EFFECT OF DROUGHT ON WATERQUALITY VARIATIONS WITH USING AQ.QA SOFTWARE IN KAROON RIVER- IRAN

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Abstract-One of kinds of the natural disasters is drought. Our country, Iran, about every five years experiences a 2-3 year period of drought. The study area is a basin of Karoon River with average annual rainfall 515.5 mm. In this research, the data of a ten year period interval obtained from hydrometric stations at the Gotvand dam, Ahwaz and Bahmanshir River in Abadan was used. Next the data was analyzed by Aq.Qa software package. The results showed that at the downstream of Ahwaz and Bahmanshir station, the water was found as C4S4 Class in some months that are unsuitable for agriculture and drinking uses. The Piper chart indicated that the water quality is not steady along the course and the dominant cations in most of the years are Na+ K>Ca>Mg and the dominant anions in the Gotvand station are Cl> HCO3 >SO4 and at Ahwaz and Bahmanshir stations are Cl>SO4>HCO3. The dominant type at the all stations is choloro- sodic Na-Cl.

Key words: Drought, Water Quality, River and Aq.Qa Software

I. INTRODUCTION

In spite of their very similar meaning, the "aridity" and "drought" are not synonyms. The former is a characteristic feature of arid and semi-arid regions and represents the conditions in which the average rainfall or available water is steadily too low as it is the case in the deserts, whereas the letter is a condition where decrease and irregularity of rainfall are such that disturb the normal growth trend and interrupt the already balanced conventional human-environment relation (Eslamian 2000).To determine the water quality, there are various techniques that have resulted from chemical analyses. Representing as graphs, these analyses take a more understandable form which includes the Piper, Schoeller and Radial plots (Mohsenifar 2008).

Koklu R. and et.al. (2010) has evaluated Water Quality Using Multivariate Statistical Methods. Obtained important parameters provided us to determine the major pollution sources in Melen River Basin. So factors are conditionally named soil structure and erosion, domestic, municipal and industrial effluents, agricultural activities (fertilizer, irrigation water and livestock wastes), atmospheric deposition and seasonal effects factors. discriminant analysis showed that the most significant parameters for temporal variations are DO, EC, F-Strip, K+, M-Al, Mn2+, NH4 –N, NO3–N, pH, SO 2−4 , TDS and for spatial variations are BOD_5, Ca^{2+}, DO, E-Coli, M-Al, Mg2+, Mn2+, Na+, NH4–N, NO3–N, pH, SO 2−4 , T,TH.

SoltaniMohmmadi(2006)has examined the quality of Karoon's water agriculturally. In his study, Sultani (2006) by investigating in all the stations fromAhwaz to Khoramshahr, assigned the quality water based on exchangeable sodium ion to class 1 and the salinity to class 2.Azen (2007) by examining the springs, surface and groundwater at the Troia region in Turkey for 25 samples through drawing the Piper, Schoeller and Wilcox plots determined the types of sampled water, for most of samples, as Mg-Cl-HCO3 and for three samples as Na-HCO3.

Sharma D. (2011) has analyzed Yamuna River water quality with using water quality index in the national capital territory of India. The indices has computed for pre-monsoon, monsoon and post-monsoon season at four locations, namely Palla, ODRB, Nizamuddin and Okhla in the river. It was found that the water quality ranged from good to marginal category at Palla and fell under poor category at all other locations. BOD, DO, total and fecal coliforms and free ammonia were found to be critical parameters for the stretch.

Hwang, J. Y. (2014) has studied Hydrodynamic and Water Quality Modeling for Gate Operation on River Basin in Korea. The Results show that the gate operators should carefully select the most appropriate operating plan to obtain better water quality in the Seonakdong River. The numerical simulation shows that a discharge of 300 CMS, which is a peak inflow from the Daejeo water gate to the river, can make it possible to achieve the target water quality of the Seonakdong River if the Daejeo water gate can remain open in connection with the Noksan water gate operation.

The aim of this study is to examine the drought effect on trend of water quality variations of Karoon River using Aq.Qa software in ten past years.

