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Hydrogeological Scenario in Kashmir Valley with Special Reference to Water Level and Water Quality of Phreatic Aquifer

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ABSTRACT

The *present* paper discusses the changing hydrogeological scenario in Kashmir Valley & its impact on ground water regime. *The paper also discusses the regional behavior of water levels in phreatic aquifers for the period of May 2009 and November 2009 with seasonal fluctuation. The results of the chemical analysis of water samples collected in May,* indicates that the water is fresh and potable. *The result of chemical analysis of phreatic (shallow) aquifer is also discussed*

Keywords: Phreatic aquifer, NHNS, water level, fluctuation.

INTRODUCTION OF STUDY AREA

Geology

Lying between the longitudes 33025'N and 34032'N and latitudes 7400'E and 75030'E, the high altitude valley of Kashmir is an ovoid basin with a nearly flat floor of around 4920 km2 and is existing between the lesser and greater Himalayas. The vale of Kashmir with tectonic origin is 135 km long and 45 km broad at its middle, lying as an oval bowl between the Zanaskar range to the North and Pir Panjal range to the South. Most of the valley lies at an elevation of just over 1500 m, though its floor rises steadily from northwest to southwest (Wadia, 1966). The tectono-geomorphic setting of the Kashmir Valley reveals that due to rise of the Pir-Panjal Range, the primeval drainage was impounded as a vast lake in which the sediments of Karewa Group were deposited as intermontane valley fill deposits (Dar *et al,* 2013). Kashmir Valley is an

intermountain valley fill, comprising unconsolidated gravel sand and mud succession known as Karewas divided into two stages, lower and upper, representing argillaceous and arenaceous facies respectively.

Geologically the strata that compose the low lying areas of kashmir valley are favorable for the occurrence of groundwater (Ahmed and Ahmed, 2013). This formation of Plio-Pleistocene age lies discomformably over the older rocks ranging in age from Cambrian to Triassic.

Formation	Age
Alluvium	Sub Recent -Recent
rewash	Plio-Pleistocene
Lime stone	Triassic
Panjal Volcanics	Paleozoic
Agglomeratic Slate Series	Late Carboniferous to early Permian
Muth Quartzites	Late Silurian to Early Devonian

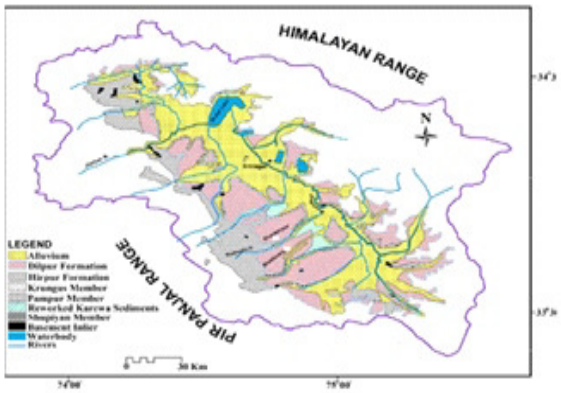

Figure1: Geological map showing distribution of Karewa Group of Sediments modified after Bhatt, 1982

Hydrogeology

Kashmir valley has rich deposits of ground water in both confined and unconfined aquifer system, but its occurrence is highly uneven due to diverse geological formations (Singh and Sharma, 1999). Despite its vastness and significance, groundwater in Kashmir Valley has received very little attention regarding estimation of quality, quantity, conservation and management (Jehangir *et. al,* 2011). Hydrogeologically, the Geological formations of Kashmir valley can be classified into two categories (GWIB, 2009)

a. Hard or consolidated formation: Hard or consolidated formations comprising of granites, slates, quartzites, traps, limestones etc belonging older than tertiary age. Ground water in consolidated formation occurs in secondary porosity in the form of fractures and joints. Yield potentiality of these formation is very limited with varying discharges, because of highly jointed and fractured nature of these formations, these area form very good recharge zones and recharge the aquifers underlying the Karewas formation in valley areas.

