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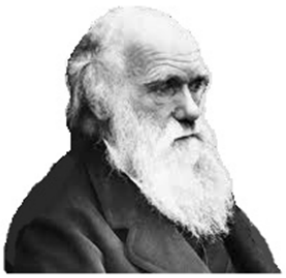

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Identification of Water Quality in Wet and Intermediate Zones in Selected, Sri Lanca: An Analytical Review

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ABSTRACT

This study is based on the analysis of drinking water parameters in selected wet and intermediate zones of Sri Lanka. Unsafe drinking water is one of the main concerns in developing countries. In Sri Lanka, the drinking water quality is a major concern in many places. A series of studies have been conducted in intensive agricultural production areas, namely, Jaffna, Vavuniya, Anuradhapura, Kurunagala and Hambantota. This represents a longitudinal section of Sri Lanka, and the study was done to understand the groundwater quality over the years of 2004 to 2009. Water from selected areas were sampled throughout the villages of this area mostly from open wells and tube wells. The samples were analysed for their chemical quality in order to identify water quality as compared with the Sri Lankan Drinking water standard. For this study, Sodium (Na^+), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Chloride (Cl^-), Sulphate (SO_4^{2-}) and Nitrate (NO_3^-) were analysed. Accordingly, in the Dry Zone, the concentration of the Ca, Mg and Cl are higher than in the Wet Zones. Indeed, some sampling wells in the Dry Zones have extreme concentration of Ca (more than 1000 mg/l) and this is a major threat to the consumers for drinking purposes. In total, of 103 wells, 6 percent of the sampling wells were identified as contaminated, whereas in total, of 96 wells in the Dry Zone, 64 percent of the sampling wells were found to be contaminated due to chemical concentration. We found that rural areas are facing agrochemical-leaching problems into the groundwater, whereas urban areas are facing industrial and biological materials seeping into the ground and surface water bodies.

***Keywords*:** Parameter, groundwater, agrochemical, concentration

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1. INTRODUCTION

Urbanization, industrialization, agriculture activity and various human activities have increased the pollution of surface water & ground water. As the safe & potable drinking water is needed. Various treatment methods are adopted to raise the quality of drinking water. Water should be free from the various contaminations viz. Organic and Inorganic pollutants, Heavy metals, Pesticides etc. as well as all its parameter like pH, Electrical Conductivity, Calcium, Magnesium, Total Hardness, Carbonate, Bicarbonate, Chloride, Total Dissolved Solid, Alkalinity, Sodium Potassium, Nitrate should be within a permissible limit [7, 5]

Lack of water supply is a major concern in developing countries. The Joint Monitoring Programme (JMP) for Water Supply and Sanitation, implemented by the World Health Organisation (WHO) and UNICEF, reports that 783 million people in the world (11% of the total population) have no access to safe water, 84% of whom live in rural areas. About 187 million people use surface water for drinking purposes; 94% of them are rural inhabitants and they are concentrated in sub-Saharan Africa. At a national level, in Chad and Cameroon, it is estimated that 49% and 23% of the population has no access to improved water sources respectively. Regarding the quality of drinking water, chemical contamination is a primary concern of developing countries. In addition, inorganic contaminants, concerning both health and aesthetic aspects, can be present in the waters. Fluoride and arsenic are a great health problem worldwide [1, 2]

Since the discovery of arsenic in Bangladesh, many countries have done at least some chemical testing, but in many cases there is little or no information about arsenic and fluoride in drinking-water. Also other physical-chemical parameters can deteriorate water quality. Heavy metals, like lead, chromium, cadmium and mercury are dangerous for human health, since they are toxic and can be carcinogenic. In spite of this, few studies have been conducted to assess their concentrations in drinking water in developing countries. A monitoring programme executed in Cambodia reported elevated levels of lead, selenium, molybdenum and chromium only in a limited number of cases [3, 4]

Sharaky et al. observed in the groundwater in the Nile delta area concentrations of trace elements lower than the standard limits, except for iron, manganese and nickel. They suggested that iron was most probably produced from iron oxides that occurred in the Pleistocene sediments and that the other trace elements (Zn, Pb, Cd, Cr and Cu) were most probably attributed to secondary minerals in the aquifer rocks. Cobbina et al. showed that in 129 boreholes in the Sahelian region of northern Ghana total iron, manganese, lead, arsenic and fluoride concentrations were above the WHO limits. They suggested that the presence of iron in these boreholes could be due to its percolation from granitic and metamorphosed rocks into groundwater. Turbidity is a typical problem of surface waters and shallow open wells, as observed in the studies done in Cameroon. Nitrate and phosphate causes groundwater quality problems for agricultural areas in Sri Lanka [4, 6]

In Sri Lanka also the drinking water quality is a major concern in many places. 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. Rural areas are facing agrochemical leaching problems in to the groundwater whereas the urban areas are facing the industrial and biological materials, seeping to the ground and surface water bodies.