II. MATERIAL AND METHOD

The Karoon River is the longest and fullest one in Iran. It has 950 km long and the extent of its watershed basin is 6000 km^3 (Power ministry guide

2010).Karoon's watershed basin with 42574 km2 area is situated between longitude, 48°4′, 51°55′ east and altitude 30°17′ , 32°04′ north(Zarei&Akhonzadeh 2006).The Karoon River and the branches flowing into it have established the greatest river system in Iran and it is a basic resource supplying water for throughout Khuzestan province. This river originating from Zagros and Zardkoh Mountains about 3500 meters above sea level, after traveling a long distance flows down in Gotvand 100 meters above sea level and runs in to Khuzestan plain. It travels 250 km across Khuzestan plain before flows into Persian Gulf. The northern part is thoroughly mountain area and the south part is the main area of Khuzestan plain. It is a perpetual river and having snow and rain regime; hence its discharge varies by seasonal changes and strongly depends on rainfall level and seasonal weather (in spring time the melted snow induces flooding). This river has the highest water-delivering in the country. The average annual long term water-delivering in the dam facilities is 300 m3/s and its volume is over 10 billion m^3 (power ministry guide 2010).

To determine the water quality of Karoon, the data of three stations setup along the river related to the years 2001, 2009, and 2011 adapted from KhuzestanWater & Power Authority was used which has been from origin to end: Gotvand, Ahwaz, Bahmanshir,

In order to determine the water quality, the parameters of electrical conductivity in ds/m and the sodium adsorption ratio were used and the water class was specified. In addition to it, the electrical conductivity (ds/m) and pH, water quality and water type for drinking were determined by drawing Piper plot using Aq.Qa software and incorporating such parameters as calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chlorine and sulfate in mmol/l.

III. RESULTS AND DISCUSSION

Determination of River`s Water Class

According to this classification, the water of Gotvand station falls into three classes C3S1 (dominant class), C2S2 and C2S1 (table 1). At the Ahwaz station dominant classes are C3S2 and C4S2 (table 2). As fallen into C4S2 and C3S2 classes, the Bahmanshir station is subjected to high salinity and sodic risk and has the lowest quality for irrigation (table 3). In the case of salinity risk, three classes were obtained: intermediate, high and very high classes. In 2011 the salinity risk at Gotvand and Ahwaz from intermediate reached to high C3 and at Bahmashir reached to very high class and three stations are facing with very high risk.

Table (1): determination of water class in Gotvand station

Month / site	March	April	May	June	July	August	September	October	November	December	January	February
Gotvand2001	C3 S2	C2S1	C3S1	C2S1	C2S1	C3S1	C3S1	C3S2	C3S1	C2S1	C3S1	C3S1
Gotvand2009	C3 S2	C3S1	C1S1	C2S1	C3S1	C3S1	C3S2	C3S2	C4S3	C3S2	C3S1	C3S1
Gotvand2011	S2 C3	C3S1	C3S2	C3S2	C3S1	C2S1	C3S1	C3S1	C3S1	C3S1	C3S1	C3S1

Table (2): determination of water class in Ahwaz station

Monthsite	March	April	May	June	July	August	September	October	November	December	January	February
Ahwaz2001	C3S2	C3S2	C3S2	C3S2	C3S2	C3S2	C3S2	C3S1	C3S2	C3S1	C3S1	C4S2
Ahwaz2009	C4S2	C4S3	C4S2	C4S2	C4S2	C4S3	C4S2	C4S2	C4S2	C4S2	C3S2	C3S2
Ahwaz2011	C3S2	C3S1	C3S1	C3S1	C4S2	C3S1	C4S2	C3S2	C3S1	C3S2	C3S2	C4S2

Table (3): determination of water class in Bahmanshir station

MonthSite	March	April	May	June	July	August	September	October	November	December	January	February
Bahmanshir2009	C4S4	C4S4	C4S3	C4S4	C4S2	C4S3	C4S3	C4S3	C4S3	C4S4	C4S2	C3S2
Bahmanshir2011	C4S3	C4S2	C4S2	C4S2	C4S2	C4S2	C4S2	C4S2	C4S2	C4S2	C4S2	C4S3

Type and Classification of Water Using Aq.Qa Software

The dominant type of water in the stations is choloro-sodicNaCl. As shown in table (4) at Gotvand station in 2009 and 2011 the water facies in two months is calcic and in 2001 and 2011 at Ahwaz station the water type is sulfate and bicarbonate(table 4).

