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Assessment of Ground Water Quality at IARI Farm, New Delhi

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ABSTRACT

The chemical characters of ground water of IARI Farm have been studied to evaluate the suitability of water for irrigation and domestic uses. Twenty five water samples representing the deep and shallow ground water of the area were collected and analyzed for pH, EC, Ca, Mg, Na, K, HCO_3, SO_4, Cl and minor/trace elements like B, Mo, As etc. To study the seasonal changes in water quality sampling was done thrice at an interval of six months. The calculated values of SAR, RSC and per cent Na indicate that the quality of water is fit for irrigation.

Key words: Hydrochemical, heavy metals, GIS themes, SAR.

Introduction

Water resources of an area must be assessed to know the water availability and to meet water needs for drinking and irrigation purposes. Agriculture, as the single largest user of fresh water on a global basis and as a major cause of degradation of surface and ground water resources through erosion and chemical runoff, has cause to be concerned about the global implications of water quality.

Recent studies have documented the potential detrimental effects of agricultural practices on water quality (Schaller and Bailey, 1985, OECD, 1985, EPA, 1983). Agricultural sources have been identified as one of the major sources of human induced contamination of ground water (U.S. Congress, Office of Technical Assessment, 1984). In addition to problems of water logging, desertification, erosion, etc. that affect irrigation areas, the problem of down stream degradation of water quality by salts, agro chemicals and toxic leachates is a serious environmental problem. In India as early as in seventies Singh and Sekhon (1977) observed that high rate of fertilizer application contributed to enriching of ground water with nitrate in Ludhiana and Hosiapur district in Punjab.

The management of water resources in rural India was examined and measures to combat the depletion of ground water in many states in India were discussed by Chatterjee (1997).

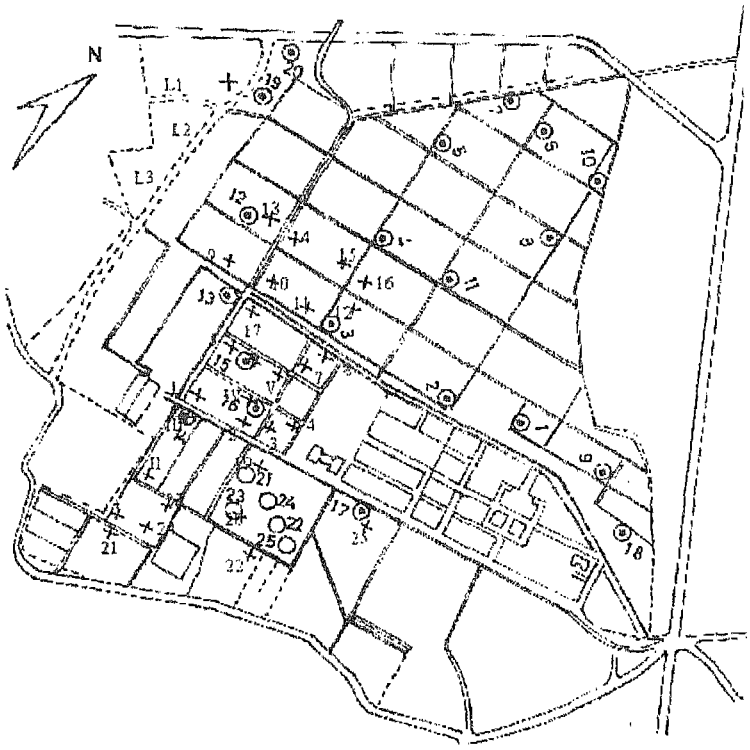
Arsenic in ground water has been found above the maximum permissible limit (0.05 mg L^{-1}) in six districts of west Bengal covering 34000 km^2 area and the entire Chennai city (Chatterjee *et al.*, 1995 and Ramesh *et al.*, 1995). Here we discuss the assessment of ground water quality at IARI Farm, New Delhi based on certain hydrochemical parameters.