2. OBJECTIVE

- To analyse of chemical quality in order to identify the contamination problems intermediate and wet zones in selected areas.

3. METHODS AND MATERIAL

The Water Samples were collected from different in plastic Bottles. The Water samples were immediately brought in to Laboratory for the chemical testing of Sodium (Na), Calcium (Ca), Magnesium (Mg), Chloride (Cl), Sulphate (SO_4) and Nitrate (NO_3) and estimated in the Laboratory By using Standard laboratory methods.

To assess the quality of water each parameter was compared with the standard desirable limits prescribed by Sri Lankan accreditation board for the permissible level of drinking water. The result of the chemical analysis was analysed using the MS office Excel software for the comparison of the Sri Lankan permissible level of drinking water and wells, exceeding concentration were identified [10-33].

4. RESULT AND DISCUSSION

According to the analysis in two climatic zones namely dry and intermediate zones the chemicals such as Na, Ca, Mg, Cl, SO_4 and NO_3 were identified in different concentration. Intermediate zones are Nikkawerettiya, Wariyapola, Puttalam mahakeliya, Anamaduwa and the dry zones are Puttalam and Anuradhapura.

The chemical concentration of all sampling wells (Fig. 1) in Nikkewerettiya area are below the Sri Lankan permissible level for the drinking water. The ranges of the Na is -193 mg/l to -158 mg/l. Ca -99 mg/l to -19 mg/l, Mg; -13 mg/l to -29 mg/l. Cl -126 mg/l to -248 mg/l, SO_4 -235 mg/l to -230 mg/l and NO_3 ranges from -42 mg/l to -50 mg/l.

In Wariyapola (Fig. 2) the chemical concentration of the sampling wells range below Sri Lankan permissible level for drinking water, except three sampling wells. Accordingly, for Na; -138 mg/l to -196 mg/l, Ca: -97 mg/l to 22 mg/l (well No: SO 58), Mg; -28 mg/l to 13 mg/l (well No: SO 58), Cl; -248 mg/l to 18 (well No: SO 58), SO_4; -249 mg/l to -208 mg/l and NO_3; -30 mg/l to -30 mg/l. In Wariyapola, only one well (well No: SO 58) has exceeded concentration in Ca, Mg and Cl parameters.

In Puttalam (Fig. 3) Mahakeliya area, Na; -190 mg/l to 133 mg/l, Ca; -95 mg/l to 128 mg/l but 05 sampling wells such as W22, W31, W12, SO35 and W13 have exceeding standard. Mg; -28 mg/l to 29 mg/l whereas wells W22, W13 and W12 have exceeding concentration. For Cl the range is -243 mg/l to 281 mg/l, only one well namely W13 has the exceeding concentration. For SO_4; the range is -250 mg/l to -116 mg/l and NO_3; all the wells have the lower concentration under Sri Lankan standard for drinking water.

