Journal of River Engineering
Volume2, Issue 3, 2014
http://www.scijour.com/jre
SCIJOUR

Classification of Water Quality of Gharasoo River for different uses in the wet and dry years

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ABSTRACT

The rivers are one of the main sources of water supply for different usage like agriculture, domestic and industrial. Therefore, according to the recent droughts in the country and also urban and rural development it is important to conserve these resources. Drought can have dramatic effects on water quality by reducing the quantity of river flow. In this study, the quality of Gharesoo river water in 1994-1995(wet year) and 2007-2008(dry year) in station selected by the Chemistry and AqQA software's was investigated and the results showed the water quality in the dry year has been lower than in wet year. According to Schuler chart quality is good for both stations and note the Wilcox diagram with two stations in both wet and dry periods of the year will be in class C2S1. Due to the close relationship between river flow and water quality, it could be concluded that water quality is vulnerable to reductions in flow. It is suggested, therefore, that water management policies design to alleviate the effects of drought on Gharasoo basin and its irrigation network.

KEYWORD

AqQA software, Chemistry software, Gharasoo River, Kermanshah, water quality.

INTRODUCTION

Water quality refers to the suitability of water to sustain various uses or processes, such as drinking, bathing, washing, irrigation, industry and so on. They require certain level of physical, chemical, or biological characteristics of water and hence water quality can be defined by a range of variables which limit water use. Water quality is perceived differently by different people. For example, a public health official is concerned with the bacterial and viral safety of water used for drinking and bathing while aquatic scientists are concerned with the health of aquatic habitats including fish, plankton, and other plants and organisms. Water quality is usually determined and measured by comparing physical, chemical, biological, microbiological, and radiological quantities and parameters to a set of guidelines, standards or criteria. Water quality differs by location (spatial factor) and season (temporal factor). Therefore, classification of water quality is the first and the most important step in surface water quality assessment for different consumptions including drinking water, industrial and agricultural usages. Identifying the source of pollution and contaminated areas will result in safe and hygienic exploitation of water for different usages [1,2]. Freshwater's monitoring is an essential activity in environmental management programs [3,4].One of the very simple methods of reporting water quality parameters, without statistical and mathematical complexity, is using water quality indexes. Water quality indexes are one of the best tools in water quality assessment and its management [5 ,6].Various techniques have been used for quality measurement of world surface waters, among which water quality indexes are one of the most popular and easiest in the word [7].The first step of surface water quality assessment, is recognition and selection of water quality parameters. Pollution of surface and ground water is a major problem due to rapid urbanization and industrialization. The large scale urban growth due to increase in population and migration of people from rural areas to urban centers has increased domestic effluents while industrial development manifested either due to setting up of new industries or expansion activities resulting in generation of copious volume of industrial effluents [8]. Clean and adequate water supply is a necessity for the health of all living organisms and ecosystems, including people and their activities. Water quality monitoring has one of the highest priorities in environmental protection policy [9,10] to control and minimise the incidence of pollutant-oriented problems, and to provide water of appropriate quality to serve various purposes such as drinking water supply, irrigation, recreational and industrial; and to protect the valuable freshwater resources to safeguard public health [11]. Ascertaining the quality is crucial before use for various purposes [12,13]. Traditional approaches to assess water quality are based on a comparison of experimentally determined parameter values with existing guidelines. However, it does not readily give an overall view of the

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Volume2, Issue 3, 2014
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spatial and temporal trends in the water quality in a watershed [14]. The classification, modeling and interpretation of monitoring data are the most important steps in the water quality assessment; the quality is difficult to evaluate from a large number of samples each containing concentrations for many parameters [15]. The index method was initially proposed by Horton in 1965. Since then, the formulation and use of indices has been strongly advocated by agencies responsible for water supply and control of water pollution. In Iran, the classification of rivers by the Iranian Department of Environment (IR-DOE) is generally carried out based on the National Sanitation Foundation Water Quality Index (NSFWQI). It should be pointed out that the sources of pollution may differ from place to place. Therefore, type of pollution and their impact on water quality should be taken into consideration while developing an index to access the water quality. For instance many Iranian rivers receive larger amounts of coliforms due to fact that municipal sewage is not being efficiently treated before discharge into the environment.

METHODOLOGY

Importance of rivers evident in terms of water quality, biodiversity conservation and use for aquaculture, as maximum of the water bodies of Iran, as well as Kermanshah province are expected to be productive. So utilization of the existing resources is very much vital. In the way to improving the condition of these water resources, its proper management is very much necessary and for doing this all information on the resources namely physico-graphic, chemical and biological characteristic of these water resources must be collected. The Gharasoo river is the most important river in Kermanshah Plain that Main water needs of agriculture, industry and drinking from the river area will be provided. Therefore, considering the importance of the study of water quality in the river has been attempted. The general location of the stations studied is given in figure (1) and Table (1). In this paper first, with using of monthly rainfall data annually SPI Index calculated to determine dry and wet years. That according to figure(2) a period of 23 years (1988-2011) 1994-1995 year as wet year and 2007-2008 as dry year were identified.

