

WATER QUALITY ASSESSMENT IN JAFFNA, VAVUNIYA, ANURADHAPURA, KURUNAGALA AND HAMBANTOTA IN SRI LANKA FOR DOMESTIC PURPOSES

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INTRODUCTION

Groundwater quality deterioration is one of the major concerns of Sri Lanka as the majority of the people in the dry zone depend on groundwater for their drinking and domestic purposes as they do not have access to clean and safe water. Major aquifer type underlain in Sri Lanka except for northern and northwestern coastal areas is hard rock aquifer with very low transmissibility. Therefore, a large number of shallow wells or agro wells having large storage capacities are constructed to provide water for irrigation. However, people in these areas use these wells water for drinking and domestic purposes too as they do not have alternative sources. Since there are complaints about health issues such as Chronic Kidney Disease of unknown etiology (CKDu) and other water related diseases for which the quality of the water the community consumes may be responsible, a series of studies have been conducted in intensive agricultural production areas namely Jaffna, Vavuniya, Anuradhapura, Kurunagala and Hambantota representing a longitudinal section of Sri Lanka to understand the groundwater quality over the years of 2004 to 2009(Figure 01).

METHODOLOGY

Analysis of chemical parameters of shallow groundwater in Jaffna Peninsula in forty drinking water wells at monthly interval was carried out from 2007 to 2009. Water quality assessments were also done on randomly selected 30 wells in the Thandikulum and Kurumankadu in Vavuniya and Thirappane in Anuradhapura during 2006 to 2007 at monthly intervals.. Malsiripura in Kurunagala also engaged in intensive agricultural activity and 10 randomly selected wells were taken for this study during 2004 to 2005 at monthly intervals. The study in the Hambantota district was carried in 2006 at monthly intervals, to assess water quality and sanitation for wells used for domestic purposes after the complaint made by the Medical Office of Health (MOH) of the area for Calculi in the urinary tract leading to renal failure and diarrhoeal diseases. Accordingly water quality assessments were done in Hambantota on randomly selected 15 wells in GN divisions of Bataatha North, Kivula South and Welipatanvila. pH, turbidity, conductivity, and fecal coli form were analyzed using the water quality microbial analysis kits (Dealgua) while nitrate-N, nitrite-N, ammonium-N, chloride, fluoride, calcium, magnesium, sulphate, iron, arsenic and phosphate were analyzed using the UV/Visible Spectrophotometer.

RESULTS AND DISCUSSION

According to the results in the Jaffna peninsula, the total iron, phosphate, manganese, arsenic, pH did not reach harmful levels even though the aquifer is highly porous and heavy fertilizer use for intensive agricultural activities was adopted. Salinity developments, high level of nitrate -N, low level of fluoride were identified as major health hazards in the study area (Figure 02). Figure 02 shows that some public, domestic and farm well exceed the permissible limit of 10mg/l of Nitrate Nitrogen. The health hazards of consumption of high nitrate contaminated drinking water was studied and emphasized by a number of scientists. Nitrate is associated with diseases like methaemoglobinemia, gastric cancer, thinning of blood vessels, aggressive behavior and hypertension(Kuruppararachi, 1995). Sivarajah (2003) supported this and reported that high nitrate content in water could be related to the high prevalence of cancer of the gastrointestinal tract in the people of Jaffna.

It could be converted into carcinogenic substances such as nitrosoamines within the body and is of importance in the incidence of esophageal cancer in the Jaffna district.