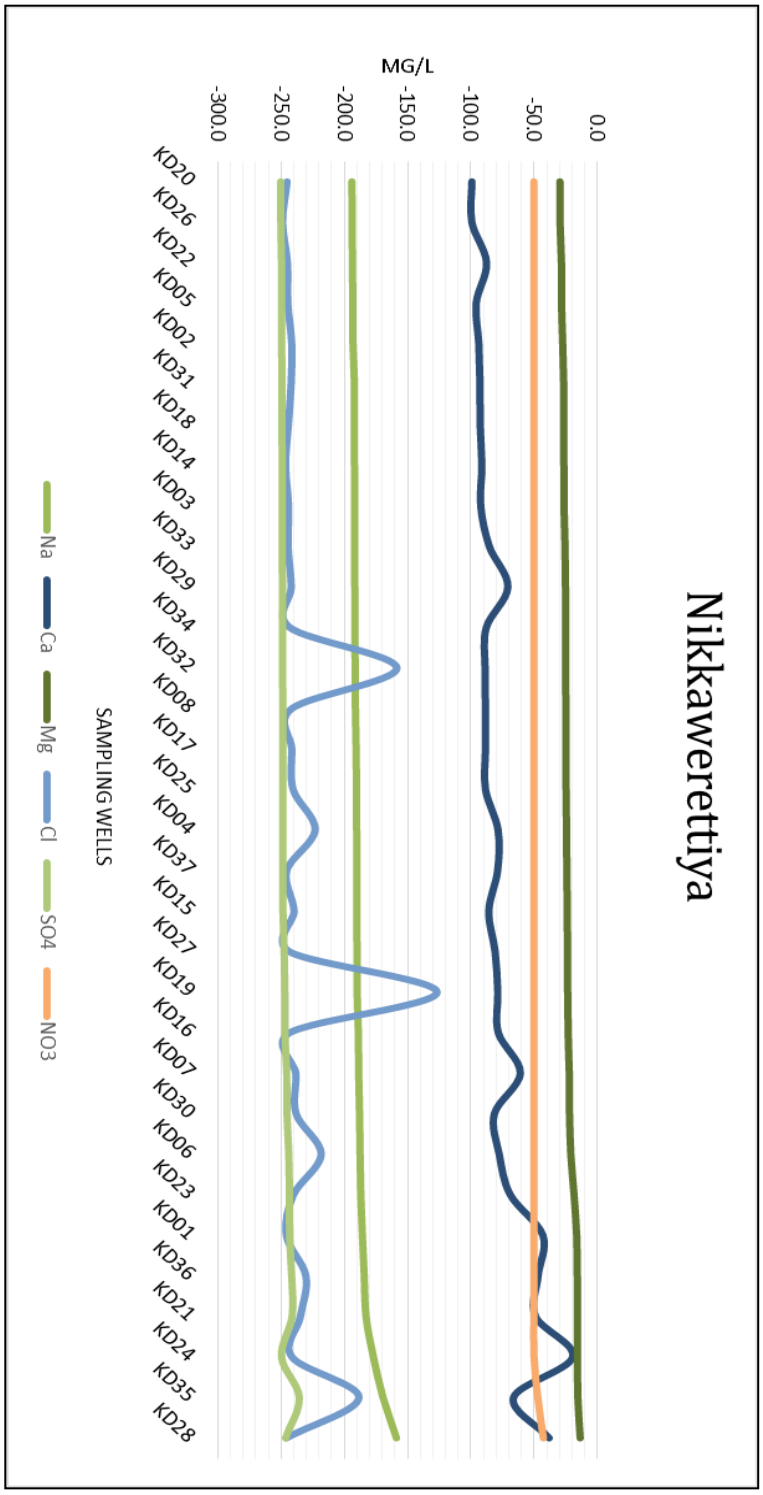

Figure. 1. Chemical concentration in Nikkawerettiya area

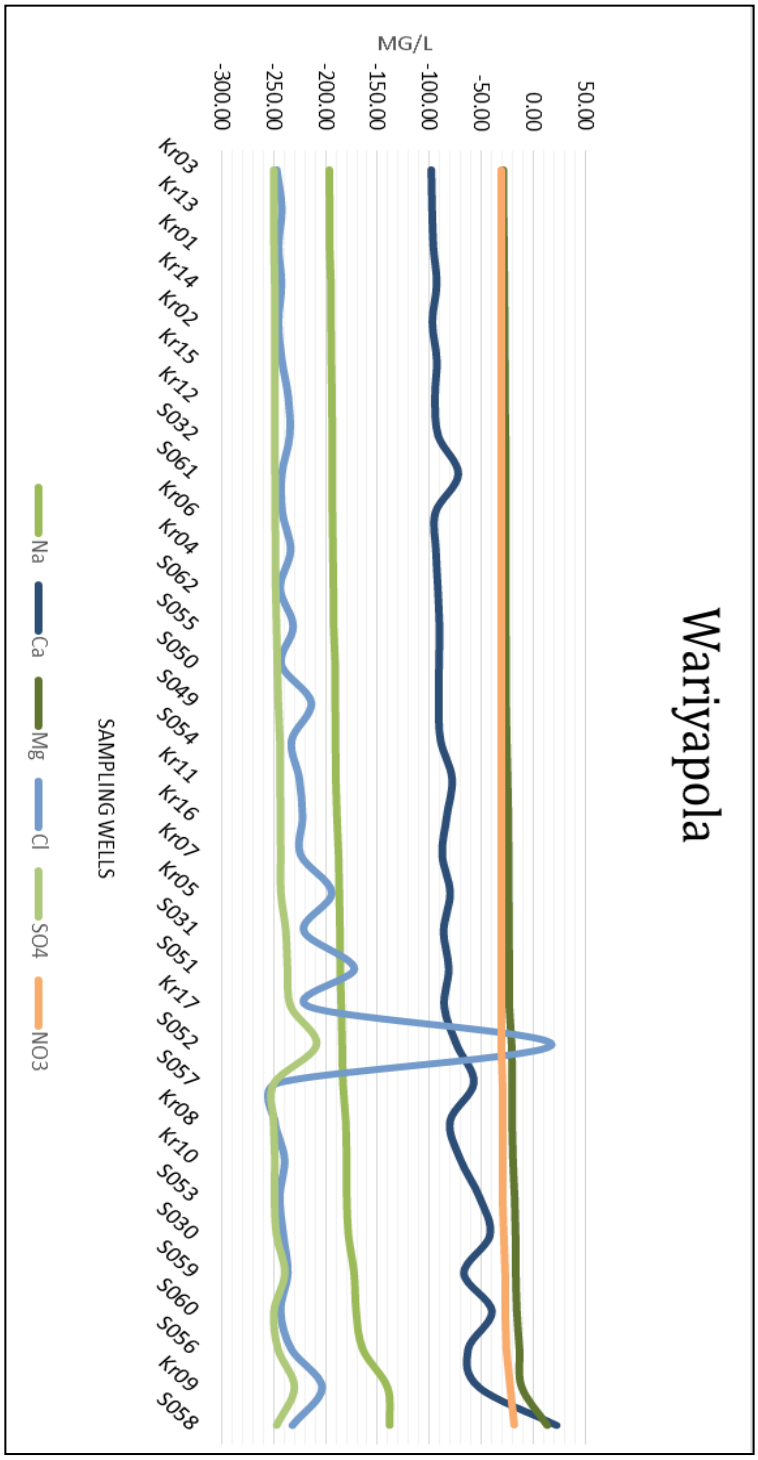

Figure 2. Chemical concentration in Wariyapola area

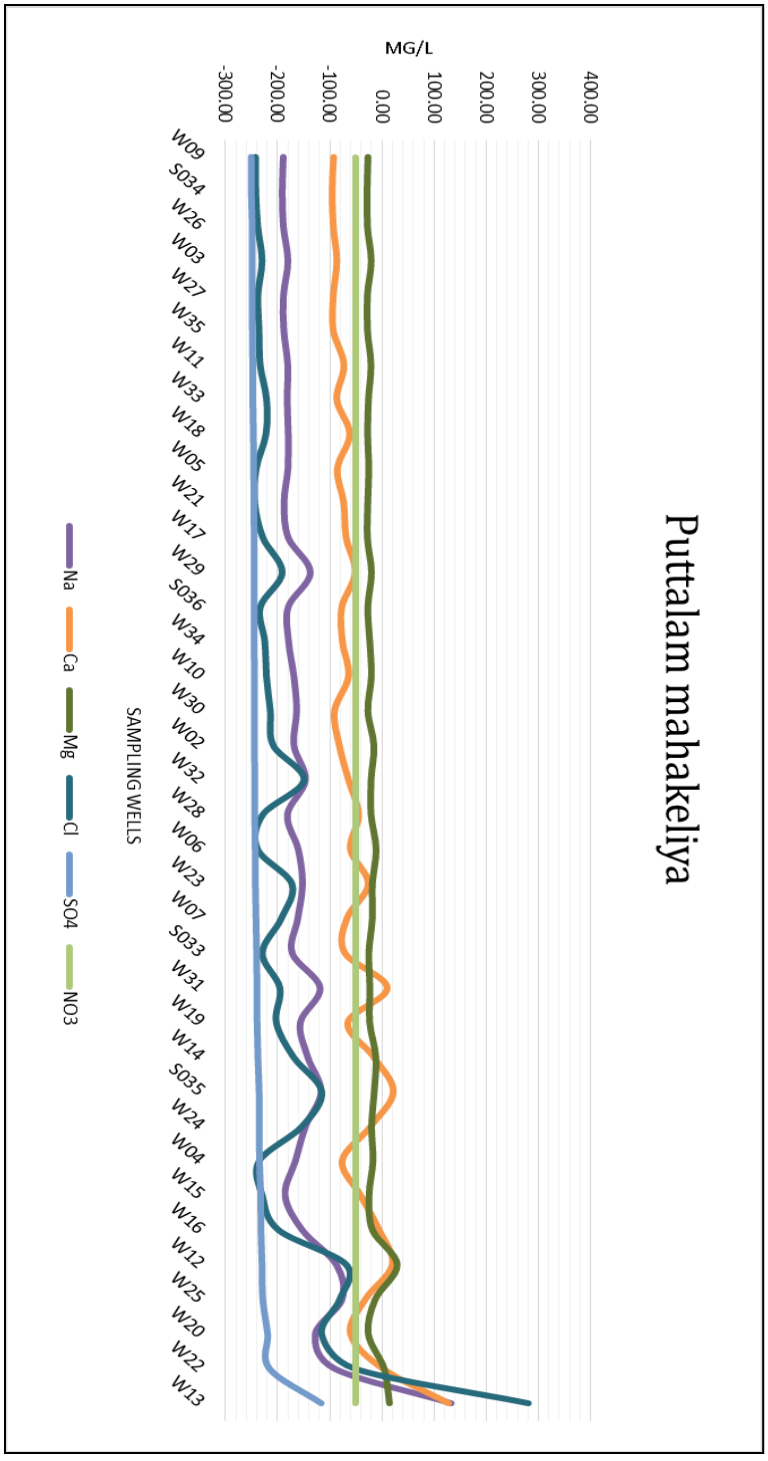

Figure 3. Chemical concentration in Puttalam mahakeliya

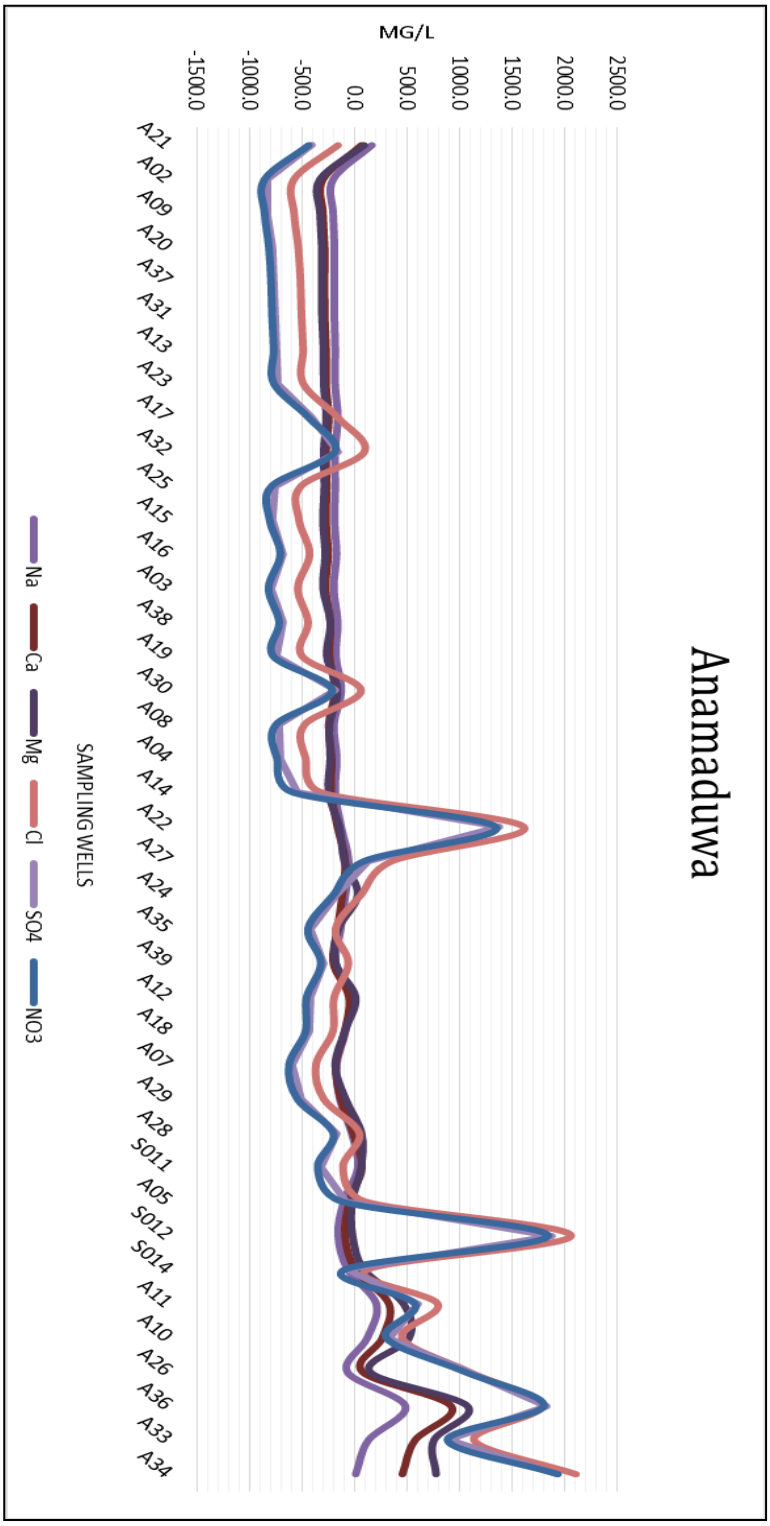

Figure 4. Chemical concentration in Anamaduwa

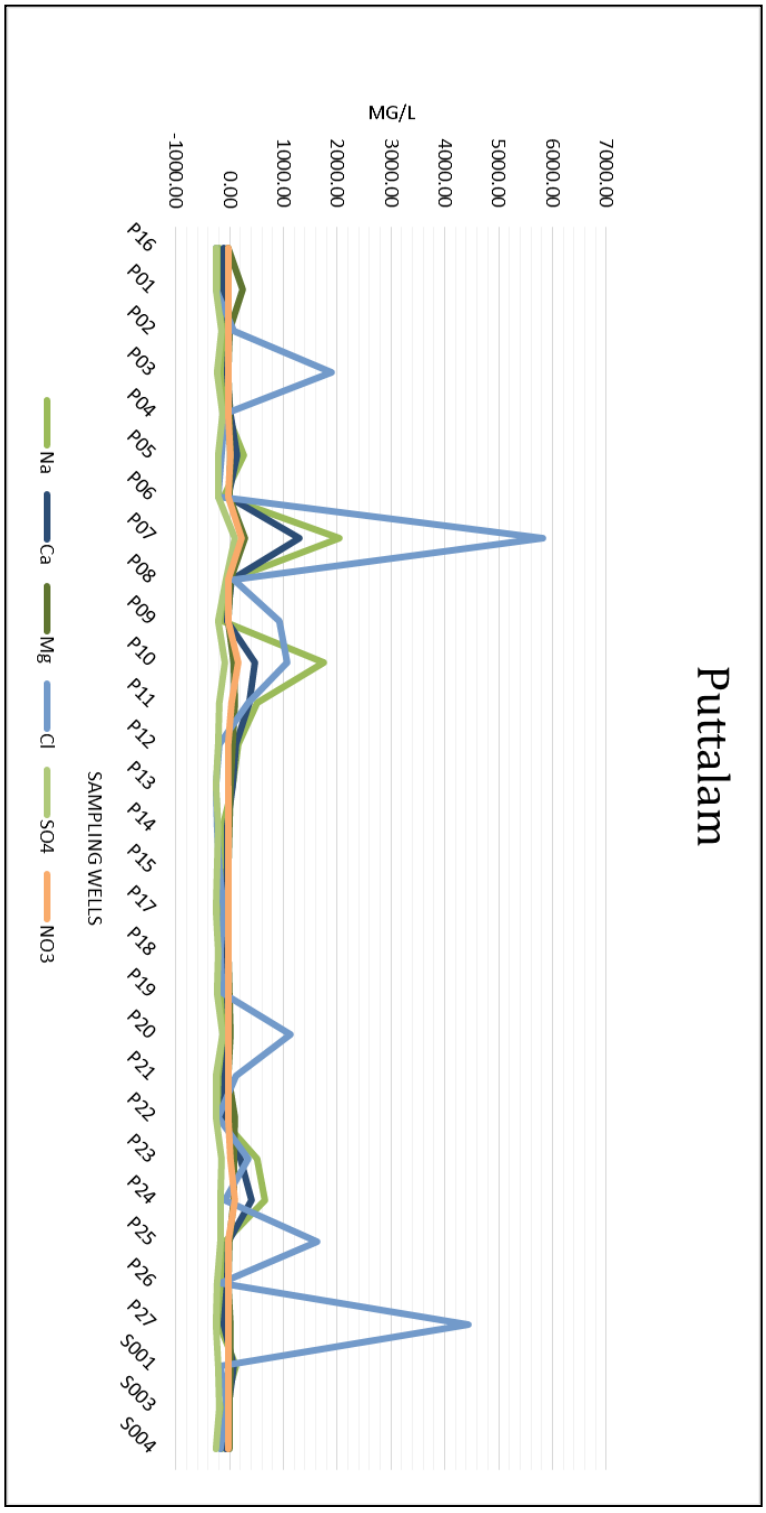

Figure 5. Chemical concentration in Puttalam

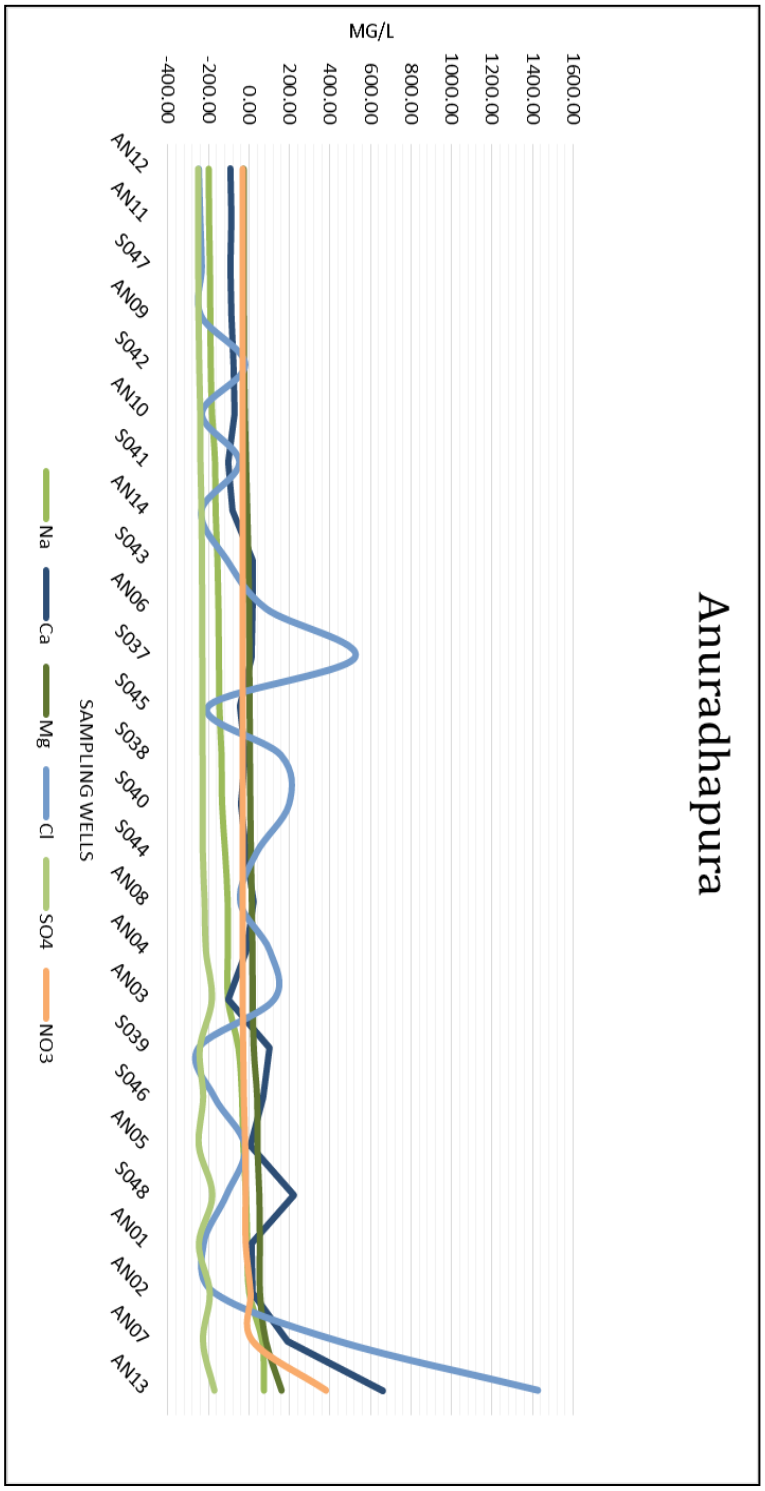

Figure 6. Chemical concentration in Anuradhapura

In Anamaduwa, (Fig. 4) the concentration of the Na ranges from -198 mg/ to 488 mg/l consisting the wells A34, SO11, A10, A33, A21, A11 and A36 have the exceeding concentration. For Ca the range is -100 mg/l to 443 mg/l. 12 wells namely A29, A28, SO11, A05, SO12, SO14, A11, A10, A26, A36, A33, and