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Hydro Chemical Status of Groundwater in Ajmer District

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ABSTRACT

Much of the country has observed high fluoride and nitrate in groundwater. However, systematic studies must be carried out to comprehend the behaviour, meteorological condition and agricultural practices of fluoride and nitrate in natural water. To comprehend fluoride, nitrate presence in groundwater and to infer the chemical factors accountable for fluoride and nitrate dissolution activities in Ajmer District of Rajasthan, this research attempts. A combination of 150 well-water samples was gathered and chemically tested, covering 8,481 km2 (which were further split into 8 blocks). Results of chemical assessments of the allowable 1.5 mg/l limit. In dry to semi-arid environments, chemical weathering with significantly higher alkalinity encourages large levels of fluoride in groundwater. The use of high-fluoride groundwater for drinking is the primary cause of dental as well as skeletal fluorosis in the geographical area of research.

Keywords: groundwater, Ajmer, fluoride, nitrate, pH of water

INTRODUCTION

water is the foundation of existence and a unique gift essential for the people of the world. Of all water resources worldwide, about 97.2% is salty, and just 2.8% is freshwater. Of the 2.8%, about 2.2% is surface water, 2.2%, approximately 77% of water is in glaciers and ice caps, 1% in lakes, rivers and rivers, and 0.6% is groundwater [1]. Of this 0,6% is groundwater, only around 0.3% since the depth is about 800 metres below ground level, it is not accessible. Groundwater for residential, agricultural and industrial purposes is one of the main water sources. It is very essential to handle this resource to satisfy the growing water demand. The geographical and temporal behaviour of groundwater has to be known in many management strategies.

Home and several businesses immediately dump their wastewaters into the public sewers, into the unprotected earth drain and into the pit, where contaminated water flows into the soil and eventually reaches the groundwater. The wells usually are regarded to be the worst kind of groundwater source owing to the absence of a concrete floor and a bordering drainage system attributable to physicochemical pollution [2]. Population overburden, uncontrolled development, unrestrained exploration and dumping of contaminated water at unsuitable locations increase the penetration of hazardous substances into groundwater.

Rajasthan is the biggest state of India, with 10% of the land yet just 1/100 of total rainfall. It just takes 1/10 of the country's average water allocation. Groundwater is deeper and includes compounds that are highly concentrated in minerals and render water undrinkable [3]. The eastern half of the state is semi-desert and hill, thus water supply is similarly restricted in this area. Sadly, the quality of the groundwater in many districts is not compliant with the standard specified. Rajasthan seems to be the only region that has high fluoride in nearly all districts [4]. This paper also discusses nitrate in groundwater that can derive from natural sources or point sources such as wastewater disposal systems and livestock facilities, causing surface water, groundwater and wells to be polluted by percolation. Waste materials are a source of nitrate pollution from groundwater from anthropogenic sources [5]. A significant potential source of nitrate pollution is the surface water runoff from fertilised farms and livestock feedlots. An example of nitrogen pollution of groundwater from the anthropic source is septic tanks. The concentration of septic systems is typically associated with groundwater pollution.

AREA OF STUDY

The district of Ajmer has 8480 square km of land. The whole area was split into eight blocks and in this research we kept the terminology to be consistent and to prevent any misunderstanding. The district's major characteristics include alluvial plains, linear ridges, and pediments, hills with denudation, buried pediments and structural valleys. The Aravalli range with NE-SW trends is the most distinctive geomorphic structure in the western portion, acting as a significant dividing point in groundwater. The Banas is the largest river along with Khari, Sagarmati, Saraswati and Dei, who drain the area as well. The area is located in the semi-arid state region with an average rainfall of 470 mm per year.

