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Water Quality Assessment of Karoun River Using WQI

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ABSTRACT: Population growth and pollutions resulting from the discharge of various urban, industrial and agricultural, sewages, emulsions of waste disposal places and surface runoffs caused the pollution extension and more limited water resources. The zoning of water quality in this river is the initial and most important phase of quality management, because it informs the analyzer from the process and nature of pollution changes related to the time, place and special conditions. Karoun river in Karoun and Dez catchment with 65509 km^2 is one of the most important rivers in Khoozestan province originated from Zagros mountains .To determine and classify the water quality of this river in Ahwaz, three stations were selected on this river and sampling was conducted monthly for one aqueous year (June 2009 to July 2010). Then using the index regime of the water quality and based on the curves and qualitative index tables given by American national sanitation association in 1970 , the annual and monthly qualitative index for any station was determined .Also different stations classified along the path of the river. According to the obtained results, the range of annual quality in different stations was 463-394. The most amount of the quality index was related to Zergan station in upstream and the least to the Pole- Panjom station in the middle of the river in Ahwaz. At each three stations, the quality of water is categorized in a bad class. Altogether, with respect to the classification regime of quality index, it is revealed that Zergan station is located at the fourth group meaning the occurrence of dangerous changes in aqueous regime and Pole -Panjom and Omotomei stations at the fitfth group meaning the pollution at a very dangerous level.

Key words: WQI, Karoun River, Pollution, Assessment

INTRODUCTION

Being aware of surface water qualitative status allows to utilize it in different cases as well as to assign the methods with the least damage to this resource. Various techniques have been studied all over the world to measure the quality of surface waters which among them, the water qualitative indices are the most conventional and simple methods all around the world.

Regarding that Iran is considered as a dry country, development of usable resources, protection and improvement besides its quality are vital matters. In this regard , qualitative indices of water as a method for determining the rate of water pollution may play a very important role because of its simple and easy application and stating the results simply and understandable by the public even non-expert persons.

Therefore , by zoning the pollution and presenting a proper view of qualitative status of surface waters the people cooperation in protecting the and quality of surface waters will be achieved and a useful tool be available for making more informed management decisions that their biological consequences are directly or indirectly on the countrýs surface waters.

Among various water qualitative indices, National Sanitation Federation of Water Qualitative Index (NSFWQI) presented by American national sanitation association in 1970, it is one of the most simple and usable methods for evaluating the water quality (Gharanee, 1994).

In a survey conducted by ecology department of Washington State in 2002, water qualitative index was used to evaluate the water quality of this state˙ rivers. In this research, 62 stations showed that at %5 significant

level, the change of water qualitative index scores had an incremental trend (Washington State, Department of Ecology, 2002).Also in Hong Kong, comprehensive studies have also been done about the water quality. The resource of supplying the water in Hong Kong is Dongeiang River. In a regularized plan, controlling the water quality of these rivers was accomplished by the water supplying department of Hong Kong. In this plan, various pollutants and related parameters were identified in all of the rivers (MS cheung and Hong Kong, 2002).In October 2000, the ecology department of Washington State started the water quality plan in five famous catchments of this state which were important from view of production of trout fish. The results of this study showed that the water quality in these five catchments except Sedar Keric was high (summers, 2001). In catchment of Jaboata river , temperature factors , PH, electrical conductions , chloride , alkalinity , solvable oxygen , oxygen required for biochemistry , nitrate ,total phosphorous and coliform were measured at eight points of the river monthly from March 1998 to Febraury 1999 in order to study and evaluate the quality of water.

The aim of this research was to evaluate the effects of human activity on the quality of water. The results showed that the concentrations of solvable oxygen, total phosphate and coliform have been in critical level (Donizetti and calizia, 2003). In 1994, self – purification of Jajrood was studied with respect to the quality of its water and the rate of river self- purification determined by considering physical, chemical and its sewages (Najafi , 1994).

Within four years, qualitative changes of Qareghach(Mand) river water was studied by Gharaee. Analyzing the statistics of discharge and monthly chemical analys of water during these four years was performed (Gharaee, 1994). Tafarzadeh et al., studied the effect of entering agricultural sewages and relevant industries on the quality of Dez Ramord river water.

