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Distribution of nitrate levels in ground water resources of Jalgaon district, Maharashtra

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Nitrate contamination of municipal and domestic well water supplies is becoming an increasing problem in many rural and urban areas. The present work has been carried out in order to study and reveal the levels of Nitrate content in underground water and create awareness amongst the people. The data generated may also be useful for policy makers. Nitrate content was estimated from underground water samples at Jalgaon District of Maharashtra in the year 2009. From this area, 165 underground water samples were collected from 15 towns of Jalgaon district for study of nitrate content. The concentrations of nitrate content were found in between 15.06 to 72.65 mg/lit. Most of the samples had nitrate content under permissible limit. But some samples had nitrate content much higher than the maximum permissible limit stipulated by Bureau of Indian Standard (B.I.S) which is 45 mg/lit. Concentrations of Nitrate above permissible limit may cause a disorder methemoglobinemia, commonly called as Blue baby sickness and therefore needs attention.

Nitrate contamination is common in many parts of the world (Spalding and Exner, 1993). In recent years, ground water has become the major water supply for the domestic, irrigation and industrial sectors of many countries. Therefore, water quality and its management strategies have become increasingly important in the developing nations for the past two decades. The water quality management mainly involves the identification and analysis of the contaminants, identification of their sources and the possible implementation of remedial measures. Nitrate (NO_3^-) contamination of the groundwater, due to the intensive use of fertilizers, has become a serious ecological problem in many rural areas of India and in many developing nations worldwide. (Shrinivasa Rao, 1998)

The main occupation of majority people of Jalgaon district is farming. Jalgaon district is well known for its banana production and besides many crops are cultivated in the area. To gain the good yields of crops, huge amount of fertilizers are being used in the area. This might have affected the underground water of the Jalgaon region. The aim of the present study was to reveal the nitrate content of underground water of the Jalgaon region. Nitrate is composed of elements of oxygen and nitrogen (Philip *et al.*, 1999). The chemical symbol for nitrate is NO_3^-. Nitrate contamination of ground water can be a serious problem in rural areas (Morgan *et al.*, 2000). The origin of nitrate in ground water can usually be traced to contamination by percolating water carrying nitrate from sources such as decaying plant or animal material, agricultural fertilisers, domestic sewage, areas of high density animal confinement or geological formations containing soluble nitrogen compound (Terblanche, 1991).

Nitrate generally has a low human toxicity, but becomes a hazard when it is reduced to nitrite by bacterial action in the human gastrointestinal tract. Nitrite converts oxygen carrying hemoglobin to methemoglobin, which then cannot transfer oxygen. The resulting condition is methemoglobinemia, or the so-called blue baby disorder. The most susceptible population to nitrate/nitrite toxicity is infants less than four months of age. Their high sensitivity is due to a combination of factors: higher gastric pH which allows greater bacterial activity in the stomach and subsequent enhanced conversion of ingested nitrate to nitrite, higher proportion of fetal hemoglobin which is more readily oxidized to methemoglobin than adult hemoglobin, and infant NADH-dependent methemoglobin reductase (the enzyme responsible for converting methemoglobin to normal hemoglobin) has about half the activity of the adult enzyme (Cross, 2002).

Study area:

Geographical location of Jalgaon city is 21.01^0 N and 75.56^0 E its average elevation is 209 Meters (http://www.answers.com/topic/jalgaon). Jalgaon District is located in the north-west region of the state of Maharashtra. It is bounded by Satpuda mountain ranges in the north, Ajanta mountain ranges in the south, Dhule District in the west and Buldhana District in the east. With an area of about 11,700 sq km, and a population of