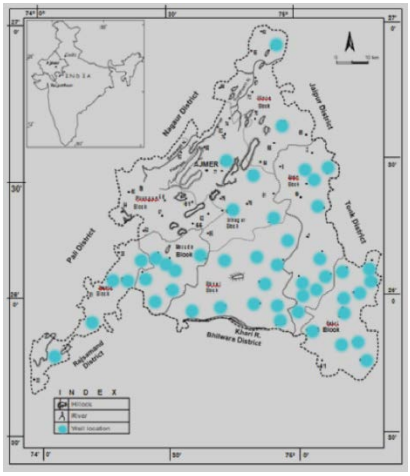

Fig 1: District map of Ajmer indicating groundwater samples location

MATERIAL AND TECHNIQUES MATERIALS

In the pre-monsoon and post-monsoon sessions, groundwater samples have been taken. In pre-cleaned, dry and sterilized plastic bottles with a capacity of one litre, the soil water samples were collected systematically. When tested, the soil water to be collected is completely collected 2-3 times [6]. After 10 minutes of pumping, these water samples are taken. Before analysis, the samples were kept at less than 4°C. Sample evaluation was carried out using analytical grade reagents, and the solution was prepared with twin distilled water. Standard techniques are used in the examination of groundwater samples of different physical-chemical parameters/ Temperature and pH were instantly determined on the site of collection [7].

METHOD OF ION SELECTIVE ELECTRODE:

The ions electrode selective approach is suited for a concentration between 0.1 and 10 mg/L by adding the buffer to free the electrode from most interference, which negatively affects the spectrophotometric technique (alkalinity, chloride, sulphate and residual chlorine). The electrode of fluoride is a selective ion sensor [8]. The key element in the electrode fluoride is the laser type doping lanthanum fluoride crystal, via which fluoride solutions of various concentrations, the sample solution for contacts in one face as well as an internal reference solution are established.

ULTRAVIOLET SPECTROPHOTOMETRIC METHOD:

At a wavelength of 220 nm, this wavelength, which is organically dissolved, also absorbs nitrate. Nitrate is not absorbed in 275 nm, but organic material is absorbed and the disruption due to dissolution of organic materials is thus determined [9].

RESULT AND DISCUSSION

The water chemical between deep and shallow groundwater is very different. In shallow aquifers, the water samples had broad pH values (4.63 to 9.2), with narrower water levels between 7.05 and 8.06. EC in shallow water samples ranges from 254 to 13045 mmhos per cm at 25^{o} C (mean - 2921 mmhos/cm), while greater EC values at 25^{o}C (mean -3692 mmhos per cm) define deeper water samples. Except for fluoride, the anion and cation levels are within the required limits. There is a total hardness of 9.4 to 2548 mg/l in groundwater owing to the presence of alkaline soil such as calcium and magnesium. The content of Ca in samples analysed varies between 8 to 539 mg/l and the concentration of Mg between 2.3 and 488 mg/l. Bicarbonate levels are between 103 and 1498 mg/l (mean - 489 mg/l). There are plenty of significant ions: $Na^{+} > SO_2^{-} > NO^{-} > CO_2^{-} > Cl^{-} > HCO^{-} > SO_2^{-} > NO^{-} > CO_2^{-}$. In the region, a smaller percentage of Cl and mixed waters according to the Piper classification predominate Bicarbonate and Na / K type. Groundwater is usually fresh, hard to very hard, mild to extremely salty, and alkaline in the region.

