Annual Changes in Some Qualitative Parameters of Groundwater in Shirvan Plain North East of Iran

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***Abstract*—**Shirvan is located in plain in Northern Khorasan province north east of Iran and has semiarid to temperate climate. To investigate the annual changes in some qualitative parameters such as electrical conductivity, total dissolved solids and chloride concentrations which have increased during ten continuous years. Fourteen groundwater sources including deep as well as semi-deep wells were sampled and were analyzed using standard methods. The trends of obtained data were analyzed during these years and the effects of different factors on the changes in electrical conductivity, concentration of chloride and total dissolved solids were clarified. The results showed that the amounts of some qualitative parameters have been increased during 10 years time which has led to decrease in water quality. The results also showed that increased in urban populations as well as extensive industrialization in the studied area are the most important reasons to influence underground water quality. Furthermore decrease in water quantity is also evident due to more water utilization and occurrence of recent droughts in the region during recent years.

Keywords—Chloride, Electrical Conductivity, Shirvan, Total Dissolved Solids.

I. Introduction

TODAY, work on water quality is more necessary compared to the past because of increase in population and increase in water utilization. Especially in the regions with arid and semi-arid climates which are confronted with water as well as soil salinizations. The investigation on water quality is important to prevent these problems . One of the most important limitations in using water resources is their chemical quality. Chemical quality referred to chemical and biological properties which appoint the limits in using the water resources[10]. In developing countries, incorrect execution and the lack of proper regulations in terms of maintenance have caused to contaminate water resources more than before[3]. Some factors called salinity which control water quality, referred to quantity of electric conductivity and concentrations of dissolved ions in the water resources. Deals with these factors are so important to use water resources as irrigation sources in cultivated lands. Using saline water would also leads to increase concentrations of salts in the soil which would may make other complications. Furthermore decrease in crop yield, specially, with changes in weather conditions and occurrence of drought is expected. Generally, water quality and their changes during the time is very important due to agricultural activities and ignoring this point may cause significant decrease in productivity and development of saline soil as well as extension of desert lands[11]. In the present study, some important annual changes in the quality of groundwater resources in Shirvan plain located at north east of Iran have investigated.

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II. Materials and methods

A. The Study Area

Shirvan plain is located in Northern Khorasan province in north east of Iran and it is part of Shirvan _ Ghoochan wide plain in Atrak aquifer area. Average rainfall in this region is 274 mm with average temperature about 10 degree od centigrade semiarid to temperate climate.

B. Sampling

By means of underground water resources maps and using topography maps, slope side of area was recognized to distinguish upstream and downstream. Then fourteen wells were selected with regard to uniformly distribution on the Shirvan plain. According to sampling time in the past years, groundwater samples were taken in 2006 and 2007 in same month as previous samples have been taken by Northern Khorasan Water Organization during 1998 till 2005.

Plastic containers each of 1.5 liters capacity were used to collect of water samples. In order to prevent any unwanted contaminations, the container was first washed with detergent, toughly rinsed with distilled water and then with 5% nitric acid [9] and finally rinsed with distilled water at the end. At each sampling point, the underground water was pumped out and allowed to run for about 20 minutes prior to collection of water sample to ensure the right representative sample is collected. The plastic containers were rinsed twice with water which is to be collected and then the final water samples were taken. The samples were put in a plastic beaker and their temperatures were taken using standard thermometer and the container's lids were immediately replaced to minimize any gas exchange. The samples were thereafter stored in an ice packed cooler during the transportation and stored in a lab fridge at 4 degree of centigrade to analyze. Prior to each laboratory determination, the samples were brought out of the fridge to equilibrate with the environment [2, 7].

C. Laboratory Analysis

The electrical conductivity was determined using conductivity meter, at the site of samples collection. The total dissolved solids in the water samples were determined gravimetrically and chloride concentration was determined according to standard frequently used method using $AgNO_3$.

Finally, the data obtained were subjected to represent by graphs in Excel software.

III. Results And Discussions

The amounts of electrical conductivities, chloride concentrations and also total dissolved solids in 2006 and 2007 were evaluated and are shown in Table 1. In order to compare the results between different years during 10 continuous years, the mean data in each year were obtained and were shown in Table 2. Generally the results showed that, increasing changes of data values are apparent during 10 years time. Changes in the data were observed for all qualitative parameters which have been measured in the project (Fig. 1-3). However, different magnitudes of changes were found among different parameters. For instance, increasing trends were much more obvious for total dissolved solids data during 1998 till 2007 (Fig. 2). These increasing changes with time could be justified to the increase of populations and extensive industrialization in the region. During the time, with increase in industrial and agricultural activities, increase in concentrations of different soluble salts would be expected. Also, moving water through soil layers and rock deposits could solve different soluble materials. These processes could raise the concentrations of cations such as Ca^{2+}, Mg^{2+}, K^+, Na^+ and anions like Cl^-, SO_4^{2-} and PO_4^{3-} more than the acceptable levels[1]. Since the underground water quality is greatly affected by the leachate as well as precipitations, the water quality could also significantly change during the drought years[4]. Water chemical properties may change during seasons and years specially in underground water resources when their water quantities are decreased due to more and extensive utilization[5]. On the other hand, occurrence of recent drought in the studied region and changes in weather conditions are the other factors which have intensified the decrease in water quantities as well as water quality which has led to water salinization. Some other similar researches have also supported degradation of water quality during the time [1,6, 8].

IV. Conclusion

The results showed that the amounts of some qualitative parameters have been increased during 10 years time which has led to decrease in water quality. The results also showed that increased in urban populations as well as extensive industrialization in the studied area are the most important reasons to influence underground water quality. Furthermore decrease in water quantity is also evident due to more water utilization and occurrence of recent droughts in the region during recent years.