b. Unconsolidated formation: Unconsolidated formation comprising of clay, silt, sand, gravels and boulders etc belonging quaternary to recent in age. The Karewas Basin in the Kashmir Himalayan preserves a record of sediment fill in an intermontane basin (lake) formed during the Late Neocene to Quaternary period in which the sedimentation is controlled the tectonic events. The main water bearing horizons in Kashmir basin are mainly Karewa succession except a marginal area of piedmont zone along the hills. The aquifer in Upper Karewa formations and at few places thin sand horizons and boulders occurring in Lower Karewas formations are main water aquifers in the area, Discharge of tube wells generally ranges from 238 LPM to 4164 LPM

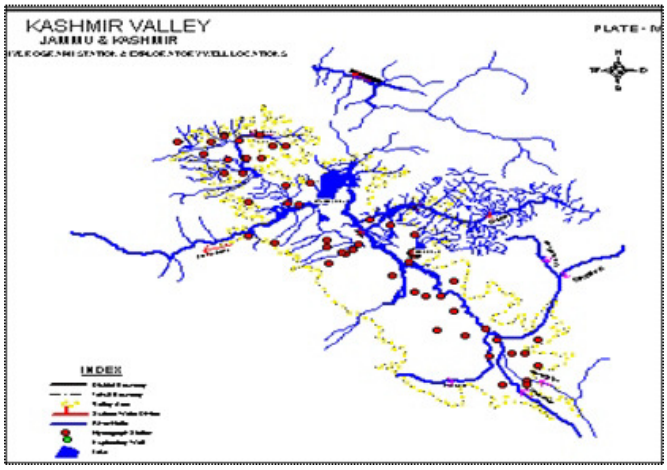

Figure 2: Kashmir valley map showing drainage and Monitoring/sampling locations

METHODOLOGY

Twenty five hydrograph stations were monitored and samples were collected from the phreatic aquifer during pre monsoon period of 2009, all across the Kashmir Valley in pre-rinsed HDPE bottles (Scalf, *et al.,* 1987). Water samples were filtered with 42 µm filters and collected in two sets. One set was immediately acidified with concentrated HNO_3 to maintain the pH of the samples. All the chemical constituents were analysed following standard methods (APHA1995). Field parameters like Temperature, electrical conductivity (EC) and pH were measured in field itself using a potable water analysis kit.

Carbonate and Bicarbonate are determined titrimertrically (acid base titration). Chloride is determined by titrating with silver nitrate. Total Hardness, Calcium and Magnesium are determined titrimertrically using standard EDTA solution. Sulphate is determined by using turbidity meter. Nitrate and Fluoride are estimated by using Spectrophotometer. The alkali metals Sodium and Potassium are determined by Flame photometer (Systronics).

The water level data of monitoring stations Kashmir Valley was analyzed using the

dedicated software 'GEMS' and water level contours were plotted by using MapInfo & Vertical Mapper software by 'natural neighborhood' interpolation method. The map shows the spatial and temporal variations of the parameters in the area.

DISCUSSIONS

Ground Water Behavior

The water level behavior in the Kashmir valley is entirely different from the other parts of the country. This is mainly because of the fact that 60 to 70% of the precipitation is received in the form of snow during December to February while March & April are the months of heavy rainfall. May to September are relatively dry months. Hence recharge to the ground water takes place in the valley in the months of April to June with melting of snow and with the beginning of rainfall. Therefore water level shows trends of rising from April (summer) onwards and falling from August onwards.

Table1: Water level data of NHS wells with fluctuation

S.No	Name of the well	May-09	Nov-09	Fluctuation
1	Sambura	3.42	6.12	2.7
2	Pampora	6.5	6.16	-0.34
3	Zeewan	4.13	4.62	0.49
4	Regal Chowk	2.81	5.67	2.86
5	Mirgund	1.6	3.85	2.25
6	Sangrama	1.33	2.09	0.76
7	Udipora	1.26	4.35	3.09
8	Langyt	1.65	7.83	6.18
9	Chowgal	1.16	4.34	3.18
10	Sopor	0.64	2.2	1.56
11	Azmathpora	0.6	1.39	0.79
12	Bomai	1.21	2.62	1.41
13	Gulgam	2.77	4.21	1.44
14	Kupwara	2.71	5.41	2.7
15	Drugmulla village	1.6	4.41	2.81
16	Panzgam	1.98	3.2	1.22
17	Dolipur	1.6	4.6	3
18	Magam	1.9	4.85	2.95
19	Trehgam	2.8	6.46	3.66
20	Warsu	4.57	5.2	0.63

