QUALITY OF GROUND WATER RESOURCES OF BARAMULLA DISTRICT OF KASHMIR

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ABSTRACT

Ground water samples were collected from nine bore wells and one dug well in Baramullah district of J&K during spring and summer, 2005 to assess the quality of water. Analysis revealed that pH, Ca^{2+}, Mg^{2+} and Na^{+} content of these ground waters were within the permissible limits, while conductivity exceeded the limit set by W.H.O. Sodium hazard or sodium adsorption ratio (SAR) ranged from 0.29meq/l to 2.04 meq/l and as such all samples conform to low sodium hazard (S_1) category. However, the higher conductivity values (range 1029 - 1543µS) place the ground water sources into high salinity hazard category (i.e. C_3).

Keywords: - Kashmir Himalaya, ground water quality, sodium hazard, salinity hazard

INTRODUCTION

Ground water is generally considered to be pure and safe to drink as it does not get contaminated by the pollutants released into the environment by human activities. However, the ground water quality can easily get deteriorated due to its continuous interactions with the subsurface environment, whereby it dissolves, transports and deposits mineral matter. This process can be intensified when polluted surface water seeps through soil and reaches ground water. Under these circumstances it is worthwhile to have an insight into the physico-chemical characteristics of a ground water source so that the negative impacts if any on the human society by these ground water sources can be prevented well in time.

Although a number of workers have worked on the quality of ground water sources in different regions, viz., Tripathy and Panigrahy (1999); Ahmed *et al.* (2000); Tripathy (2003); Jain *et al.* (2004); Sharma *et al.* (2005), but the information about ground water sources of

Kashmir (Dubey and Amin, 1982; Bhat and Yousuf, 2002; Jeelani, 2004; Pandit et al. 2005) is very scanty. It was therefore decided to have a detailed investigation on ground water sources of the valley to assess their portability. The present paper is based on a part of the data collected during this study and reports on the quality of ground water in Baramulla district in J&K.

MATERIAL AND METHODS

The area under investigation is located within the co-ordinates of 34°-15'N 34°-28'N and 74°-30'E 74°-45'E. Nine bore wells and one dug well, each provided with hand pump, were selected for the study (Table 1). The water samples were collected in 2 liter plastic bottles (previously cleaned with 10% HNO_3 followed by distilled water) during spring and summer 2005. Prior to the collection of samples, hand pumps were flushed for 5-10min. Collected samples were analyzed for pH (digital pH meter MKVI), Conductivity (digital conductivity meter DB 104), Ca^{++}, Mg^{++} (EDTA titrimetric method), and Na^{+} ions (flame photometer Systronics 130) according to standard methods described in APHA (1998). Sodium Adsorption Ratio (SAR) was calculated by the formula proposed by Richards (1954).

i.e.,

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

All values are expressed in meq/l and represent the index of sodium Hazard (S). Salinity hazard (C) was calculated by using conductivity as an index at 25°C.

Table 1. List of Bore wells/dug well surveyed

SAMPLING SITES	LOCATION / AREA
I	Mirgund
II	Pattan
III	Tappar
IV	Haigam
V	Sangrama
VI	Chandsuma
VII	Baramulla Town
VIII	Azadgunj
IX	Sopore Town
IX	Allahabaad

RESULTS AND DISCUSSION

Changes in physical and chemical characteristics of the ground water in the area are greatly influenced by its meteorological and topographical settings. Besides, geology of the area also affects the ground water chemistry. The data obtained on the water quality parameters are depicted in Table 2. The pH ranged from 6.74 to 7.33 for Site IX and Site I respectively and all samples are well within the permissible limits of WHO (1993). Conductivity values ranged from 1029 µS (Site I) to 1543 µS (Site IX) and all the samples except Site VI and Site IX were within the permissible limits set by WHO (1984). According to Langengger (1990) the importance of electrical conductivity is its measure of salinity, which greatly affects the taste and thus has a significant impact on the user's acceptance of the water as potable. Total hardness of the samples ranged from 260mg/l (Site I) to 564 mg/l (Site VI) and all samples except Site VI and Site IX were within permissible limit. Sawyer & McCarty's classification of hardness for ground waters (c.f. Bell, 1998) places all the water samples, except that of Site I, in very hard category (i.e., total hardness > 300 mg/l). Ca^{++} content ranged from 61.2 mg/l (Site I) to 164 mg/l (Site X). Though all the samples with the exception of Site I had Ca^{++} much higher than the desirable limit, yet all the samples fall within the permissible limits of WHO (1993). Mg^{++} content ranged from 26.03 mg/l for Site I to 39.41mg/l for Site VI. The water samples of Site VI, VII and IX showed values much higher than the desirable limit set by WHO (1993). Na^{+} ions varied between 13.0 mg/l (Site IV) to 76.5 mg/l (Site I), and the values were within the permissible limits (WHO, 1993).

