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RESEARCH ARTICLE

Quality of the rivers water for potation purposes in the west of Qazvin province.

***Naser Ebadati.**
Dept.of Geology, Islamshahr branch, Islamic Azad University,Iran.

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Corresponding Author

Naser Ebadati.

Abstract

The effects of geology on surface water resources and water quality and quantity changes of Rivers in the western part of Qazvin province were analyzed. And in particular Khar-roud River, Abhar-roud River and tributaries have they been reviewed. Sampling was made from the surface waters of the under study area in 5 stations and the samples underwent experimental analysis to determine the qualitative changes of the water in terms of drinking, agricultural and industrial consumptions. In sum according to the study results, drinking water quality of Abhar-roud, khar-roud and Golanjin chay Rivers was classified as good to moderate, moderate and respectively unsuitable.
Also in terms of agricultural consumption the water quality of Abhar-roud, Chay-roud and GolanjinKhar rivers was evaluated as good to moderate, moderate to unsuitable and moderate respectively. and Increase the EC from West to East along the river Abhar-roud represents an increase of ions in surface water due to the passage of water through evaporation and dissolution of the formations mostly Democrats.

Introduction

Qualitative and quantitative changes of ground and surface waters area function of physico-chemical parameters whose impacts are mainly the resultant of the water path way lithology, feature soft the ground water tables and tectonic factors. Hydro-chemical assessment of underground water flow systems is usually performed (Nabeel et al., 2012)based on a series of hydro-chemical information and data such as geologic settings, weather ingrate of different rocks in the basin, the quality and quantity of the feeding water volume in to underground water table and the chemical reactions between water and surrounding rocks in the ground (Ma soudi et al., 2006 and Peyrovan 2001).The folding form, faulting type and failures' structure play decisive role in quantitative changes and hydrodynamic flow of water ; hence examining the quantitative and qualitative variables of hydrous stratums is an inevitable and necessary issue for optimized management of water sources (Dehghani et al.,2009).

In the region the low precipitation volume and high evaporation in this plain besides more than50%shortage of precipitation and other adverse hydrogeological conditions has caused the high water and important rivers of the area to stop flow. The exploitation level in the area is higher than the feed ingrate and causing falling down of the underground water level and consequently shortage of the water sources' budget in area (Nabeel et al., 2012).

Harz and at plain area located adjacent to Takes tan and Qazvin plain studied the effect of geological formations on the quality of groundwater sources and concluded that the plain's underground water table has been constituted from fine particle sediments like silt and clay accompanied by sand and gravel that are materials with law permeability (Aganabati 2004 and Annells et al., 1975). Askari and Masaedi (2009) used geo statistical analysis and geographical information system(GIS) to study the local changes of the underground water quality of Qazvin plain and proposed that Qazvin plain is almost bowl like in shape and the underground and surface waters are entered from all directions and ultimately in eastern part where lies the weakest area of the basin, the water passes through as a line pass way,

so that it changes considerably when reaching Qazvin plain; such waters after joining Khar-Roud and Haji-Arab Rivers, get highly saline due to passing through a Tertiary evaporative formation (Askari and Masaedi 2009).

Abdinam (2004) analyzed the salinity of Qazvin plain soil in Takes tan region through preparing the soil salinity map using developing correlation between the satellite data and numerical values. Given the presence of solvent son the surface of the saline soils, they are readily distinguishable from other soils due to producing high reflection on the satellite images. In this study through defining the correlation between the satellite data and the soil salinity numerical values, the soil salinity map of the area has been prepared.