In pre-monsoon (May 2009), about 57% of the total hydrograph stations come in the water level range of 0-2 m bgl. About 28% comes in the water level range of 2-5 m bgl, 4% in the range of 5-10m , 10-20m and >20 m bgl. The data is shown the thematic layer as below.

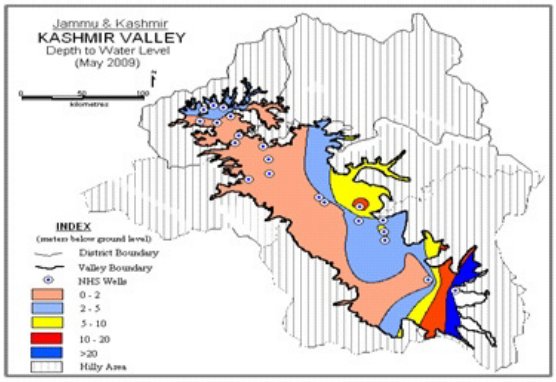

Figure 3: Kashmir valley map showing DTW in May 2009

In post monsoon (November 2009), about 2% of the total hydrograph stations come in the water level range of 0-2 m bgl. About 11% comes in the water level range of 2-5 m bgl, 6% in the range of 5-10m and 2% comes in the range of 10-20m bgl. The data is shown the thematic layer as below.

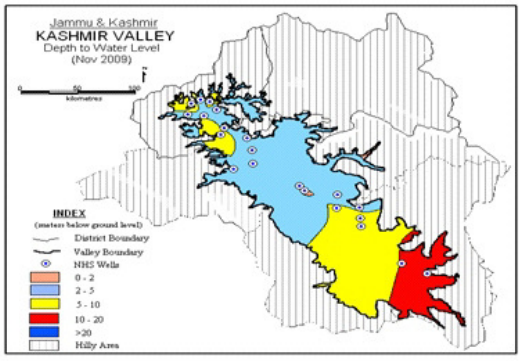

Figure 4: Kashmir valley map showing DTW in November 2009

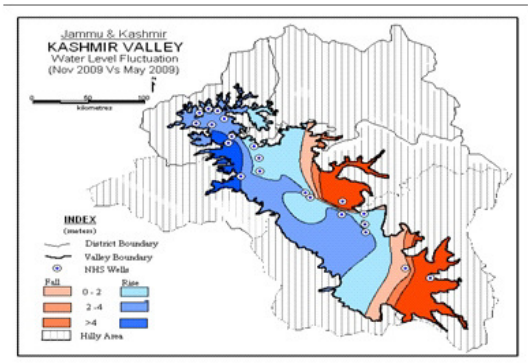

Figure 5: Kashmir valley map showing Fluctuation

Chemical Behavior

For interpretation of Hydrochemistry of Kashmir valley, water sample collected from shallow aquifer and analyzed. Water quality parameters of shallow aquifer are summarized in table given below.