A34 have the exceeding concentration of Ca. considering the concentration of the Mg; in 40 wells 20 wells have exceeding concentration in the range of -28mg/l to 320mg/l such as A18, A35, A08, A22, A39, A30, A05,A21, A29, A12, A26, SO12, A28, SO14, A11, A24, A36, A33, A10 and A34. The Cl concentration ranges from -248 mg/l to 2078 mg/l containing 15 wells such as A30, A05, A21, A29, A12, A26, SO12, A28, SO14, A11, A24, A36, A33, and A10 have the exceeding concentration. SO_4 ranges from -250 mg/l to 51 mg/l having only one well named A34 exceeded concentration and NO_3; ranges from -30 mg/l to 2 mg/l. Only one well namely A34 has the exceeding concentration.

In Puttalam area (Fig. 5), 10 wells (P08, P13, SO01, P12, P05, P23, P11, P24, P10 and PO7) out of 30 have exceeding concentration of Na within the range from -183 mg/l to 2049 mg/l. Ca ranges from -100 mg/l to 1297 mg/l consisting 12 wells such as P20, P04, P08, P13, SO01, P12, P05, P23, P11, P24, P10 and PO7 have exceeding concentration. Mg ranges -25 mg/l to 289 mg/l and the excessive concentration was identified among wells namely P25, P02, P20, P04, P08, P13, S001, P12, P05, P23, P11, P24, P10 and P07. The concentration of Cl ranges from -248 mg/l to 5831 mg/l and the exceeding concentration among the wells such as P20, P04, P08, P13, S001, P12, P05, P23, P11, P24, P10 and P07. SO_4 ranges from -250 mg/l to 91 mg/l and only one well - PO7 has the exceeding concentration. NO_3; ranges -30 mg/l to 214 mg/l and the exceeding concentration in P05, P23, P11, P24, P10 and P07.

In Anuradhapura area (Fig. 6) the concentration of the Na range from -197mg/l to 75mg/l. in total 26 well 03 wells (AN02, AN07 and AN13) have