Haqighi and Lashkari (2006) studied the surface and underground waters of Takes tan plain region and concluded that dramatic drop in the level of the ground water table in Takes tan plain and construction of a series of reservoirs in Qazvin plain during the recent year sand decline of the precipitation has caused severe reduction of the yield in Abhar-roud and Khar-roud river basins (Ebadati and Sepahvandi 2015). Azizi (2003) studied the severity of drought and the relationship between the climatic and hydro geological droughts using precipitation and ground water's data in Takes tan region of Qazvin plain and obtained the following results: The number of precipitation negative anomalies during the study period has been more than the positive one sand the effect of human activities in the negative anomalies of the area ground waters is highly impressive; the drought of the ground water occurs with a delay of about two to three month compared with the climatic droughts. On average, during the study period the underground water level has dropped for about 25cm each year. Cao et al. (2014) have investigated the effects climatic factors and seasons changes in the upper catchments of the yellow River. As a result of global climate change and intense human activity, the spatio-temporal variations in vegetation are showing significant changes. Also multivariate statistical method including cluster analysis (CA) was used to assess temporal and spatial variations in the water quality of Euphrates River, Iraq, for a period 2008-2009 using 16 parameters at 11 sampling sites. And this study shows usefulness of cluster analysis method for analyzing and interpreting of surface water dataset to assess the temporal and spatial variations in the water quality parameters and the optimization of regional water quality sampling network. Moyel (2014) presents the results of statistical analysis of a set of physico-chemical water quality parameters, monthly collected from December 2012 to November 2013 at seven sampling stations spread over the Shattol-Arab River. This study suggests that principal component analysis and cluster analysis techniques are useful tools for identification of important surface water quality monitoring stations and parameters (Jafari 2015).

In the year 1995 and 2010 a series of studies concerning expanding the utilization of water sources of Abhar-roud, Khar-roud and Haji-Arab Roud basins were under taken and for each of the above basins a specific agricultural plan including exploring the water sources, storing and artificial feeding of ground water table has been proposed. These studies for Darman-Chay, Takand, Abhar-roud and Khar-Roud drainage basins were performed and ultimately resulted in planning basic studies for construction of 4dykes. So, here is a significant relationship between lithology features, structural geology of the basin and quantitative-qualitative changes of water sources in the area.