Materials and methods

The study was conducted at IARI farm that covers 473 ha area and lies between 28°37'-28°38' N latitude and 77°9'-77°11' E longitude. The farm area has an elevation ranging from 217 to 240 m above mean sea level. The general slope is from South-East to North-West. There is an elevation difference of about 8 to 9 m between the south and east corner, commonly known as Todapur area and the north west corner of the farm known as Shadipur area. The topographic situation of the farm influences the leaching pattern. The climate is sub tropical, semiarid with hot dry summer and cold winter with mean annual rainfall of 710 mm (average of past 30 years) of which 75 per cent is received during the monsoon month (July-September). Soils of IARI watershed represents a typical alluvial profile of Jamuna origin. As per the USDA classification, the soil belongs to sandy loam textural class.

For hydrochemical investigation, three sets of water samples were collected from 25 tubewells in the study area at an interval of six months (Fig 1). The first samplings was carried out in the first week of July 2001. Second and third sampling were done in Dec. 2001 and July 2002 respectively. Water samples collected as above were subjected to chemical analysis in the laboratory using the standard procedures.

Heavy metal analyses were carried out in soil science laboratory of PAU, Ludhiana using inductively coupled plasma emission mass spectrometer (ICP).



1	Near FOSU
2	NRL (MB-1)
3	Field No.2
4	Field No.8
5	Field No.14
6	Field No.16
7	Field No.17
8	Field No.10
9	Genetics-H
10	Shadipur
11	Field No.7
12	Middle Block B
13	Engineering (Ag. Store)
14	Indo-Israel
15	Top Block-6
16	todapur6a
17	todapur bagh
18	G-1 Genetics
19	Sewage -I
20	Sewage -II
21	W1-BIOGAS
22	w2-pdc field
23	w3 chropa
24	w4-cycle stand
25	W-5 ber field

Fig 1. Layout of IARI farm indicating sample locations

Results and discussion

Quality of ground water of IARI farm used for irrigation is described through variations of total salinity expressed as EC in dSm^{-1} and sodium adsorption ratio (SAR). GIS themes were prepared taking these quality parameters using ArcInfo Package Analysis of water samples of IARI farm showed that the samples had salinity values varying from 1.02 dSm^{-1} in field number 7 to 4.5 dSm^{-1} in Todapur 6a. The GIS theme of EC is presented in Fig. 2. According to Ayers and Westcot only the samples collected from Todapur 6a are having severe salinity problem while the rest 24 samples are having slight to moderate salinity problem.

SAR values of ground water collected from IARI farm varies from 2.84 in Field No. 10 to 17.64 in Indo-Israel area (Fig. 3). SAR values of 20 samples are less than 10 and safe for irrigation. On an average these sample comes under S1 class in USSL classification. Three samples are having SAR value in the range of 10-18 rated as medium sodium (S_2) water. Continued use of water with high SAR value leads to a break down in the physical structure of the soil caused by excessive amount of colloidally adsorbed sodium. This break down results in the dispersion of soil, clay that causes the soil to become hard and compact when dry and increasingly impervious to water penetration due to dispersion and swelling when wet. Fine textured soils, those high in clay, are especially subject to this action.

Variation of Mg/Ca ratio with respect to season and locations is presented in Fig. 4. It ranges from 0.8 in the ber field of WTC area to 4.8 in Field No. 10. Samples at location numbers fifteen, seven and three have average Mg/Ca ratio less than 1.5 (safe), from 1.5 to 3.0 (moderate) and >3 (unsafe), respectively. The maximum permissible limit for Ca^{++} and Mg^{++} in drinking water are 100 and 150 ppm (5 and 12.5 me L^{-1}), respectively.