exceeding concentration. Ca ranges from -100 mg/l to 662 mg/l and the wells exceeding the concentration are S044, AN08, AN04, AN03, S039, S046, AN05, S048, AN01, AN02, AN07 and AN13. Mg ranges from -25mg/l to 162 mg/l and the exceeding concentration in 17 wells namely AN06, S037, S045, S038, S040, S044, AN08, AN04, AN03, S039, S046, AN05, S048, AN01, AN02, AN07 and AN13. Cl ranges from -249 mg/l to 1427 mg/l and 09 wells named AN03, S039, S046, AN05, S048, AN01, AN02, AN07 and AN13 have exceeding concentration. For SO_4 the range is within -250 mg/l to -169mg/l and all the wells have the permissible concentration of the Sri Lankan drinking water standard. NO_3; ranges from -30 mg/l to 381mg/l 03 wells namely AN02, AN07 and AN13 have excessive concentration.

5. CONCLUSIONS

As conclusion of this study, all the sampling wells in Nikkewerettiya area are below the Sri Lankan permissible level for the drinking water. In total 34 wells, 2.9 percent of the sampling wells have been identified as contaminated wells which exceeding the permissible rate in Na, Mg and Cl in Wariyapola area. In Puttalam mahakeliya area in total 37 wells 10.8 percent of the sampling wells have exceeding concentration of the Na, Ca, Mg, and Cl and in 05 sampling wells the Ca is higher rate of other contaminated wells. In Anamaduwa area 55 percent of the sampling wells have high concentration in all chemical and 16 wells are below the permissible rate of Sri Lankan. In Puttalam area, in total 30 sampling wells, 60 percent of the sampling wells were identified as contaminated and 3 percent of the well water have been

contaminated in all chemicals. In Anuradhapura, in total 26 sampling wells 69 percent of the sampling wells have been identified as contaminated. There is no any wells in this area contaminated with SO_4.

In total selected area 03 areas such as Nikkawerattiya, Wariyapola and Mahakeliya in Puttalam areas are intermediate zone and rest namely Anamaduwa, Puttalam and Anuradhapura areas are included in dry zones. In selected area in Dry zone the concentration of the Ca, Mg and Cl are higher than wet zones. Some sampling wells in dry zones have extreme concentration of Ca more than 1000 mg/l and this is a major threat to the consumers for the drinking purposes. In total 103 wells 6 percent of the sampling wells have been identified as contaminated whereas in total 96 wells in dry zone 64 percent of the sampling wells have been contaminated due to the chemical concentration.

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