# EVALUATION OF NITRATE LEVELS IN GROUNDWATER OF KOKRAJHAR TOWN AND ITS ADJACENT AREAS OF ASSAM, INDIA

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## Abstract

Water with high nitrate concentration ($NO_3^-$) is not suitable for human consumption, particularly when its concentration exceeded the threshold limit (50 mg/l) recommended by the health authorities such as the World Health Organization (WHO). Nitrate is highly mobile and present in agricultural as well as domestic waste and thus this study focused mainly on nitrate as both a contaminant of concern and as an indicator of groundwater contamination. A total of 36 groundwater samples were collected from 8 ring wells, 2 tube wells and 2 deep tube wells in different sites of Kokrajhar town and its adjacent areas, for three consecutive months (June to August) and investigated for $NO_3^-$ concentrations. Analysis was carried out according to the methods described by the American Public Health Association (APHA). Results showed that there was an increase in $NO_3^-$ concentrations from June to August in most of the sampling stations. $NO_3^-$ concentration was ranged from BDL (below detectable level) to 6.0 mg/L.

**Keywords:** Analysis , Nitrate , Groundwater , APHA , Kokrajhar.

## Introduction

The contamination of groundwater by nitrate is common in many parts of the world (Kacaroglu and Gunay 1997; Thorburn *et al.* 2002; Mourabit *et al*. 2002). It usually arises from diffuse sources such as intensive agriculture and unsewered sanitation in densely populated areas, or point sources such as irrigation of land by sewage effluents (Eckhardt and Stackelberg 1995; McLay *et al.* 2001; Obeidat *et al*. 2007). Due to its higher solubility in water, nitrate is not strongly adsorbed to soil colloids and is highly mobile within the soil liquid phase. As water percolates through the soil, nitrate within the soil pores is highly subject to leaching to the ground water. Nitrate is the stable form of nitrogen in oxidizing groundwater. It enters into groundwater without any transformation.

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$NO_3^-$ is particularly dangerous to infants less than six months old, causing methemoglobenemia or blue baby syndrome (Fianco *et al.*2010). Moreover nitrate leads to formation of carcinogenic nitrosoamines. According to the World Health Organization (WHO 2004), the maximum acceptable nitrate concentration for drinking water is 50 mg/l nitrate. Nitrate is highly mobile and present in domestic, agricultural and industrial waste. Thus this study focused initially on nitrate as both a contaminant of concern and an important tracer of man made environmental degradation. The main aim of this study was to determine the extent of nitrate concentration in groundwater at Kokrajhar and to assess the temporal trends. Groundwater is the major reliable source of drinking water in the study area, and evaluation of its quality and the identification of changes over space and time, the parameter such as nitrate can greatly help in the protection of groundwater quality of the area.

**Study area**

Kokrajhar town is the head quarter of Kokrajhar district as well as of Bodoland Territorial Council (BTC). It is a growing city. In all around of the town greenery is available. Population of the town is nearly 51 thousand according to 2001 census. The area enjoys comparatively mild subtropical climate with a dry pre-monsoon from February to May, wet and hot monsoon from June to October and cool, foggy winter from November to January.

**Material and methods**

A total of 36 samples covering the monsoon season were used in this study. The samples were collected from 12 sampling stations (Table 1.) mainly used for drinking purposes as well as other domestic purposes. The samples were collected in clean polyethylene bottles and immediately brought to the laboratory for analysis. The analyses were carried out in the laboratory of Department of Chemistry, Gauhati University, Guwahati. Analysis was carried out according to the methods described by the American Public Health Association (APHA, 1995). The absorbance was read at 220 nm to obtain $NO_3^-$reading and at 275 nm to determine the interference due to dissolved organic matter using Hitachi 3210 UV-Visible spectrophotometer. The absorbance at 275 nm was subtracted from the absorbance at 220 nm to obtain absorbance due to nitrate.