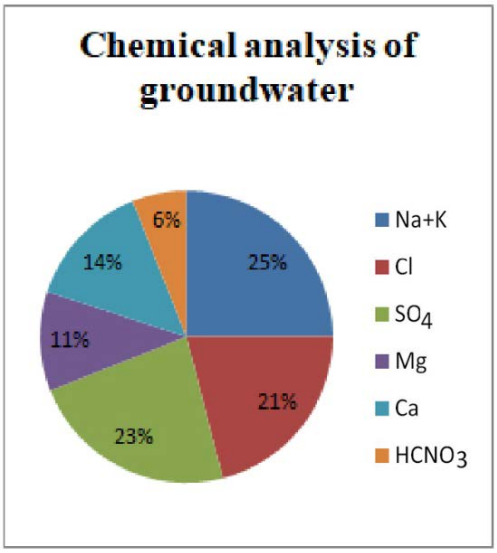

Fig 2: chemical analysis of groundwater in Ajmer

The content of fluoride in flaky aquifer samples varies from 0.11 to 15.8 mg/l (Arain village) at an average of 2.89 mg/l, with a size of 2.87 mg/l. Deeper samples of aquifers range from .98 to 7.87 mg/l (mean -2.69 mg/l) at relatively low F^{-} levels. Only 38% of the wells report F^{-} concentration levels within the allowed limits for open wells. However, the F^{-} concentration

levels within the maximum allowed limit were registered for just 25 per cent of Borewell samples.

Fluoride deposition is very irregular and even over relatively short distances significant variations in concentrations develop. The pre-Monsoon quick review of fluoride distribution demonstrates that F^- is constrained to a limited linear area and isolated pouches at a concentration under acceptable limits of 1.4 mg/l, while higher concentrations can be seen in Bhina, Srinagar and Silora blocks in the masudas, pisangan, kekri, arain and jawajas.

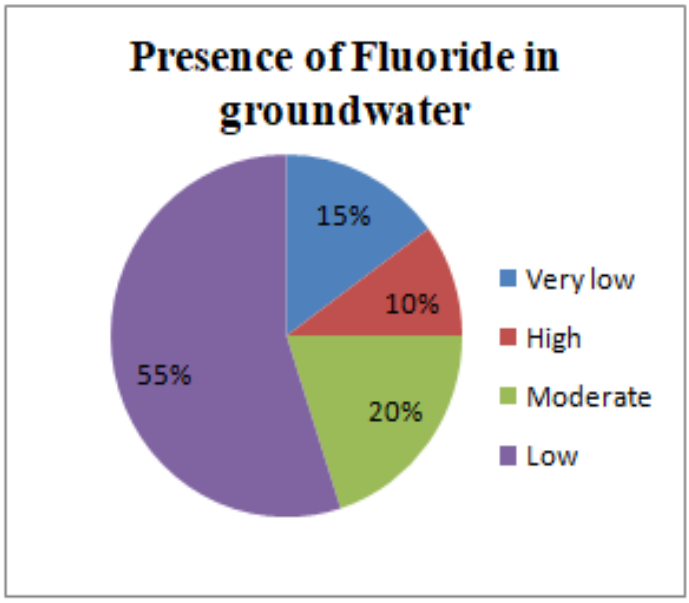

Fig 3: Presence of Fluoride in groundwater

F^- Concentration is similar in all blocks in the district between 1.4 mg/l and 2.98 mg/l. In Silora, Arain, Srinagar, Masuda and Jawaja, higher concentrations have been observed, whereas in Kekri, Bhinai, and Pisangan the lesser concentration was seen. In and around Srinagar, Silora, Masuda and Jawaja blocks, F- concentration over 3.0 mg/l is observed. The isolated blocks of Kekri, Bhinai, Arain, Srinagar, Pisangan, and Silora showed very high F^- contents (>5.68 mg/l. These high values are mainly limited to the east and southeast of the region, which creates drainage regions where schistose and gneissose rocks have been affected. Blocks of F^- over 2.85 mg/l may be regarded as very troubling for drinking water in groundwater. There are various kinds of rocks in the region where groundwater is loaded with fluoride. Schist, gneisses, granites

and quartzites with alluvial deposits are the most important rock formations in the west and southeastern portion of the area. Reservoirs in weathered and cracked areas that occur under unconfined/semi-contained conditions constitute the majority of samples. The amount of F^- in groundwater relies on the quantity and breakdown, fragmentation and dissolution of fluorine-bearing minerals in rock types together with the retention time for the chemical reaction.

