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SANITATION AND WATER FOR ALL

Chemical quality of groundwater of Rawalpindi/Islamabad

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DRINKING WATER IS vital for all living organism including human beings. Like most part of world, 60% of total water supply in study area comes from groundwater source. Water is present in sufficient amount and being used for drinking, irrigation, and industrial purposes. Usually the person or department exploring and using the groundwater are mostly interested in the amount of water, and its chemical composition and quality is generally of minor interest. Research has shown that chemical composition of ground water has marked impacts on well being of human being. It is not necessary that a person fell ill soon after drinking contaminated water, rather it needs years before adverse affects appears. Often time these adverse impacts are not even recognizable. Similarly to achieve optimum yield from agricultural and industrial activities, water with specific chemical composition is recommended. Use of water with adverse chemical composition and quality (high sodium adsorption ratio) causes salification of agriculture soil, and over period of time rendered it unusable for further use. The rehabilitation of the unusable soil requires expensive treatment. Likewise, use of water with high concentration of certain ions (Polyvalent cations) decrease the efficiency of Industrial units which results in loss of productivity and benefits.

These are some of the reasons why a comprehensive four months program for hydrochemical groundwater investigations in the twin cities of Rawalpindi and Isalamabad was carried out. The main objectives of this study were:

- The chemical classification of ground water of study area based on difference in regional hydrogeology.
- Possible contamination of groundwater due to anthrapogenic activities; untreated domestic and industrial waste discharge in Nallah Lei, which is running all along the project area.
- To give recommendation for the right use of water from right area.

Methodology

Representative Ninety (90) wells, both open and tube wells, were selected for collecting water samples. These well are spread through out the project area. One of the main selection criteria was that the well should be in use. This ensure collection of water sample from non-stagnant water, as stagnant water may change its chemical composition over the time. Sampling density was kept greater, where water chemical composition is expected to vary rapidly. The area of high sampling density corresponds to:

- area with non-uniform geologic formation
- vicinity of untreated waste discharge area e.g., section of Nallah lei located downstream of Waste water treatment plant.

This section of Nallah lei is running through the cantonment area (marked as central area on figures 1 to 6) of Rawalpindi city, which is expected to have contaminated groundwater due to anthropogenic activities.

Water samples were collected in two liter plastic bottles. All the sample were preserved and stored at 20 C^0 before chemical analysis are carried out. Parameters such as Electrical conductivity(EC), pH value, Temperature, and Oxygen content of the samples were determined directly in the field. Rest of the parameters like Calcium, Magnesium, Sodium, Potassium, Sulfate, Nitrate, Chloride, Bicarbonate ions were determine in Laboratory . All parameters were determined using procedures as given in 19th edition of "Standard Methods".

Results and discussion

The water table of the study area is on the average 7 to 15m deep. Wells located on the bank of Nalleh lei shows water table 7-10 m deep, indicating that Nalleh lei serves as a discharge area for ground water. The lowest depth of water table near Nallah lei has led construction of most of the well near vicinity of the area. There is a general groundwater flow towards the center of the basin from Margalla and Murree Hills. The ground water discharges its contents in Kurrange river. The dominate aquifer system of the area is built up by a very hetergenous alluvial fill of alternating layers of clay, silt, sand and gravel which reaches a thickness of more than 200 m in the central part of the plain. Only near the mountain, which is surrounded the basin, carbonatic rocks are present.

Figures 1 to 6 show spatial variation of selected parameter namely, Electrical conductivity, Nitrates, Chloride, Sulphate, Hardness, and Sodium. All these parameter shows increasing trend as water moves from adjoining recharge areas of Margalla and Murre Hills towards center of Basin, which acts as discharge area for ground water. The electrical conductivity (EC-value) showing the grade of water mineralization, are increasing from less than 400 m S/cm nearby the mountains to a maximum of 1200 m S/cm in the center of the basin. Values of other parameters also shows the similar trend with maximum values at the center of basin. High values of Nitrates and chloride at center of basin is alarming, showing intrusion of water from Nallah