**Table 1 :** Sample code and Name of the selected sampling stations

| Sample Code | Type of Source and depth | Sampling station |
|---|---|---|
| RW-1 | Ring Well, 23ft | Gaurnagar |
| RW-2 | Ring Well, 28ft | Shantinagar |
| RW-3 | Ring Well, 25ft | Bidhanpally |
| RW-4 | Ring Well, 22ft | Tengapara |
| RW-5 | Ring Well, 20ft | Hatimatha |
| RW-6 | Ring Well, 14ft | Kokrajhari |
| RW-7 | Ring Well, 20ft | Dimalgaon |
| RW-8 | Ring Well, 30ft | Kokrajhar Bazar |
| TW-9 | Tube Well, 30ft | Charaikhola |
| TW-10 | Tube Well, 40ft | Titaguri |
| DTW-11 | Deep Tube Well, 150ft | Subhaspally |
| DTW-12 | Deep Tube Well, 100ft | Baganshali |

A standard calibration curve was constructed by plotting absorbance due to nitrate against $NO_3^-$concentration of the standards. $NO_3^-$concentration in the sample as was directly read from the standard calibration curve. The results are expressed as mg/L $NO_3^-$.

## Result and discussion

The nitrate contents of different samples are shown in the Table 2. The ranges lie between – BDL to 6 mg/L in ring well; 0.44 to 5.2 mg/L in tube wells and 0.17 to 0.3 mg/L in deep tube well, From the analysis it is seen that for some samples the nitrate contents found at below detectable level in the month of June. The highest value of nitrate content is obtained in the ring well water of Hatimatha.

Table 2. Nitrate mg/L.

| Sampling Station → / Month ↓ | RW-1 | RW-2 | RW-3 | RW-4 | RW-5 | RW-6 | RW-7 | RW-8 | TW-9 | TW-10 | DTW-11 | DTW-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June | 1.80 | 0.96 | 3.2 | BDL | 5.8 | 3.6 | BDL | BDL | 0.4 | 4.9 | 0.17 | 0.17 |
| July | 2.00 | 1.10 | 3.5 | 0.5 | 6.0 | 3.9 | 0.7 | 0.1 | 0.7 | 5.0 | 0.30 | 0.20 |
| August | 2.10 | 1.00 | 3.6 | 0.6 | 6.0 | 4.0 | 0.6 | 0.5 | 0.9 | 5.2 | 0.20 | 0.21 |
| Mean | 1.97 | 1.02 | 3.4 | 0.37 | 5.93 | 3.83 | 0.43 | 0.20 | 0.68 | 5.03 | 0.22 | 0.19 |

Nitrate represents the end product of oxidation of nitrogenous matters and its concentration is a product of the nitrification and denitrification activities undergoing and in water rich in oxygen. Nitrates generally occur in trace in surface water, but may attain high values in some ground water. Oxides of nitrogen present in the atmosphere are brought to the surface as nitrates by the rains. Fertilizers used in cultivation, decayed vegetables and animal bodies, domestic effluents, sewage, sludge, industrial discharge etc add nitrate to the water bodies. The level is higher in ground water than in surface water where aquatic plants decrease the level. During the rainy season the level of $NO_3^-$ tends to go up.

## Conclusion

The contamination of ground water by nitrate is a common problem of many parts of the world. However in the present study area the nitrate concentrations in groundwater have been found less than the WHO permissible limit, but the trend is increasing. The increasing concentration may be due to domestic and agricultural waste. Factors like the absence of scientific drainage system, poor sanitary system, presence of stagnant water, unhygienic conditions etc., are facilitating enhanced nitrate contamination. The variation in $NO_3^-$ concentration from well to well may be due to several factors including hydrogeological regime, depth to groundwater etc. From the above study it is

observed that water of Kokrajhar town is not so much contaminated by nitrate. But its increasing trend may be a matter of concern.

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