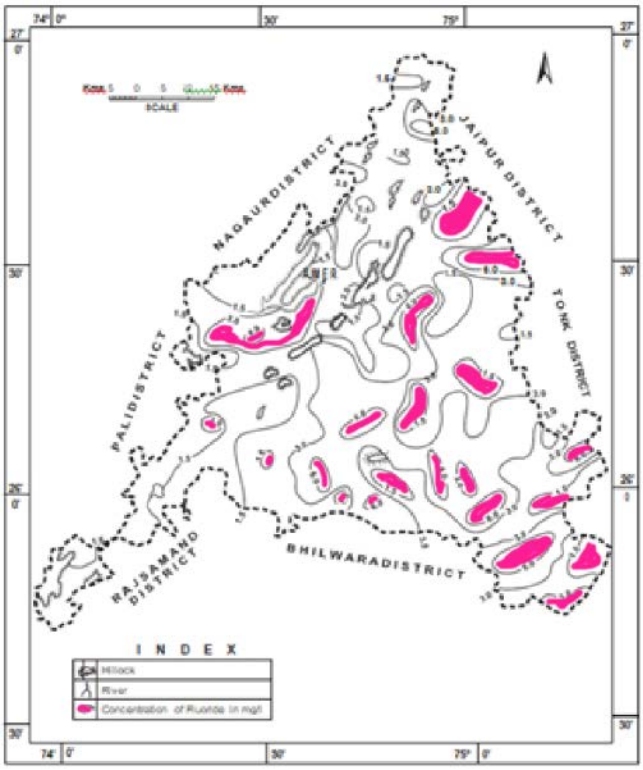

Fig 3: Isofluor map of groundwater in Ajmer district

Groundwater nitrate usually comes from nitrogen sources on the top of the soil or from shallow subsurface zones, which bury abundant waste of nitrogen. Nitrate which enters the water system comes from the trash or fertilisers that are put to the surface of the land as nitrate for certain circumstances. Nitrate comes via organic nitrogen conversion. Ammonification and nitrification processes are processes usually occurring in the soil area above the water table, where organic matter and oxygen is plentiful. Although other nitrogen products exist in the nitrogen cycle, Ground Water's nitrate concentration will likely be regulated by nitrification directly linked to soil microorganisms' ability to transform ammonia to nitrate to provide developing plants with the assailable nitrogen form. Nitrate concentrations are not restricted to solubility limitations in the frequently reported range of groundwater. It travels without change and/or delay with groundwater. In extremely permeable sedimentary or broken rocks, very shallow groundwater

usually contains significant dissolved oxygen and nitrate migrates vast distances from the input regions in these hydrological settings.

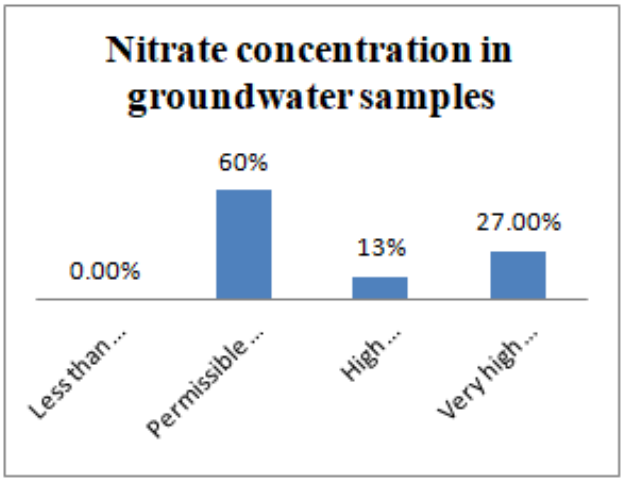

Fig 4: Nitrate concentration in groundwater samples

Nitrate ions may be easily changed from haemoglobin to methemoglobin, a pigment that cannot be an oxygen carrier in the blood. Milk meals prepared for babies containing above 45 mg NO_3/L were well established to be responsible for methemoglobinemia in neonates (blue baby disease). Nitrate is a fairly frequent component, particularly in shallow aquifers, in groundwater. The source is primarily from actions carried out by people.