Sodium Hazard (S)

The data regarding the SAR are presented in Table 3. The mean SAR values ranged from 0.29 meq/l for Site IV to 2.04 meq/l for Site IV, indicating that all the samples fall under low Sodium Hazard (S_1) category of ground waters for irrigation (Richards, 1954). The low SAR values seem to be due to the presence of significant quantities of divalent cations like Ca^{++} and Mg^{++} which are more strongly bonded and tend to replace monovalent ions like Na^{+} by way of ion-exchange capacity (Fetter, 1994; Todd, 2003).

Salinity Hazard (C)

According to Wilcox's (1955) classification of waters for irrigation on the basis of conductivity, all the samples fall under the permissible category (Table 4). However, when the salinity hazard (C) was computed on the basis of sodium adsorption ratio (SAR) and conductivity values (Fig. 1), all the samples were found to belong to high salinity hazard category and are not fit for irrigation purposes, as such waters may lead to changes in soil structure, permeability, aeration and deflocculation, which eventually affects plant growth (Todd, 2003).

Table 2. Mean values of different parameters and their comparison with standards

Parameters	SITES										WHO Standards	
	I	II	III	IV	V	VI	VII	VIII	IX	X	Desirable	max. permissible
pH	7.33	7.09	7.16	6.99	7.12	6.93	7.05	7.25	6.74	7.10	6.5	8.5
Conductivity (IS)	1029	1257	1050	1154	1161	1476	1187	1058	1543	1368	1400	
T. Hardness (mg/l)	260	470	481	398	434	564	457	417	543	432	150	500
Ca^{++} (mg/l) 61.2	144	148.4	116	124.4	160.8	128.8	120	152.8	164	75	200	
Mg^{++} (mg/l) 26.03	26.76	26.76	26.27	29.92	39.41	32.84	28.46	39.17	29.68		30	150
Na^{+} (mg/l) 76.5	42.5	32.5	13.0	29.5	65.0	24.0	30.0	57.0	28.0		200	

Table 3. Mean values of Sodium Adsorption Ratio

Sampling Sites	SAR VALUE (meq /l)		
	Spring	Summer	Mean
I	1.91	2.16	2.04
II	1.08	0.57	0.83
III	0.40	0.87	0.64
IV	0.16	0.42	0.29
V	0.39	0.83	0.61
VI	1.06	1.32	1.19
VII	0.39	0.57	0.48
VIII	0.64	0.63	0.64
IX	1.09	1.02	1.05
X	0.67	0.37	0.52

Table 4. Mean of conductivity values

Sampling Sites	Conductivity (µS)		
	Spring	Summer	Mean
I	864	1194	1029
II	1325	1188	1257
III	1032	1068	1050
IV	925	1382	1154
V	1037	1284	1161
VI	1345	1607	1476
VII	1003	1330	1167
VIII	903	1212	1058
IX	1307	1778	1543
X	1227	1509	1368

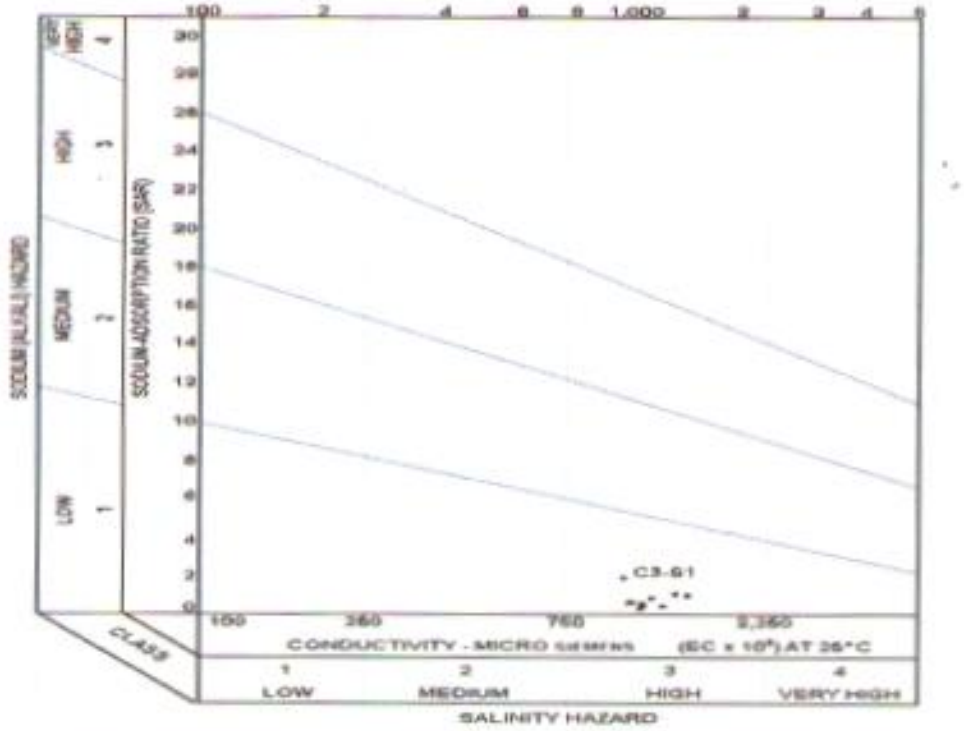

Fig 1. Classification of ground water for irrigation use (USSI, 1854)

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