012). As groundwater flows, metals such as iron and nitrates are dissolved and may later be found in high concentrations in the groundwater. Industrial discharges, urban activities, agriculture, groundwater pumpage and disposal of waste, all can affect groundwater quality (Jameel and Hussain 2007; Kumar et al. 2005). Contaminants can be human-induced, as from leaking fuel tanks or toxic chemical spills. Pesticides and fertilizers applied to lawns and crops can accumulate and migrate to the water table. Soil can eventually end up in water drawn from a well. Or, a well might have been placed in land that was once used for something like a garbage or chemical dump site. In any case, if you use your own well to supply drinking water to your home, it is wise to have your well water tested for contaminates (Raval and Malik 2010; Rout and Sharma 2011).

Occur naturally but also enters in environment from man-made sources such as storage of industrial effluents landfill leachate, feedlots, or sewage. Measure of the dissolved "salts" or minerals within the water may embrace some dissolved organic compounds. That has an influence on the acceptability of water in general which indicated the presence of excess concentrations of specific substances not included in the Safe Water Drinking Act, which would make water objectionable (Garg et al. 2004). High concentrations of dissolved solids shorten the life of hot water heaters. Fluoride occurs naturally but an additive to municipal solid and liquid waste supplies; widely used in industry. Occurrence of iron were naturally as a mineral from sediment and rocks or from mining, industrial waste and oxidize metal which imparts a bitter astringent taste to water and a brownish color. Nitrate (as nitrogen) occurs naturally in mineral deposits, soils, seawater, freshwater systems, the atmosphere and biota which are more stable form of combined nitrogen in oxygenated water. The toxicity results from the body's natural breakdown of nitrate to nitrite causes "blue-baby disease," or methemoglobinemia, which threatens oxygen-carrying capacity of the blood (Singh et al. 2011). Nitrite (combined nitrate/nitrite) enters in the environment from fertilizer, sewage and human or farm-animal waste (Brabec et al. 2002). Chloride may be associated with the presence of sodium in drinking water when present in high concentrations. Often from saltwater intrusion, mineral dissolution, industrial and domestic waste, can change the taste of water and has a laxative effect in high doses. Groundwater volumes which cover 5.61×10^6 cubic miles have 1.69 percent of total water present in the earth (Igor S. 1993). The objectives of the present study are to correlate the seasonal changes in groundwater quality of Amethi district Uttar Pradesh.

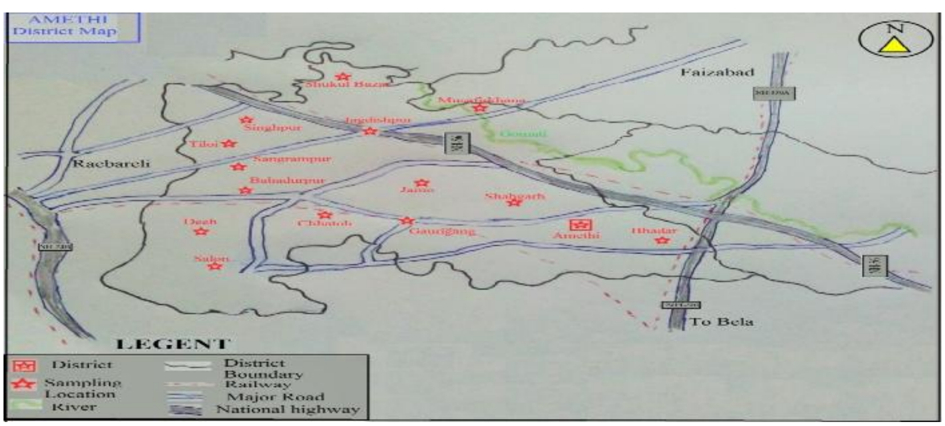

Figure 1: Showing sampling locations of Amethi district

Materials and Methods

In this study grab sampling was done in Amethi district Utter Pradesh in winter, summer and monsoon. All samples were collected from different blocks of Amethi and analyzed in laboratory according to APHA/ AWWA- 2012 (22nd edition). For physico-chemical analysis, sampales were collected in sterilized Teflon bottles and preserved with nitric acid and place it into the laboratory. Ion-Selective Electrode used for pH, Argentometric titration method for the Chloride, Sulphuric acid titration method for Total Alkalinity, EDTA titration for Total Hardness, UV Spectro-photometric Screening method for Nitrate, Turbiditimetric method for Sulfate, Ion-Selective Electrode for Fluoride and Gravimetric method for TDS.