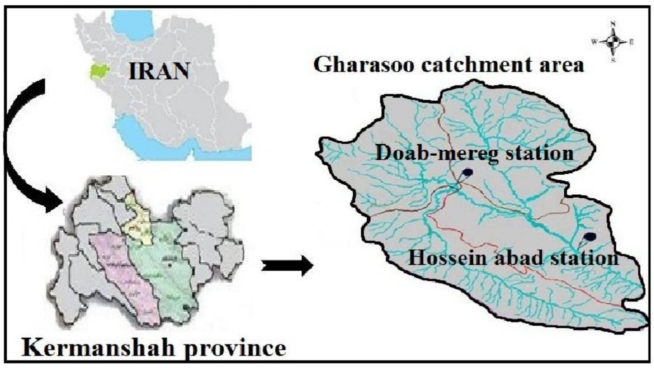

Fig.1. location of the station on Ghara Soo River

Table.1 Geographical positions of the station on Gharasoo river

Station	Latitude	Longitude	Altitude(m)
Doab-mereg	34'33"	47'46"	1290
Hossein abad	34'25"	47'00"	1304

Table 2 show results of the chemical analysis of the samples in wet and dry years in two Doab-mereg and Hossein stations (Cations and anions and TDS is mg/L and electrical conductivity according µm/cm).

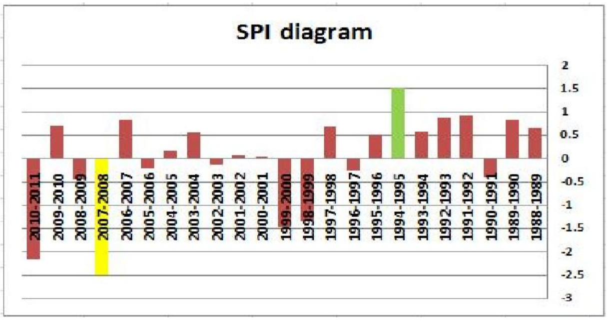

Fig.2. SPI diagram for 23 year period(1988-2011)

Table.2 Result of chemical analysis for water samples of Gharasoo river

Career	Station	Discharge	temperature	EC	T.D.S	PH	Ca	Mg	Na	K	HCO3	CO3	CL	SO4
wet	Doab-mereg	13.96	23	459.2	293.56	7.64	58.4	13.68	10.7	0	219.6	2.4	12.07	25.63
	Hossein abad	37.69	20	408.69	285.33	7.72	49.6	12.84	10.12	0	193.37	4.8	9.04	21.12
Dry	Doab-mereg	0.98	12	557.57	357.14	7.81	59.6	21.6	16.79	0	252.54	1.2	22.01	31.2
	Hossein abad	2.04	10	494.83	316.67	7.95	53.2	15.18	15.18	0	225.7	3	18.46	24

Hydrochemistry data processing of samples, various chemical diagrams were prepared with using of AqQA Software, that compared based on the state of water quality. AqQA Software is one of the most powerful hydrochemistry software in the field of water quality is analyzed, that uses field and laboratory analyzes of water samples provides useful information about the properties such as water type, total soluble solids (TDS), hardness, sodium absorption ratio and determination of water quality for different uses. This software has the ability to display the results in different diagrams. In this research also Chemistry software to verify that water quality in Microsoft Excel written in Visual Basic language has been used.

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This software is designed according to the requirements Water Resources Atlas of studies and guidelines of the Ministry of Energy have been conducted. At the same time it enables the exchange of water quality data to other applications, especially AqQA. For1994-1995 year and 2007-2008 at the station, the comparison between the measured parameters and water quality standards in Table 3 is done and then Schuler diagram in Figure (3) and (4) for classification in terms of drinking water, for stations in the software AqQA was drawn.