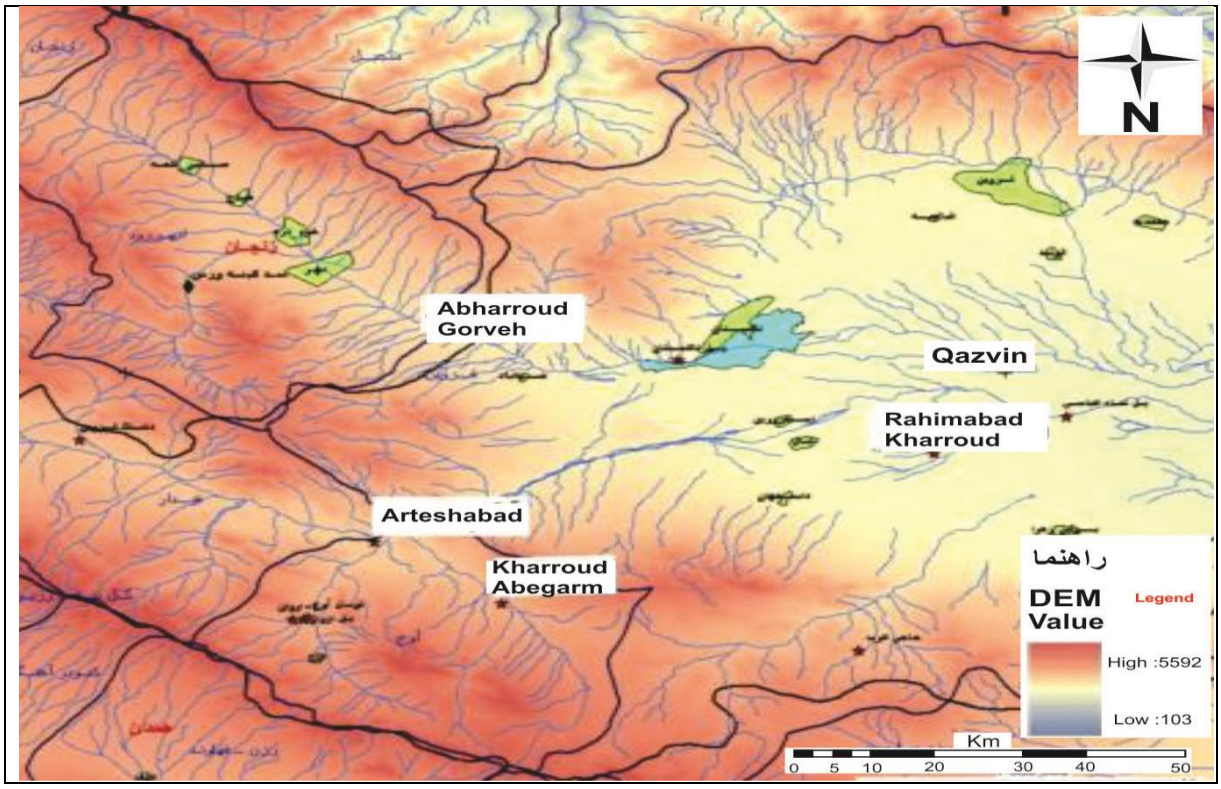

Fig1 : geomorphological map of study area

Methodology:

Initially through geomorphologic analysis and field observations as well as using satellite images the drain age basin range was determined and accordingly the geological formations and existing fault sand out crops of the study area were investigated and evaluated. To determine the In the next stage sampling was made from the surface waters of the under study area in 5 stations and the samples underwent experimental analysis to determine the qualitative changes of the water in terms of drinking, agricultural and industrial consumptions. The sampling included TDS, pH, total captions and total anions. Accordingly, parameters like Sodium absorption rate, total hardness etc. were determined observing the current standards and using the facilities data in Water, Laboratory Department of deputy basic studies and master Plans of Qazvin Water Sources Management (Tooss Ab 2009).Ske_Ngton et al. (2015) present 5 concerned with the accuracy and precision with which chemical status in rivers can be measured given certain sampling strategies, and how this can be improved. And these results suggest that in some cases it will be difficult to assign accurate WFD chemical classes or to detect likely trends using current sampling regimes, even for these largely groundwater-fed rivers (Jafari 2015). Also application of Multivariate Statistical Techniques in the Assessment of Water Quality in Sakarya River studied. And Using Multivariate Statistical Techniques in Red Soil Hilly Region worked for Assessment of Surface Water Quality. Analyze physical, chemical and microbiological quality were subjected to two multivariate methods, namely Cluster analysis (Ward's method) and Principal Component Analysis (PCA). Ali Khan et al. 2014) found that the water available in the Hingol River Bridge is not absolutely safe and contaminated with human and animal wastes (Taherkhsn 2010). Multivariate statistical techniques namely factor analysis and cluster analysis were applied to evaluate spatial variations, and to interpret measured water quality data set. Assessment and benchmarking of Mediterranean Basin for Water Pipe Networks Performance worked (Kanakoudis et al., 2015). The obtained results were used in statistical analyses as follows (Ebadati and Sepahvandi 2015).

The study is a morphologically has been constituted from two mountainous and plain parts. In the mountainous part generally young and old volcanoes and Plutonic rocks are seen and the heights are made of Pyroclastic and plutonic rocks. The plain part of the township is generally made of red and brown alluvial depositions; the heights of the region have been formed by the effects of Eocene volcanic activities in Alborz structural zone and due to the folding and faulting activities in the western parts of the region, such volcanic rocks often have under gone alteration