Table 4: type and facies of Karoon water using Aq.Qa software

Monthsite	March	April	May	June	July	August	September	October	November	December	January	February
Gotvand2001	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl
Gotvand2009	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Ca-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl
Gotvand2010	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Ca-HCO3	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl
Ahwaz2001	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-HCO3	Na-Cl	Na-Cl
Ahwaz2009	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl
Ahwaz2010	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-So4	Na-So4	Na-Cl	Ca-So4	Na-Cl	Na-Cl	Na-Cl
Bahmanshir2009	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl
Bahmanshir2011	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl

Classification of Water Using Piper Chart

At Gotvand station in 2001(figure 1) and 2009 (figure 2) the dominant types of water were sodium, potassium and chloro, but in 2011 (figure 3) the dominant type was sulfate and without any specific type.

At the Ahwaz station in 2001 (figure 4) and 2009 (figure5), the dominant types of water were sodium, potassium and choloro, but in 2011 (figure 6) the dominant type was sulfate without specific type similar to Gotvand. At Bahmanshir station in 2009 (figure 7) and in 2011(figure 8) sodium, potassium and chloro were dominant types of water. Therefore, totally, with respect to plots the dominant type of Karoon's water in all the stations are Na+ K and Cl. As mentioned above, SotaniMohammadi(2006) has examined the quality of Karoon River agriculturally and found that in all the stations from Ahwaz to Khoramshahr the quality of water exchangeable sodium ion is fallen to class 1 and the salinity to class 2, whereas this study showed that at the downstream of Ahwaz station the exchangeable sodium ion is extremely increasing and the water quality declinesdue to discharge of wastewater effluent from industries, factories and refineries, being saline and sodic of surrounding lands and so on. Thus the salinity of water along the river route has less incremental trend (the dominant class in Gotvand C3S1 and in Bahmanshir C4S1) but the exchangeable sodium ion is increasing strongly, even it can be said that beyond Ahwaz it is impossible to use the river's water for agriculture purpose.

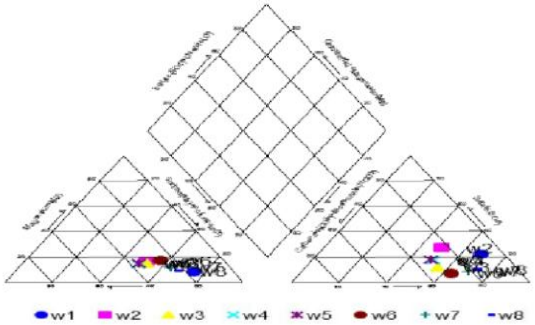


Figure (1): Gotvandstation (2001)

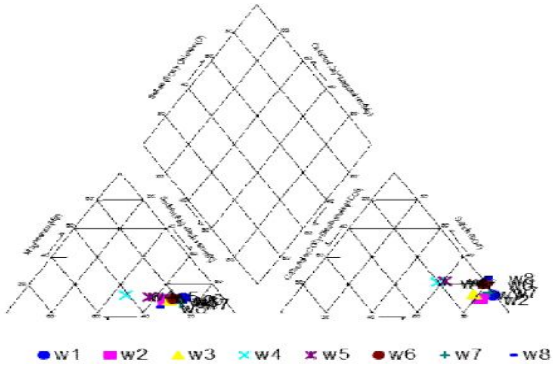


Figure (2): Gotvand station (2009)

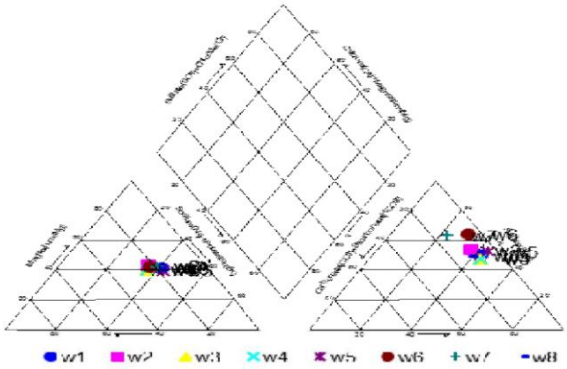


Figure (3): Gotvand station (2011)