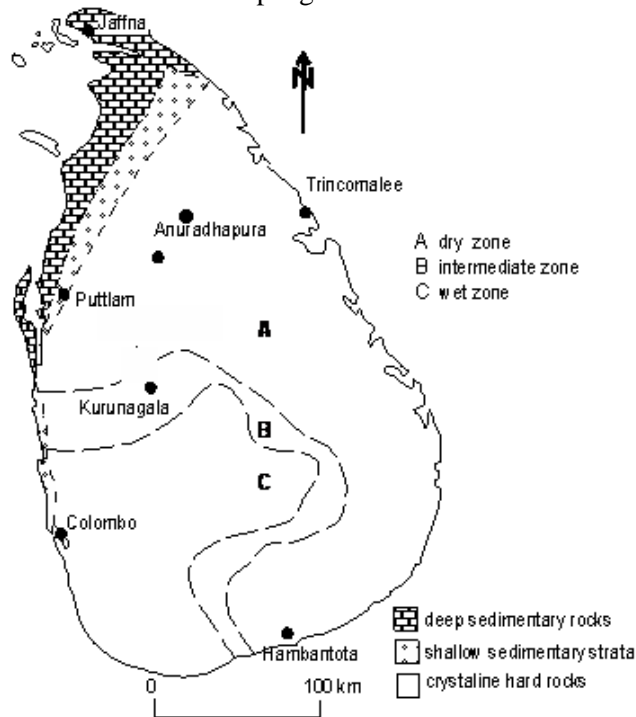


Figure 01. Study locations , zones and aquifer types

In Vavuniya and Anuradhapura all samples showed lesser turbidity below 5 TU. pH of all the wells was in the range of 6.4-7.4. All the wells can be categorized as low salinity water. The thermo tolerant fecal coli form was much higher in some wells near residential areas. Nitrate-N was higher in 20% of the wells above the recommended level of 10 mg/l for drinking water and nitrate-N was low until the beginning of October and has increased after wet season rains in November/December.

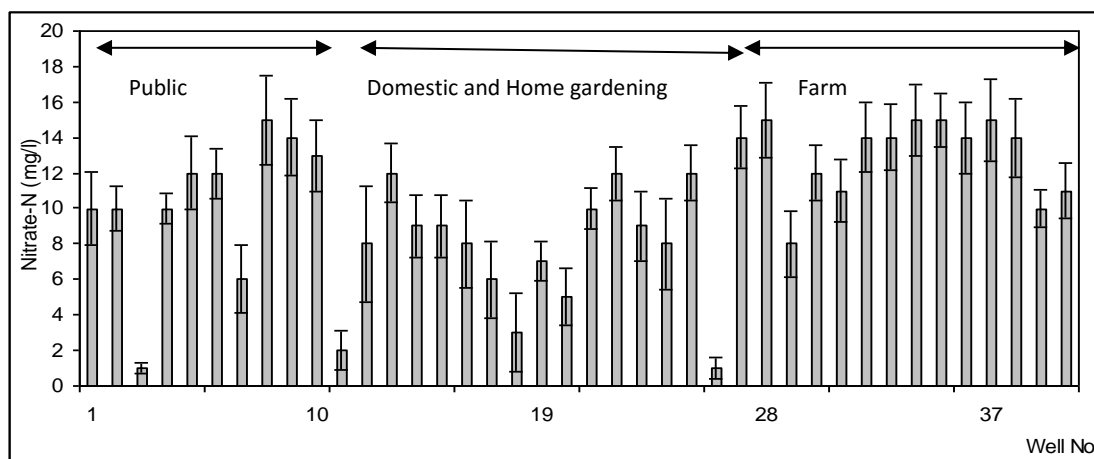


Figure 02: Average concentration of NO₃- N with standard deviation in Jaffna Peninsula.

The ammonium concentration increased after rainfall and exceeded the recommended level of 0.2 mg/l according to World Health Organization (WHO,1995) . In all wells sulphates were below recommended level of 600 mg/l for drinking water (WHO,1995) . Chloride ions were within the permissible limit. The maximum limit of fluoride for insignificant risk (1.5 mg/l), was exceeded by some of the wells and were in the range of 0.28 mg/l to 1.74 mg/l especially

in Anuradhapura (Figure 03). Concentrations above this value carry an increasing risk of dental fluorosis, and much higher concentrations lead to skeleton fluorosis. Research findings showed that the higher concentration of Fluoride may cause even Kidney diseases (Sivarajah, 2003). In most of the study areas, there are a lot of complaints about the hardness of water and kidney ailments, especially during the wet season. Even though, Malsiripura in Kurunagala is an intensively vegetable cultivated area, all the measured parameters were within the permissible limit except for the Nitrate concentration. The wells within the cultivated areas showed a higher value of 8mg/l during wet season where the permissible limit is 10 mg/l.