processes (Aganabati 2004 and Berberian 1983). Also the Silica sources in the sep arts have been developed following the alteration sand metamorphism arising from the tectonic activities and hydro thermal processes. In the highland sand mountainous areas are with maximum elevation to 2500m and lowest of the plain 1250m above sea level. Khar-roud and Abhar-roud are two important rivers of the west of Qazvin province. These Rivers reach to their highest yield in the spring due to melting of the winter snow sand become low watered and often get dry in the summer. Abhar-roud River is formed from two permanent and seasonal branches whose permanent branch-Kinehvars-is comprised of several branches and has its head stream in the western and south western mountains of Abhar. Abhar-roud seasonal branch flows from around Chaman Soltaniyeh and Allahdaghi height sand pours in to the permanent branch in the vicinity of Abhar Township and continue its path way in the name "Abhar-roud". Abhar-roud passes Takes tan Township with western-eastern path and with as light bent towards the south it enters Tehran State and finally it pours into Shour River. Khar-roud River is the longest and highest water river of the region which after irrigation of many villages exits the region from the east. Aqueducts, wells and springs area number of Takes tan Township underground water sources (QPRWO 2011). The main branch of this river has its head stream in the eastern highlands of Qeydar and Qezeldagh mountains in Kharaghan region, deviates from Zarringoland follows towards northwest in Abgarm and receive so the branches like Avaj-roud and Kolanjin-roud after passing Abgarm region it enters into Takes tan flatland.

The average rain fall in recent 30 years has been 407mm and the average temperature in the area has been 13ºC and the average evaporation during the last 10 years has been recorded to be about 1551mm. The plain locates in the semi-arid regions (Tooss Ab 2009). During the Early Oligocene, the magmatic activities are seen as numerous plutonic rocks with diverse compounds in most of Alborz and Azerbaijan areas:

Based on the studies under taken three main drainage basins can be observed in Takes tan region. The investigated basins for supplying water for Takes tan area villages are Darman chay, Abhar-roud and Khar-roud drain age basins. Based on the results of previous studies on the geology of the above basins, the nature and lithology of the formations, sedimentology, tectonic and other geological features and their effect on different options have been investigated (Ebadati and Sepah vandi 2015).

Result and discussion:

Assessment of the quality of the water sources for potation purposes:-

The overall amount of the soluble solid materials or total dry solids (TDS) is one of the main parameters of in classification of the waters concerning different consumptions like potation, etc. Also total hardness (TH) relates to specific solvents which are soluble in the water and increase the water weight; these solvents mainly include cations such as calcium, magnesium, strontium and silicate anions and soluble nitrate that a represent in the water (Sedagat 2003). The measured indexes of Khar-roud River like sulphate, hardness and solids have been used as the standard and other indexes in the samples taken from Abhar-roud have not been measured. To determine the average qualitative status the measured indexes in the hydrometer stations along the under study rivers have been used. After wards using there Levant graphs the zonation fields' values of them was determined and was multiplied by the index weight. Then the existing total indexes were divided on total sum of the measured indexes' weights. Accordingly the average values of the measured indexes and their weights obtained in the hydrometer stations have been given in the following table.

Table 1:- Result of quality parameters on the hydro meter station of Abegarm-Kharroud

Parameter	% Na	SAR	Sum.kmeq/l	K meq/l	Na meq/l	Mg meq/l	Ca meq/l	Sum.A meq/l
Max	83.00	16.39	66.22	0.77	30.25	10.4	24.8	68.89
Mean	65.34	7.65	23.09	0.18	15.09	4.49	3.33	23.38
Min	7.85	0.72	3.98	0.01	2.16	1.36	0.45	3.36
SE	7.34	2.23	7.07	0.10	5.23	1.53	1.84	7.08
% S	11.23	29.15	30.61	55.74	35.30	33.9	55.39	30.27
Parameter	**SO_4 meg/l**	**Cl meg/l**	**HCO_3 meq/l**	**CO_3 meq/l**	**PH meq/l**	**EC micro mohs/cm**	**TDS meq/l**	**Discharge m^3/s**
Max	25.20	28.50	13.61	1.28	9.20	4355	2680	28
Mean	4.65	13.55	5.12	0.50	7.93	2341	1448	3
Min	0.40	1.59	1.37	0.1	6.85	715	465	0.01
SE	2.48	5.15	1.59	0.3	0.34	713	464	4.31
% S	53.29	38.02	31.03	59.3	4.32	30	32.4	141