As shown in Fig. 5 boron, arsenic and molybdenum are found to be present in relatively higher quantities while rest of the heavy metals are present in trace amount. Concentration of boron is found out to be higher than the standard recommended for irrigation purpose at Field No. 8, 14, 16, Gen H, Gen I, Todapur Bagh and Sewage II. At field No. 8, Todapur, Sewage II boron concentration is above the standard recommended for drinking water purpose. Highest concentration of boron is 1.96 ppm observed in Todapur Bagh. Concentration of arsenic is above the limit set for drinking water purpose in Todapur 6a, Todapur Bagh and WTC3 area. But these water are within the safe limits for irrigation purpose. High molybdenum concentration is observed in FOSU,

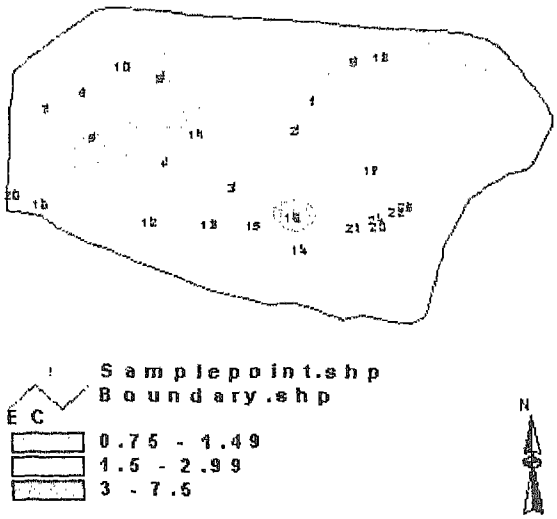


Fig. 2. GIS theme showing variation of EC at IARI Farm

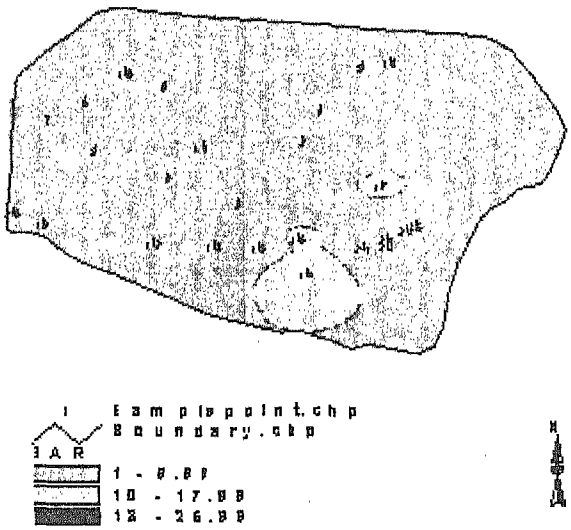


Fig. 3. GIS theme showing variation of SAR at IARI Farm

MB 1, Field 2, 8, 14, 16, Todapur Bagh, Sewage I and Sewage II and WTC2. Higher concentration of B, Mo, AS in these areas can be associated with the application of fertilizers particularly phosphatic fertilizers in these areas.

Conclusion

Analyses of 50 water samples have shown that 23 samples had EC value less than 2.25 dSm^{-1} and the sample collected from Todapur 6a is having severe salinity problem while the rest are having slight to moderate salinity problem. On an average these waters come under C_3S_1 class in USSL classification. Results of heavy metal analysis showed that boron, arsenic and molybdenum were

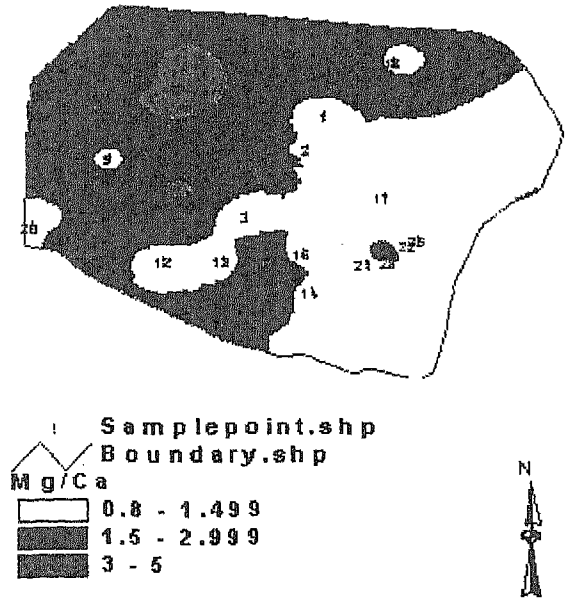


Fig. 4. GIS theme showing variation of Mg/Cl at IARI Farm

present in relatively higher quantity while rest of the heavy metals were present in trace amount. By and large these waters are well within the safe limits for irrigation purpose.