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TABLE I
THE AVERAGE OF ELECTRICAL CONDUCTIVITY, TOTAL DISSOLVED SOLIDS AND CHLORIDE CONCENTRATIONS OF GROUNDWATER IN DIFFERENT YEARS

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
EC (µmho/cm)	2354	2450	2530	2534	2535	2587	2639	2728	2634	2852
TDS (mg/l)	1544	1544	1550	1568	1586	1608	1694	1719	1666	1790
Cl (meq/l)	8.35	8.35	8.488	9.88	10	10.1	9.87	10.6	10.32	12.01

TABLE II
THE COMPARISON BETWEEN SOME QUALITATIVE PARAMETERS OF GROUNDWATER IN THE TWO CONSEQUENT YEARS

Year	2007			2006		
Well No	Cl(meq/l)	TDS(mg/l)	EC(µmoh/cm)	Cl(meq/l)	TDS(mg/l)	EC(µmoh/cm)
1	25.15	3290	4940	26.5	3111	5700
2	17.55	4510	6220	16.9	3449	5300
3	20.5	2602	5130	18	1602	4130
4	8.8	1360	3080	7	1348	2300
5	6.35	1110	2380	5	1153	1930
6	5.9	995	1580	3.2	947	1520
7	9.55	1390	2090	7.3	1220	2050
8	5.8	1260	1880	2.5	1155	1774
9	6.68	1275	1960	5.6	1205	1913
10	8	822	1210	6.4	850	1104
11	22.3	2400	3510	20.8	2320	3250
12	14.66	2050	3060	11.3	1805	2719
13	9.5	710	1030	8	1468	1330
14	7.5	1290	1866	6	1695	1865
Average	12.01	1790	2852	10.32	1666	2634

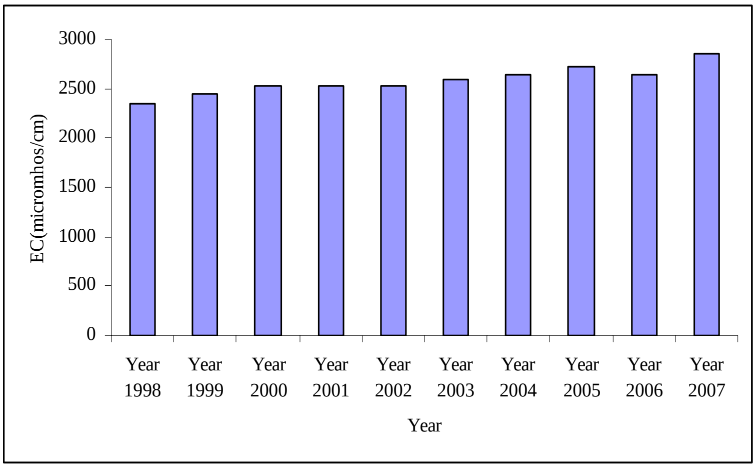

Fig.1 Average Changes in the Groundwater Electrical Conductivity with Time

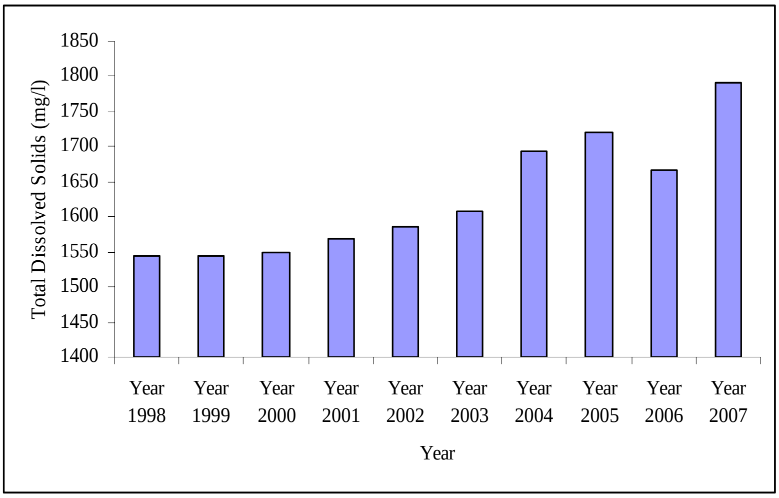

Fig.2 Average Changes in the Groundwater Total Dissolved Solids with Time

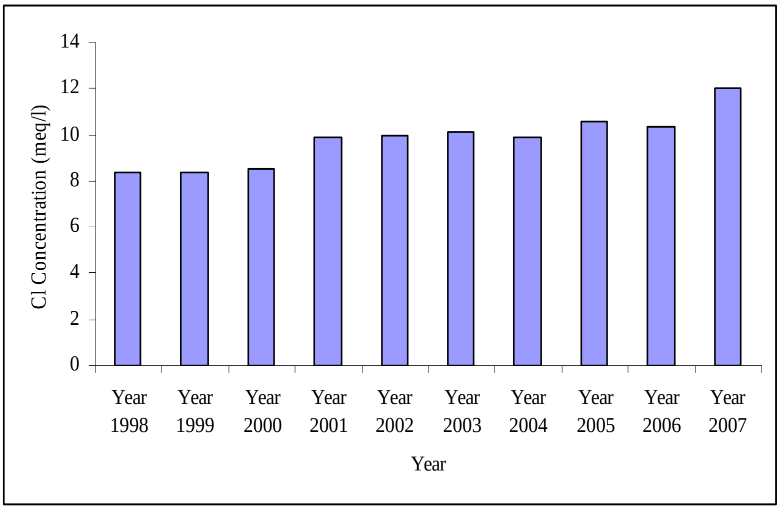

Fig. 3 Average Changes in the Groundwater Chloride Concentrations with Time