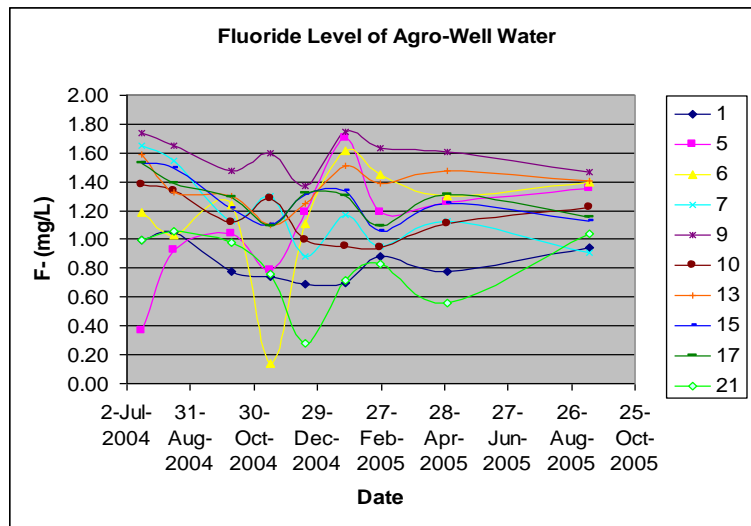


Figure 03: Temporal variation of Fluoride in agro-well water in Anuradhapura

In Hambantota too all the measured parameters were within the permissible limit except for ammonium, nitrate, phosphate and sulphate. The study results showed that 26 % of the wells in the study areas exceeded the permissible limit of 0.06mg/l of ammonium (0.068mg/l). In addition 20% of the wells exceeded the 2mg/l permissible limit of phosphate (2.97mg/L) and 20% of the wells exceed the permissible limit of sulphate during the study period (487mg/l). The maximum permissible level of sulphate is 400 mg/l. Similarly 30% of the sample well water exceeded the permissible limit of 10mg/l (as N) in January at the end of the rainy season (11.1mg/l).

Correlation between agricultural land use and high nitrate concentrations in ground water have been documented since at least the 1970s (Hallberg, 1986). Studies conducted in Jaffna by Nagarajah et al (1982) and in Kalpitiya by Kurippuarachchi (1995) reported about high concentration of nitrate in ground water under different soil conditions. The high concentration of nitrate may also be due to the characteristics of the soil in the study area having sandy loam nature with high porosity compared to clayey soils restricting leaching of nutrients to the shallow ground water (De Silva and Ayomi, 2004).

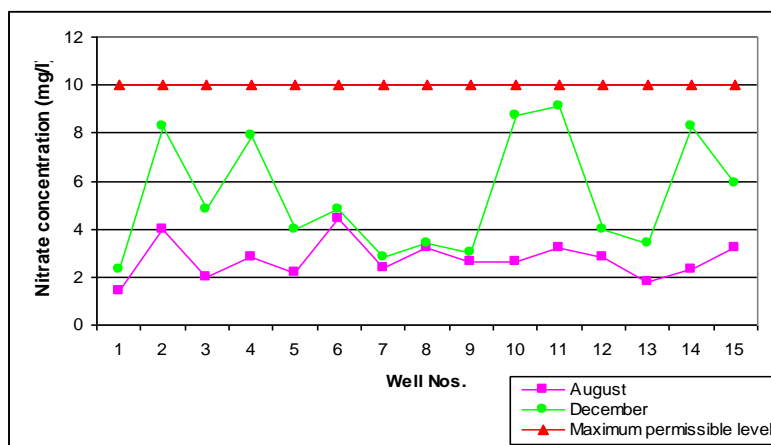


Figure 03. Variation of Nitrate concentration in Hambantota wells

CONCLUSIONS

Groundwater quality assessment was carried out in intensive agricultural activity areas in Jaffna, Vavuniya, Anuradhapura, Kurunagala and Hambantota to study the suitability of shallow groundwater in agro-wells for domestic and drinking purposes following the complaints made by the community on kidney related ailments such as Chronic Kidney Disease (CKDu), diarrhoeal and other water related diseases. Results of all the study areas on several parameters showed that the agro-well or shallow well (6m-10 m deep) water is not suitable for drinking and domestic purposes. Complaints are more during the wet season as the salts and other elements in the soil are washed to the well water due to wet season rains. However, there is no proof to show that the higher nitrate or fluoride or any compound of mixture of heavy metals such as Cadmium and/ or Arsenic is the actual cause for kidney and other health related issues among the community. But it is very clear that the well water from shallow wells (less than 10m) in dry and intermediate zones is not suitable for drinking and domestic purposes. Unlike rivers, aquifers do not have any self cleansing capacity especially with respect to aeration. Hence, once polluted they remain polluted for long periods. Therefore, all the households using shallow wells in these zones must be encouraged to use rainwater collected by a recommended rainwater harvesting system until the water supply is provided for this community for drinking and domestic purposes.

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