Table.3 Drinking water standards

Chemical parameter	Symbol	Unit	Standard value	Recommending Agency
Sulfate	SO4	mg/L	250	USEPA(1995)
Chloride	CL	mg/L	250	USEPA(1995)
sodiume	Na	mg/L	200	WHO(1994)
PH	PH	-	6.5-8.5	WHO(1994)
Total Dissolved Solids	TDS	mg/L	500	WHO(1994)
Magnesium	Mg	mg/L	40	USEPA(1995)
electrical conductivity	EC	µm/cm	1400	WHO(1994)

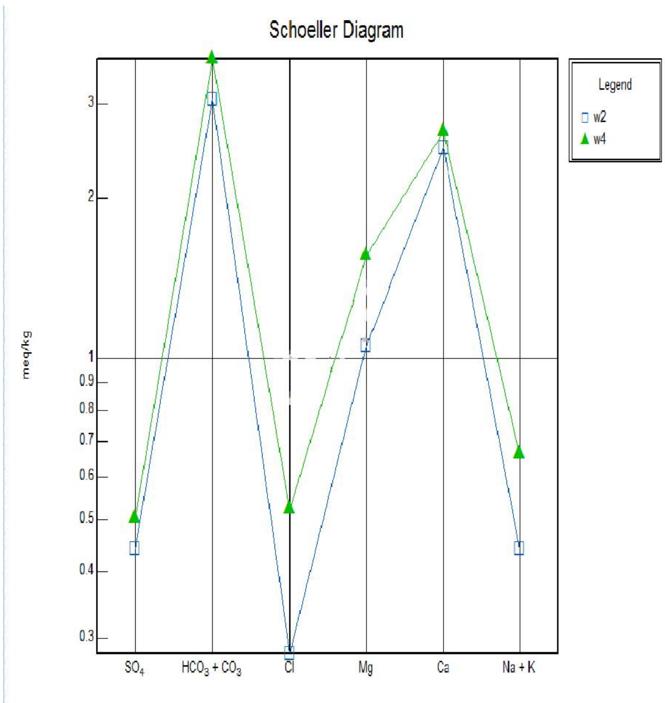

Fig.3. scholler Diagram of Doab-mereg station in wet and dry year

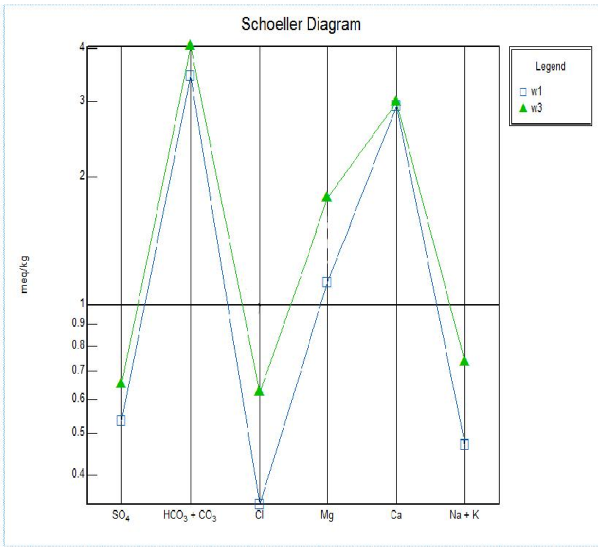

Fig.4. scholler Diagram of Hossein abad station in wet and dry year

For quality comparison, in terms of Agriculture and Irrigation Wilcox classification that is one of the best classification system of agricultural and Chemistry software were used. Wilcox diagram based on two factors SAR, EC classifies the samples in 16 different classes. that its best C1S1 (the lowest SAR, EC), the minimum salinity and alkalinity At worst, C4S4 (salinity and alkalinity levels too high). Sodium adsorption ratio Wilcox diagram represents the losses caused by sodium. High amounts of sodium cause the production of alkaline soil and eventually reduce soil permeability and according to the formula (1) can be obtained [16].

$$SAR = \frac{Na}{\sqrt{Ca \times mg}} \tag{1}$$

Where is SAR = sodium adsorption ratio, Na= sodium ions, mg = magnesium ions, Ca= calcium ions. Figure (5) samples of the Wilcox diagram shows both wet and dry years. According to the class diagram samples in both wet and dry years with quality specified in the table (4) is shown in the Summary.

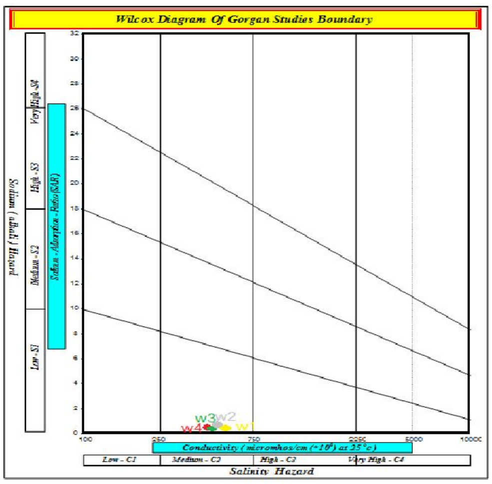

Fig.5. Wilcox Diagram of water samples in wet and dry year

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Table.4 Classification of Water Quality of River for agriculture according to Wilcox Diagram