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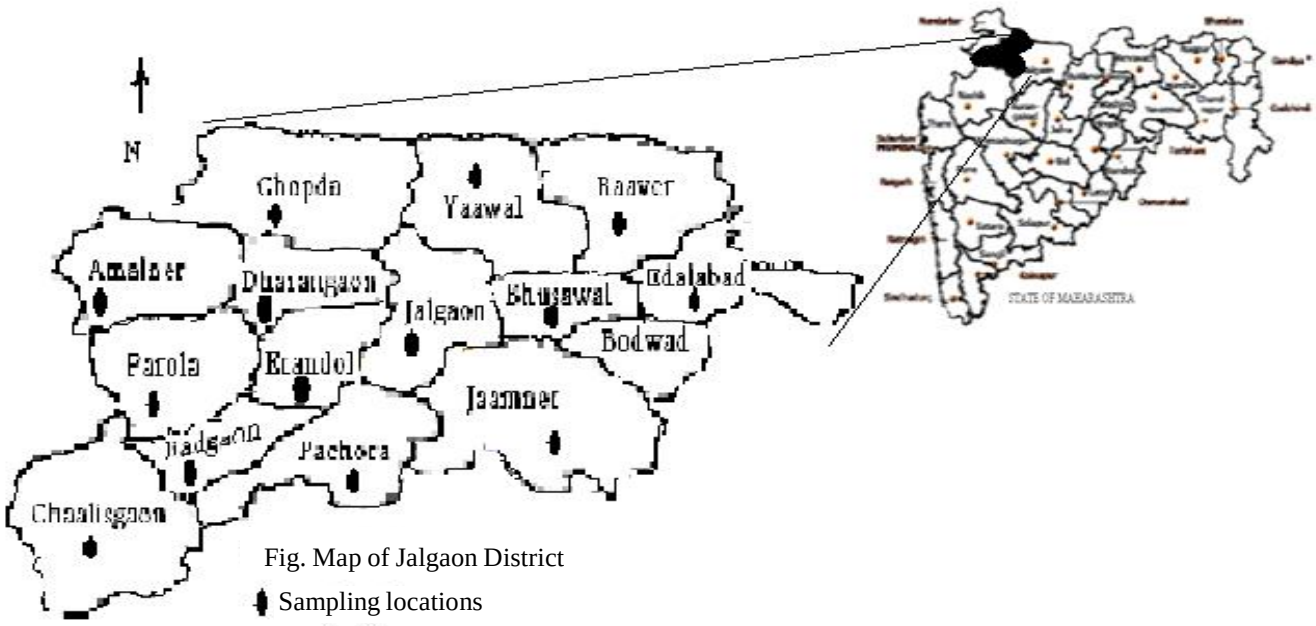

Fig. Map of Jalgaon District

Sampling locations

about 4 million. Jalgaon is rich in volcanic soil which is well suited for cotton and banana production. The total irrigated land for banana production is only around 49,000 hectors. Jalgaon District receives an average rainfall of about 750 mm and the temperature varies from 10 degree celsius to 48 degree celsius in peak summer. There are 19 rivers run from Jalgaon district (http://www.e-Jalgaon.com).

Sampling

Sampling was carried out at random covering at least one sample in 100sq. km area wherever wells and tube wells exist in the study area; the samples were collected (Ramaiah *et al.*, 2006). 164 underground water samples were collected from 15 towns of the Jalgaon district. At each town more than 10 water samples were collected from wells and tube wells of different locations. Clean polythene bottles were used for sample storage with 5% HCL as a preservative and kept refrigerated until analyzed for nitrate (Mutewekil *et al*., 2007).

Laboratory analysis:

The methods described by the APHA were followed during field and laboratory analysis of the nitrate (Clesceri *et al*., 1998). The brucine method was adopted for laboratory estimation of nitrates in groundwater samples. The results are expressed as mg/l NO_3^-.

The data regarding nitrate concentrations were statistically analyzed. Results in the present study indicated that the ground water concentrations of nitrate ranged from 15.06 to 72.65 mg/lit. Out of 164 ground water samples, 106 samples had the nitrate concentrations below the permissible limit whereas 58 samples were containing the nitrates above permissible limit stipulated by (B.I.S) which is 45 mg/lit. for drinking water. The Table 1 shows the minimum, maximum and average nitrate concentrations at its relative locations. 64.64% of samples were containing the nitrates in the permissible range, remaining 35.36% of samples had the nitrate concentrations above permissible limit.