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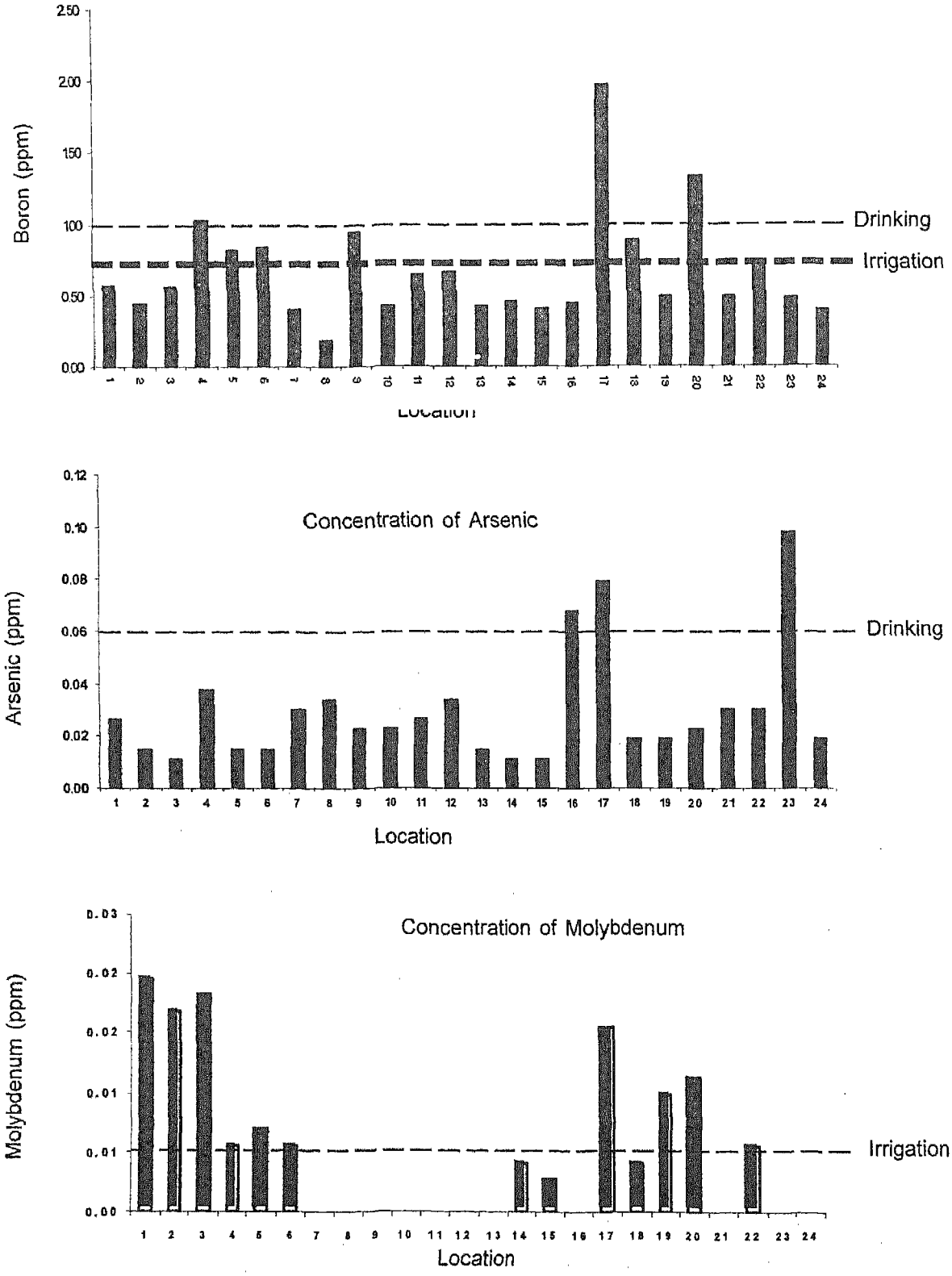

Fig. 5. Concentration of heavy metals in ground water at IARI Farm