Station	career	Symbol	SAR	EC	Water class	Water Quality for Agriculture
Doab-mereg	wet	W1	0.33	459.2	C2-S1	a little salty, appropriate for agricultural
	dry	W3	0.47	557.57	C2-S1	a little salty, appropriate for agricultural
Hossein abad	wet	W2	0.33	408.69	C2-S1	a little salty, appropriate for agricultural
	dry	W4	0.45	494.83	C2-S1	a little salty, appropriate for agricultural

Calcium carbonate remaining concentration of carbonate and bicarbonate ions in order to determine hazards on water agricultural quality is calculated. Its value can be obtained the following equation. [17].

$$RSC=(HCO_3 \times CO_3)-(Ca \times Mg) \quad (2)$$

Parameter in the above equation are described in meq/lit [18]. Table (5) shows amounts of remaining sodium carbonate in irrigation water.

Table.5. Remaining amounts of sodium carbonate in irrigation water.

Station	career	Symbol	RSC	Water Quality according to RSC
Doab-mereg	wet	W1	-0.38	Appropriate -Water consumption does not cause any problems
	dry	W3	-0.6	Appropriate -Water consumption does not cause any problems
Hossein abad	wet	W2	-0.22	Appropriate -Water consumption does not cause any problems
	dry	W4	-0.43	Appropriate -Water consumption does not cause any problems

For check the status of industrial water Langelier saturation index (Is) was calculated for all stations (equation (3)). According to Langelier equation using chemical analysis of water, PH can be saturated (PHs) that the equation (4) obtained.

$$Is = PH - PHs \quad (3)$$

$$PHs = C + Pca + Palk \quad (4)$$

Where C is a function of temperature and total dissolved solids (TDS), Pca negative logarithm of the negative logarithm of the concentration of calcium ions and alkalinity of the entire Palk water. Whenever Langelier index is negative, the water tends to be corrosive, the water balance is zero, and if it positive if the water has a tendency to sedimentation. As shown in Table (6) The status of all stations in the river water is corrosive [19].

Table.6. Status of river water for industrial use

Station	career	Symbol	Alkalinity According CaO	Ca	Coefficient C	PHs	PH	Is	Status
Doab- mereg	wet	W1	10.764	58.4	11.28	8.5	7.64	-0.86	Corrosive
	dry	W3	16.79	59.6	11.28	8.3	7.81	-0.49	Corrosive
Hossein abad	wet	W2	10.12	49.6	11.28	8.6	7.72	-0.88	Corrosive
	dry	W4	15.18	53.2	11.28	8.4	7.59	-0.45	Corrosive

Chemistry software also feature classification water quality calculated based on the total hardness stone flooring and also, according to the order of reagent ratios in table (7) and (8) are given.

Table.7. According to the total hardness classification water quality.

Station	career	Symbol	total hardness	Temporary hardness	permanent hardness	Quality status
Doab-mereg	wet	W1	202.12	202.12	0	Hard
	dry	W3	237.71	237.71	0	Hard
Hossein abad	wet	W2	176.69	176.69	0	Hard
	dry	W4	210.37	210.37	0	Hard

Table.8. Reservoir rock according to the reagent ratios

Station	career	Symbol	reagent ratios				
			Ca/Mg	reservoir rock	Non-equilibrium index Claire and alkaline	Na/Ca	an igneous rock
Doab- mereg	wet	W1	2.56	Dolomitic limestone	-0.38	0.16	Alkaline feldspar - basalt
	dry	W3	1.66	Dolomitic limestone	-0.18	0.02	Alkaline feldspar - basalt
Hossein abad	wet	W2	2.32	Dolomitic limestone	-0.57	0.04	Alkaline feldspar - basalt
	dry	W4	1.69	Dolomitic limestone	-0.27	0.03	Alkaline feldspar - basalt

CONCLUSION

Given the importance of rivers Gharasoo in this study in order to assess water quality was conducted during drought and wet. SPI drought index showed that the study area in wet year 1994-1995 and 2007-2008 dry years has experienced. A long drought in the region has led to increased concentrations of most water quality parameters. Then in two Doab-mereg and Hosseinabad stations water quality river in stations studied were lower in dry years than in wet years. And a total station in the Doab-mereg each year have the lowest quality. According to Schuler quality diagram Both stations are placed within range good. And according to the quality standards for drinking water table, both stations are located in an excellent area and will not cause problems for drinking. According to Wilcox diagram of Agricultural in both wet and dry years, both stations are placed in classes C2S1 is a little salty, but is suitable for agriculture. Water Quality Survey of Industrial Langelier saturation index (Is) showed that all the stations you are Corrosive water. Also quality of river water according to the total hardness classes are placed in hard water.

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