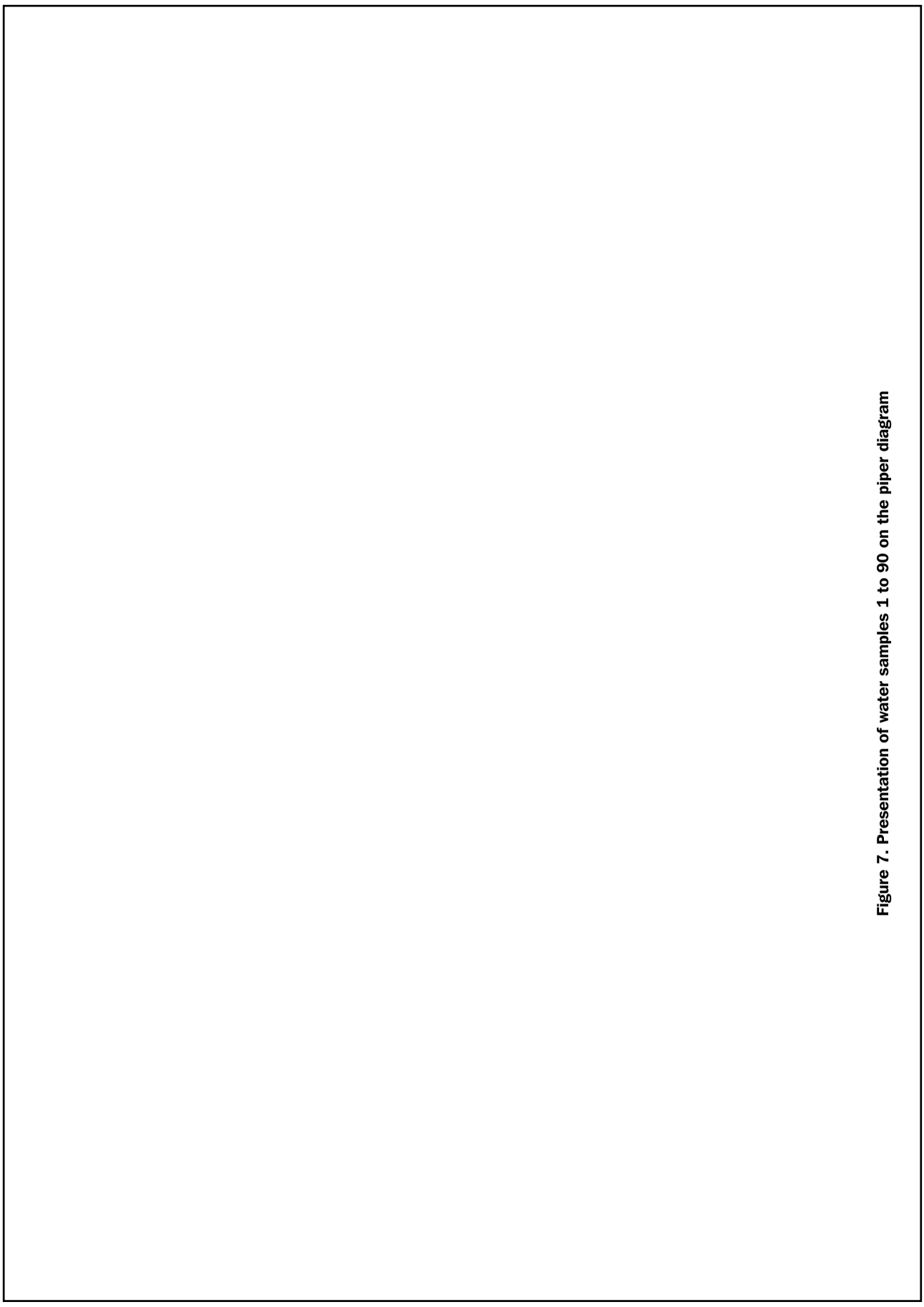

Figure 7. Presentation of water samples 1 to 90 on the piper diagram

lei into the ground water through diffusion and advection processes. Absence of Sulfatic-chloridic rocks any where in project area reinforce the hypothesis that waste content of Nallah Lei is responsible for high values of Nitrate, Chloride, and Sulphate values.

Figure 7 shows chemical classification of ground water after PIPER diagram. The chemical classification shows that groundwater is coming from same aquifer. The groundwater of the project area is normal alkali earth freshwater with medium contents of alkalis with prevailing Hydrogencarbonatic origin.

Recommendation

From the hydrochemical point of view the quality of groundwater in project area, except in central area, is good and fit for human consumption and other uses. The ground water in the central part of Rawalpindi i.e. cantonment area containing high amounts of Nitrate, chloride, and Sulfates and should not be used as drinking water as it is done nowadays. Right away, ground water source shall be abandoned for drinking purpose and alternate source i.e., surface water source shall be developed. Abatement measure against anthrapogenic chemical pollution of groundwater shall be adopted as long term measures and include:

- Stop discharging of untreated sewage in Nallah lei.
- Lining of Nallah lei with suitable material.
- Construction of Sewage treatment plant, for the sewage which is presently being thrown untreated in Nallah lei.
- Treatment of Groundwater before human consumption.

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