Table 2: Water level data of NHS wells with fluctuation

S. No.	Water Quality Parameters	Location	
		Minimum	Maximum
1	pH	6.9 Kangan (Pulwama)	8.80 Kadalbal Sufi Mohlla
2	Electrical conductivity µmhos/cm at 25ºC	97 Udipora (Kupwara)	2800 Pampore (Pulwama)
3	Bi carbonate (mg/l)	49 Udipora (Kupwara)	708 Gundemacher(Kupwara)
4	Chloride (mg/l)	04 Dholipora(Baramulla)	273 Pampore (Pulwama)
5	Nitrate (mg/l)	0.48 Regal Chowk (Srinagar)	394 Pampore (Pulwama)
6	Fluoride (mg/l)	0.01 Regal Chowk (Srinagar)	1.00 Malingpur (Anantnag)
7	Sulphate (mg/l)	02 Sodipura (Anantnag)	260 Pampore (Pulwama)
8	Calcium (mg/l)	12 Udipora (Kupwara)	174 Gundemacher(Kupwara)
9	Magnesium (mg/l)	2.6 Rambelpur (Anantnag)	193 Pampore (Pulwama)
10	Sodium (mg/l)	2.0 Udipora (Kupwara)	160 Pampore (Pulwama)
11	Potassium (mg/l)	0.2 Telbal (Srinagar)	215 Kadalbal Sufi Mohlla
12	Total Hardness as $CaCo_3$ (mg/l)	42 Udipora (Kupwara)	871 Pampore (Pulwama)
13	Iron (mg/l)	0.03 Zakura (Srinagar)	5.72 Sadipur (Pulwama)

RESULTS

Hydrogeology

- The water level data from phreatic aquifers revels that the water levels are shallow in the month of May. Deeper water levels are reported in the month of November.

- Water level ranges from 0.6m bgl (in Azmathpora) to 6.5 m bgl (in Pampora) in the month of May 2009.
- Similarly Water level ranges from 1.39m bgl (in Azmathpora) to 7.83m bgl (in Langyt) in the month of November 2009.
- As the water levels are very shallow, most of the water levels are shown in the range of 0-2m bgl in May 2009. 12 numbers of wells falls in 0-2m bgl, 7 wells in 2- 5m bgl and 1 well in the range of 5-10m bgl.
- In November, as the water levels have gone down, 1 well falls in the range of 0- 2m bgl, 12 wells fall in the range of 2-5m bgl and 7 wells fall in the range of 5-10m bgl.
- When the water level data for May 2009 was compared with November 09, it was revealed that 8 wells have shown rise in water level from 0-2m, 10 wells have shown rise from 2-4 m and only 1 well have shown rise more than 4m.

Hydrochemistry

- The chemical analysis shows that the water is fresh and potable.
- The value of pH shows that shallow ground water is alkaline in nature. Its ranges from 6.9 (Kangan) to 8.80 (Kadalbal Sufi Mohlla).
- Electrical conductivity value ranges from 97µmhos/cm (Udipora) to 2800 µmhos/cm (Pampore).
- Bi-carbonate value ranges from 49mg/l (Udipora) to 708mg/l (Gundemacher).
- Chloride value ranges from 04mg/l (Dholipora) to 273mg/l (Pampore).
- Nitrate value ranges from 0.4mg/l (Regal Chowk) to 394mg/l (Pampore) and shows that Pampore's shallow water exceeding the permissible limit. For nitrate permissible limit is 45 mg/l for drinking water standard set up by BIS.
- Fluoride value ranges from 0.01mg/l (Regal Chowk) to 1.00mg/l (Malingpur) and

shows that concentration of fluoride is within permissible limit (1.5 mg/l) for drinking purpose (BIS)

- Sulphate value ranges from 02 mg/l (Sodipura) to 260mg/l (Pampore) and shows that the concentration of sulphate in shallow aquifer is within the maximum permeable limit (400 mg/l)
- Calcium value ranges from 12mg/l (Udipora) to 174mg/l (Gundemacher).
- Magnesium value ranges from 2.6 mg/l(Rambelpur) to 193mg/l (Pampore).
- Sodium value ranges from 2.0 mg/l (Udipora) to 160mg/l (Pampore).
- Potassium is also important parameter for quality aspect. In shallow aquifer potassium value ranges from 0.2mg/l (Telbal) to 215mg/l (Kadalbal Sufi Mohlla).
- Harness of water is the capacity to neutralize soap and is caused by carbonate and bicarbonate of calcium, magnesium. In shallow aquifer total hardness value ranges from 42mg/l (Udipora) to 871mg/l (Pampore).
- Iron value ranges from 0.03mg/l (Zakura) to 5.72mg/l (Sadipur) and shows that the maximum concentration of iron 5.72 mg/l (Sadipur) is exceeding the maximum permissible limit (1.0 mg/l) of BIS for drinking water purposes.

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