Table 2:- Result of quality parameters on the hydro meter station of Rahimabad -Kharroud

Parameter	**% Na**	**SAR**	**Sum.k meq/l**	**K meq/l**	**Na meq/l**	**mg meq/l**	**Ca meq/l**	**Sum.A meq/l**
Max	74	9.28	42.20	0.22	20.7	10.80	10.48	48.77
Mean	59.22	5.95	20.87	0.13	12.20	4.55	3.99	21.10
Min	12.91	0.54	2.88	0.01	0.93	0.64	1.30	2.27
SE	7.11	1.25	6.20	0.04	3.51	1.72	1.86	6.21
%S	12.01	20.92	29.71	32.27	28.74	37.81	46.71	29.42
Parameter	**SO_4 meq/l**	**Cl meq/l**	**HCO_3 meq/l**	**Co_3 meq/l**	**PH meq/l**	**EC micro mohs/cm**	**TDS meq/l**	**Discharge m^3/s**
Max	20	17.50	9.87	1.40	9.20	3625	2240	723
Mean	7.32	9.99	3.71	0.68	7.93	2104	1327	8.8
Min	1.35	0.57	0.35	0.22	2.93	605	170	0.01
SE	3.90	3.03	1.02	0.30	0.48	624	431	55.5
% S	53.26	30.30	27.38	42.1	6.10	30	32.5	631

Table 3:- Result of quality parameters on the hydro meter station of Arteshabad-kalinchay

Parameter	**% Na**	**SAR**	**Sum.k meq/l**	**K meq/l**	**Na meq/l**	**Mg meq/l**	**Ca meq/l**	**Sum.A meq/l**
Max	71.24	11.27	41.03	0.36	26	7.54	7.13	49.12
Mean	52.25	3.54	10.95	0.09	5.69	5.64	2.54	11.06
Min	13.68	0.44	1.93	0.01	0.62	0.40	0.90	2.42
SE	7.34	0.97	3.10	0.04	2.11	0.87	0.97	3.14
% S	14.05	27.36	28.28	40.20	37.14	32.99	38.27	28.37
Parameter	**SO_4 meq/l**	**Cl meq/l**	**HCO_3 meq/l**	**CO_3 meq/l**	**PH meq/l**	**EC micro mohs/cm**	**TDS meq/l**	**Discharge m^3/s**
Max	16.20	25	6.50	1.42	8.80	3750	2390	5.94
Mean	3.82	3.11	4.06	0.55	7.93	1094	682.9	0.54
Min	1.12	0.30	1.00	0.2	7.20	473	302	0.003
SE	1.32	1.96	1.04	0.28	0.29	310	196.8	0.88
% S	34.36	63.14	25.67	51.2	3.61	28.4	28.8	162

Table 4:- Result of quality parameters on the hydro meter station of Gorveh-Abharroud

Parameter	**% Na**	**SAR**	**Sum.k meq/l**	**K meq/l**	**Na meq/l**	**mg meq/l**	**Ca meq/l**	**Sum.A meq/l**
Max	64.04	6.25	23.75	3.05	11.10	5.00	4.60	25.57
Mean	38.91	2.00	7.78	0.06	3.05	2.37	2.29	7.78
Min	4.55	0.17	1.36	0.01	0.30	0.60	0.45	1.30
SE	9.14	0.75	1.73	0.21	1.22	0.69	0.74	1.73
% S	23.50	37.52	22.29	346.5	40.01	29.06	32.43	22.29
Parameter	**SO_4 meq/l**	**Cl meq/l**	**HCO_4 meq/l**	**CO_3 meq/l**	**PH meq/l**	**EC micro mohs/cm**	**TDS meq/l**	**Discharge m^3/s**
Max	7.50	9.87	6.90	1.30	8.80	1850	1105	22.10
Mean	2.39	1.14	4.14	0.6	7.96	753	471.6	1.50
Min	0.05	0.35	0.90	0.1	7.00	326	212	0.004
SE	1.05	0.91	0.96	0.3	0.33	176	113.9	2.92
% S	44.05	79.51	23.24	50.7	4.10	32.4	24.15	194.8