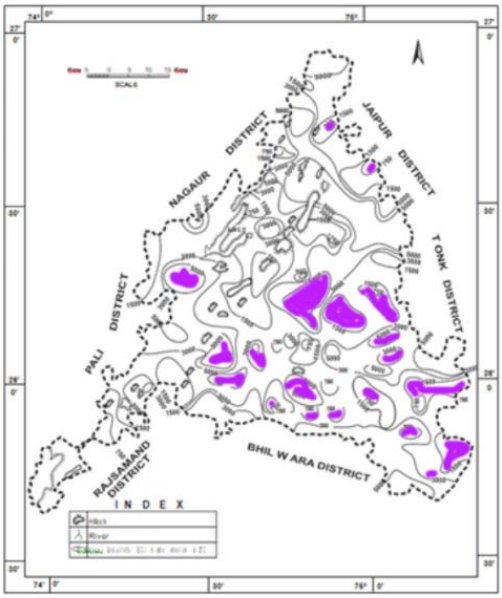

Fig 3: Isoconductivity map of groundwater in Ajmer district

The water used for drinking or other household purposes should not be contaminated physically, chemically and bacterially. The physical nature characteristics of water comprise turbidity, colour, smell, etc. The chemical quality of water is linked to the presence of dissolved water of key chemical components. The substantive chemical quality of groundwater differs everywhere and is assessed mostly based on the 'drinking water norms' established by certain recognized bodies, e.g. WHO, ICMR, UNESCO, ISI and BIS etc. The research indicates that the chemical composition of groundwater changes sometimes, and in many areas of the study region its quality deteriorates. Awareness of negative impacts of quality parameters in rural and suburban populations is important. The residents must avoid direct wastewater dumping to the groundwater. Reverse osmosis deployment, Ion exchange as well as electro dialysis facilities should be developed in regions affected. Uncontrolled use and encouragement of bio-fertilizers application and nitrogen fertilizers must be stopped. Building of wells/tubes in regions with minimal nitrate and fluoride should be encouraged. Ascorbic acid, methionine, and methylene blue supplementation are helpful for resolving the nitrate toxicity issue. Water with high amounts of nitrate may be used safely for washing, cleansing, bathing or any other use in which no water is consumed.

CONCLUSION

Mast sections of the research field exhibit F^- levels in comparison with recharge regions, over the maximum allowed limits (1,5mg/l), with high fluoride soil water. The primary reason for fluorine enrichment in groundwater is the availability of the fluoride-containing minerals in host rocks and their contact with water [10]. The major chemical reactions involved in the mobility and transportation of fluoride into southern water are decomposition, dissociation and dissolution. In dry to semiarid environments, the chemical weathering with relatively high alkalinity and extended interactions seems to favour high fluoride concentrations in soil waters. The research geochemical behaviour of groundwater reveals a low amount of Ca and significant alkalinity in high fluoride groundwater. The primary reason for elevated fluorosis in the area appears to be regular consumption of fluoride heavy groundwater. Mixing dilution, artificial recharge, efficient irrigation and well building are some of the popular, cost-effective fluoride management methods to enhance the health of the population.

Nitrate levels are higher after the mountain than in the pre-monsoon season, which indicates the source in the post-monsoon season from agricultural fertilizer. The nitrate levels were detected in all the groundwater samples within BIT (45-100 mg/L) and the WHO (50 mg/L) permitted limits within the research region. Excess nitrate intake causes mostly methemoglobin (Blue Baby Disease) in infants because of the iron oxidation in Fe (II) to Fe haemoglobin (III). In post-monsoon sulphate, readings are raised from pre-monsoon levels, which indicate greater usage of fertilizers in the post-work season.

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