The descriptive statistics of nitrate concentrations is presented in Fig. 1 where it shows 7.31% of samples had nitrate concentrations below 22 mg/lit. While 57.31% samples were within the range of 22 to 45 mg/lit. and 35.36% samples were containing nitrate above permissible limit. Fig. 2 shows the frequency distribution of the nitrates in the range of 10 to 80 mg/lit. of nitrates.

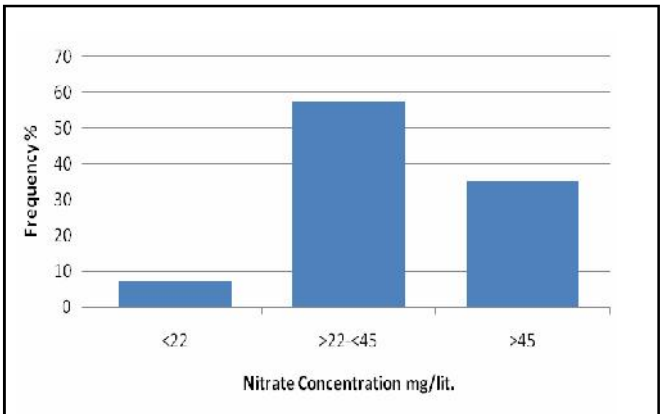

Fig. 1 : Frequency distribution for nitrate concentration

Table 1: Maximum, minimum and average nitrate concentrations

Sr. No.	Sampling Location	No. of samples analyzed (n)	Minimum	Maximum	Average	Standard Deviation
1.	Amalner	11	26.50	56.70	38.68	12.37
2.	Bhadgaon	09	35.41	72.65	50.35	13.15
3.	Bhusawal	13	28.52	72.65	43.23	12.81
4.	Dharangaon	09	16.83	59.36	28.15	12.88
5.	Erandol	09	25.69	48.73	37.40	09.83
6.	Jalgaon	27	18.60	54.93	35.82	13.20
7.	Muktai nagar	11	22.15	70.88	42.36	17.07
8.	Chalisgaon	10	15.94	71.76	51.01	18.37
9.	Pachora	09	23.92	69.99	45.92	18.49
10.	Parola	09	15.06	51.38	35.89	10.42
11.	Jamner	10	23.92	68.22	50.65	13.04
12.	Bodwad	08	28.35	66.45	43.19	12.41
13.	Chopda	10	16.83	79.71	39.80	19.21
14.	Raver	09	22.15	70.80	43.76	16.07
15.	Yawal	10	27.46	60.24	40.83	10.76

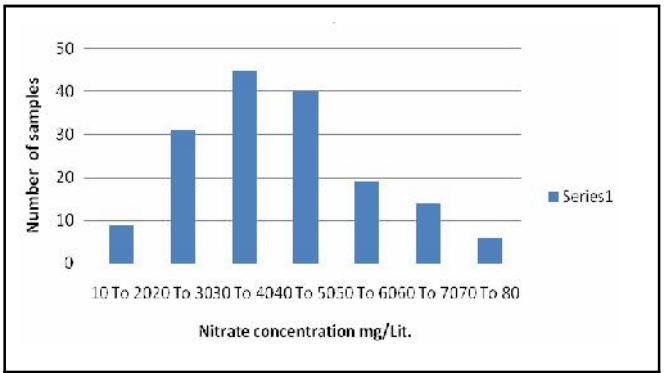

Fig. 2 : Frequency distribution for nitrates in the samples

Conclusion:

In Jalgaon district area high nitrate concentrations have been identified in ground water samples of many sample stations. Results have shown that 35.36% of water samples were containing nitrate concentrations above the permissible limit of ICMR, which can cause the methamoglobinemia and various other ill effects of nitrate. These need the treatment of water before use and reduce the pollution of water bodies through controlled application of chemical fertilizers.

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