The qualitative and quantitative analysis of the rivers water sources:

Based on the investigations made on the quality of drinking water, the following results were obtained considering the available information: Regarding Khar-roud in the Abgarm station, on the whole it is in the moderate status of the water quality, not suitable for drinking consumptions. The quality also in Rahimabad station is not suitable for

drinking purposes. Concerning Kolanjin chay River in Arteshabad station which is one of sub-branches of Khar-roud River, the water quality for drinking consumption is in the moderate acceptable conditions. Given the above mentioned issues it can be predicted that the water quality of Khar-roud sub-branches feature better drinking conditions. Considering the existing Schuler information in the hydrometer stations the water quality has been determined solely based on the Schuler parameters and using the saline diagram (WHO 1993 and 2004). The water quality of Abhar-roud for drinking consumption based on the saline parameters has been classified as being in the moderate acceptable conditions. Accordingly the head streams of the main and sub-branches of this river areal so predicted to be in good suitable conditions for drinking consumptions. The water quality for agricultural consumptions as was mentioned in the report has been determined using Wilcox classification (Sedagat 2003).

Based on the obtained results the agricultural water quality of Abhar-roud River in Ghorveh station can be classified in C2-S1 and C3-S1 classes. Hence the water quality for agricultural consumptions in this river belongs to the good to moderate class. Considering the inter views made with the villagers in the area concerning the agricultural water quality in the sub-branches of this river, the farmers and orchard men made no complain tab out the water quality, salinity or any other limiting factor except regarding the shortage of water for irrigation. It seems like the quality of water sources in the area considering its smaller basin is in better conditions compared with Abhar-roud River and can be classified in moderate quality C2-S1 class.

Regarding Khar-roud River in terms of agricultural water quality, it is in lower quality conditions compared with Abhar-roud River, so that in Abgarm station the water quality classes mainly are C4-S3 and C3-S2 that is moderate to improper. Also in Rahimabad station the water quality is manly C4-S2 and C3-S2. But the water quality of Kolanjin chay in Arteshabad station has better conditions for agricultural consumption sand belongs to the class C3-S1. Thus given the fact that the farmers in the area were satisfied with the water quality concerning the under study head streams of Khar-roud river, it seems like that the quality of the suggested options in the area can be classified in C3-S1 and C2-S1 classes.

Conclusion-:

The effect of lithological characteristics of surface water resources and water quality and quantity changes are evident rivers. And the most important results of this study are the following:

1. The increase in the EC value from the west toward the east along Abhar-roud River is indicative of the water flowing on the mainly evaporative formations and their dissolution.
2. In respect with the changes of the surface water soft he area, the potable water quality in Abgarm and Rahima bad stations located on Khar-Roud River bank is evaluated as being moderate-improper an dim proper. In Arteshabad station the water quality is acceptable and ultimately the quality of Abhar-roud potable water is classified as being moderate-good.
3. From the drinking water consumption perspective, the best part of the area suffers from moderate to improper water quality and the agricultural water quality in Abhar-roud, Khar-roud and Kolanjin chay is assessed as good to moderate, moderate to improper and moderate respectively.
4. TheCa^{+2}rates along with Abhar-roud River has increased and towards the exit of the plain aquifer it decreases due to the dissolution of limestone unit sin to the ground water along the flow direction.

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