Results and Discussion

The physico-chemical parameters and the GPS location of the water samples collected in Amethi are shown in Table1. The parameters determined were pH, hardness, alkalinity, TDS, sulphate, nitrate, fluoride and chloride content.

Table 1: Longitude and latitude of sampling locations

S. No.	Block name	Longitude	Latitude
1	Amethi	81°48’50.98”E	26°09’14.33”N
2	Gauriganj	81°40’56.96”E	26°12’26.28”N
3	Musafirkhana	81°48’07.24”E	26°22’28.84”N
4	Tiloi	81°24’48.79”E	26°23’54.11”N
5	Salon	81°27’00.53”E	26°01’46.70”N
6	Jagdishpur	81°37’21.94”E	26°27’33.61”N
7	Shukul Bazar	81°37’08.53”E	26°27’47.87”N
8	Bhadar	81°56’39.59”E	26°06’31.59”N
9	Sangrampur	81°27’48.70”E	26°19’16.98”N
10	Shahgarh	81°46’13.82”E	26°15’25.51”N
11	Jamo	81°39’54.55”E	26°22’00.40”N
12	Deeh	81°24’36.07”E	26°08’37.09”N
13	Chhatoh	81°31’26.43”E	26°09’17.52”N
14	Singhpur	81°26’29.85”E	26°28’40.85”N
15	Bhadurpur	81°98’31.19”E	26°07’82.84”N

In our study the pH range in all seasons (winter, summer and monsoon) 7.64 ± 0.32, 8.42 ± 0.59, 8.06 ± 0.49 respectively. The pH range indicates that the water is alkaline. These values were within the limits prescribed by BIS (IS: 10500: 2012, Table 2). Total alkalinity in all seasons (winter, summer and monsoon) varied from 305 ± 73.08, 236 ± 43.40, 276 ± 45. Alkalinity varied from 84-112 mg/L in pre-monsoon and 60-128 mg/L in post-monsoon (Agarwal et al. 2012) Total hardness in all seasons (winter, summer and monsoon) varied from 302 ± 64, 224 ± 46, 260 ± 54 and Total dissolved solid varied from 457 ± 132, 491 ± 130, 548 ± 139, The physico-chemical characteristics of hand pumps water of Banda city the values of pH, TDS and hardness were 7.8 to 8.3, 320 to 370 and 200 to 341 mg/L respectively (Gupta et al. 2014), Chloride in all seasons (winter, summer and monsoon) varied from 26 ± 10, 56 ± 13, 106 ± 30, Nitrate in all seasons (winter, summer and monsoon) varied from 0.74 ± 0.48, 0.89 ± 0.70, 1.42 ± 1.10, Sulphate in all seasons (winter, summer and monsoon) varied from 21 ± 9.36, 13.46 ± 6.87, 15 ± 6.63 and Fluoride varied from 0.34 ± 0.14, 0.46 ± 0.21, 0.26 ± 0.10 respectively (Table 3). The maximum seasonal variations are found of TDS, Alkalinity and Hardness from winter to monsoon at Amethi district shown in ternary plot (Figure 2). From Figure 2, it is concluded that the concentrations of chemical constituents were more in monsoon season followed by winter and summer season.

Table 2: Standard limit of drinking water IS 10500 (2012) in mg/L

Characteristic	Requirement (Acceptable Limit)	Permissible limit in the absence of alternate source
Hardness	200	600
Alkalinity	200	600
TDS	500	2000
Chloride	250	1000
Sulphate	200	400
pH (Unit)	6.5-8.5	No relaxation
Fluoride	1.0	1.5
Nitrate	45	No relaxation

Table 3: Summary of season-wise physico-chemical composition of groundwater samples collected from the study area in 2013-14

Chemical constituents (mg/L)	Winter season				Summer season				Monsoon season			
	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD
Hardness	200.0	430.0	300.7	63.9	160.0	300.0	224.7	45.8	180.0	350.0	260.7	54.2
Alkalinity	180.0	460.0	303.0	73.1	170.0	300.0	235.3	43.4	200.0	340.0	276.0	45.3
TDS	250.0	700.0	454.7	131.7	300.0	710.0	496.8	129.8	390.0	810.0	549.3	138.8
Chloride	10.0	40.0	26.1	9.8	40.0	80.0	56.2	13.1	60.0	160.0	107.7	29.7
Sulphate	12.1	45.3	21.1	9.4	6.9	30.8	13.7	6.9	8.4	28.8	15.3	6.6
pH (Unit)	7.0	8.0	7.7	0.3	7.8	9.3	8.5	0.6	7.6	9.0	8.1	0.5
Fluoride	0.1	0.6	0.3	0.2	0.2	0.9	0.5	0.2	0.1	0.4	0.3	0.1
Nitrate	0.5	2.1	0.7	0.5	0.4	2.7	0.9	0.7	0.8	4.3	1.5	1.1