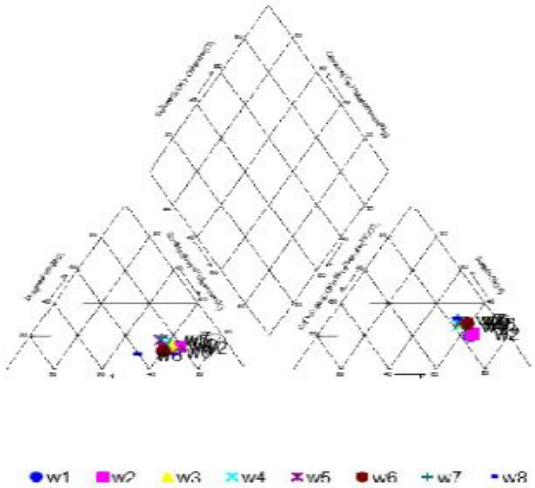


Figure (4) Ahwaz station (2001)

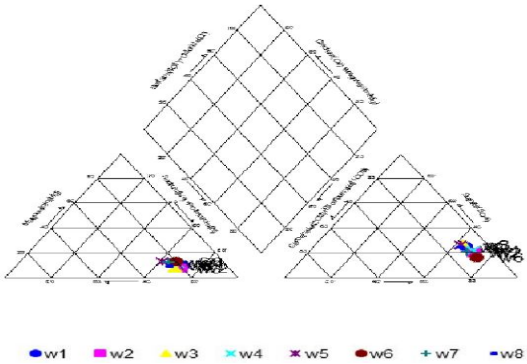


Figure (5): Ahwaz station (2009)

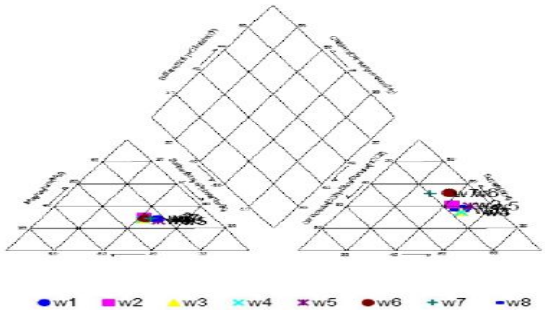


Figure (6): Ahwaz station (2011)

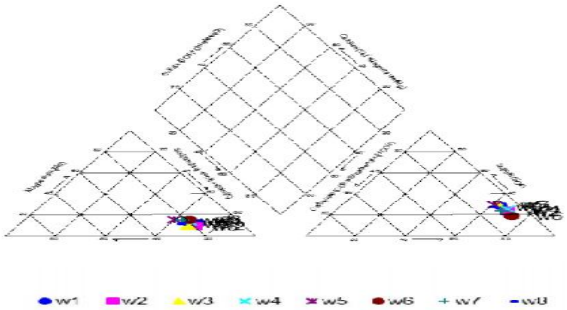


Figure (7): Bahmanshir station (2009)

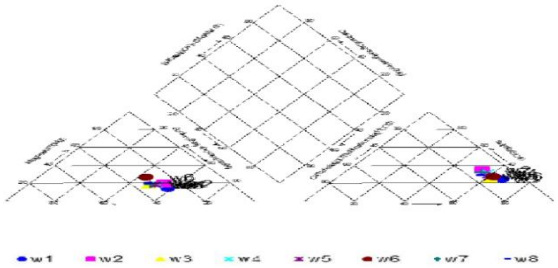


Figure (8) Bahmanshir station (2011)

CONCLUSION

This study shows that the quality of Karoon's water is decreasing as the rainfall decreases. Also the concentration of dominant cations in most of the years at all the station is Na+K>Ca>Mg. Being sodium dominated, has made the water CholrosodicNa+K and CI. If various pollutions are entered in to rivers and in respect to recent droughts, in the coming years it is accepted the quality of water to be extremely decreased. Therefore it is recommended the pollutions to be controlled through accurate management and planning and the exploitation of the rivers is done in respect to rainfall amount and the quality of water.

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