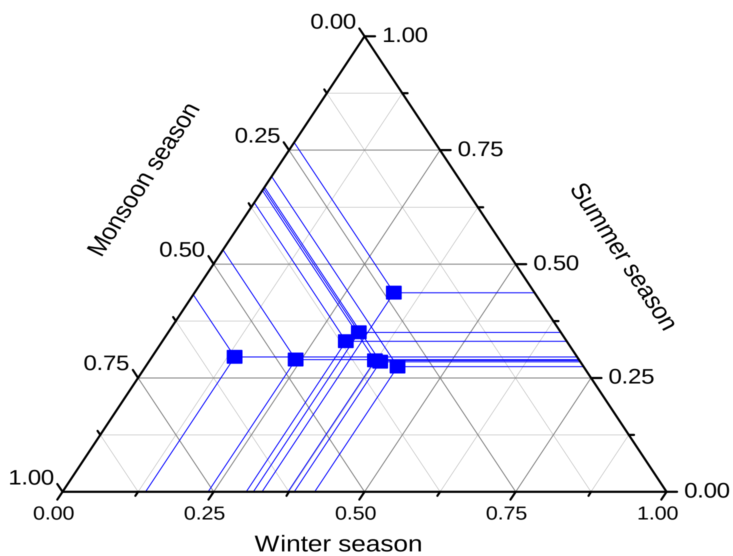

Figure 2: Ternary Plot of groundwater quality of Amethi District

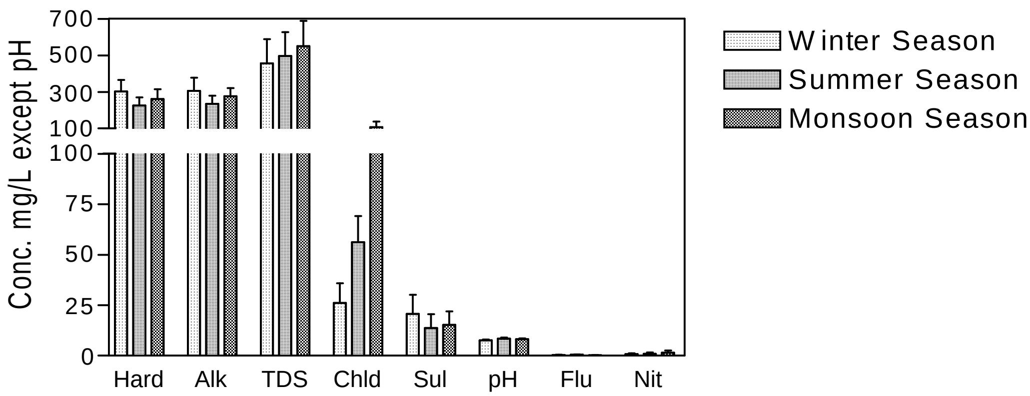

Figure 3: Seasonal variation groundwater quality of Amethi District

In present study a most important knowledge evaluates that in our life a big challenging agent is groundwater because year to year our groundwater quality decreases. The limit of TDS is 500 mg/L but values of study found higher the standard and total hardness, alkalinity respectively. This study suggested that manage and prevention of groundwater quality degradability in modern life and awareness to villages peoples of Amethi district Uttar Pradesh.

Conclusion

The groundwater qualities in around Amethi district of Uttar Pradesh have been evaluated for physico-chemical composition and suitability for drinking purposes. In the study area majority of groundwater samples are within permissible limits prescribed for drinking purpose. Groundwater in the area is alkaline in monsoon and winter seasons and hard in winter season due to the influence of longer contact of groundwater with the aquifer material and anthropogenic activities. TDS levels in all groundwater samples in all seasons are above drinking water standards. The limit of TDS is 500 mg/L but in some locations (Gauriganj; 810 mg/L, Jagdishpur; 780 mg/L, Salon; 650 mg/L etc.) values of study found higher the standard and total hardness (Jagdishpur; 350 mg/L, Shahgarh; 320 mg/L, Bahadurpur; 310 mg/L etc.), alkalinity (Shahgarh; 340 mg/L, Salon; 330 mg/L, Bahadurpur; 330 mg/L etc.) and chloride limit are also found higher in the prescribed limit. An appropriate management plan is suggested in the study area to have a better groundwater quality for proper plant growth as well as for maintaining human health for sustainable development.

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