The catchment of Karoun and Dez involving 6550 km^2 has been located as one of the most important catchment of the country at the heights of middle Zagros limited to five provinces of Chaharmohal Bakhtiari, Fars, Kohkiloye and Boyer Ahmad, Lorestan and Khoozestan . Karoun river is the most important river in this area originates from these faults of middle Zagros at altitude of 3500 km from the sea level and which crossing the mountainous Zones , three original braches of Karoun , that is , Khersan , Bazoft and vanak are linked to each other and set up Karoun. Crossing Shahid Abbaspoor dam and passing 400 km in Gotwand, Karoun descended to the sea level of 80m and enters Khoozestan plain. At the north of Molla Suni , Dez river joins to Karoun and after passing 30 km , Karoun will cross Ahwaz and in its south , after passing 200 km of a semiarid zone in the south of Khoozestan plain , it arrives to Khorramshahr . After arriving to Khoramshahr , Karoun is divided into two branches of Bahmanshir and Haffar that Haffar connected to Arvand and the other Branch , meaning Bahmanshir is poured into the Persian Gulf through Abadan (Naderi Boldaji and Balaghi Aynalo , 2011) . This river in its passing way of Ahwaz provide the drinking water of Dezfool, Andimeshk and tens of villages at its ways as well as the water required for the industries of Haft Tapeh and Karoun sugar filteration , Dezfool sugar , pars paper-making , Ramin and Zergan power plants , hays and poultries production , pasteurized milk of Shush and tens of small and middle units.

Karoun river is one of the most important resource of supplying the water of surrounding agricultural lands including thousands acre of Haft Tapeh and Karoun sugar- cane lands at a rate of 1.6 billion / m^3 per year (Jafar Zadeh and et al , 1998) . The aim of this research is to evaluate the quality of Karoun River based on the WQI.

MATERIALS AND METHODS

To evaluate the quality of Karoun river water in Ahwaz, three stations along the river during four seasons were sampled. After delivering to the laboratory, the samples were measured based on the stated standard methods in water and waste water standard methods book, 20 the edition.

To analyze the qualitative data of water at different stations, the regime of water qualitative index has been used .For this purpose, firstly the seasonal mean is calculated for any parameter and then with respect to these rates and by using suitable criteria curves available for any parameter, the purity of that parameter is extracted and recorded. The weight of each parameter in table (1) and the water qualitative index at different stations in any season are calculated , Based on that and with the aid of table (2) , the quality of the river water may be classified in five groups . To calculate the index, the following relation is applied. Relation (1) is a weighted – linear function given by Brown et al(Ott, 1987).

Relation1: $NSFWQI=\sum WiQi$

Qi: sub- index of each factor

Wi: weighted factor of any parameter

To determine oxygen solution parameter because the related curve is based on the percent of saturation, initially by considering temperature, altitude and atmosphere pressure, the rate of saturated oxygen solution is

extracted and then with respect to the rate of extracted saturated oxygen, the percent of saturation is calculated for it. The sum of the qualitative index at different seasons determines annual qualitative index. Table (3) shows the classification of the river water quality based on annual qualitative index and features of any class (Nasrollah Zadeh and Vardi ,2002) .

Table1. The final weighting of parameters in NSFWQI

Parameter	Final weighting
DO	0.17
Fecal Coli form	0.16
pH	0.11
BOD5	0.11
Nitrate	0.10
Phosphate	0.10
Temperature	0.10
Turbidity	0.08
TDS	0.07

Table2. Colors and definition used in the classification of pollution using NSFWQI

Color	The numerical value of Index	Definition
Red	0-25	Very bad
Orange	26-50	Bad
Yellow	51-70	Moderate
Green	71-90	Good
Blue	91-100	Excellent

Table3. Classification of water based on annual quality index of rivers

General status
1.clean and health water 2. without contact or contact with indoor pollution 3. Ideal for natural applications as fish raising and will life 4. This state is observed in some of the rivers as limited
1.Onset of serious changes in the water status as the result of environment destruction 2. Contact with domestic and agricultural pollutions 3. Usable with simple preparations for domestic and industrial 4.Suitable for the requirements of wild life 5. Reproduction of immigrant fishes is affected
1.Making severe changes in water properties 2. Onset of changes in color and smell of water 3.Usable through serious preparations for domestic and industrial applications 4. Lowered return of reproduction in fishes and the other aqueous groups 5. The possibility of occurring the damages of aquatic vertebrates at some days of the year
1.Development of dangerous changes in aqueous systems 2. Substitution of the group resistant to the pollution 3.Mass losses of vertebrates and the other aquatic consumers 4. The risk of the disease prevalence and causing the poisoning for the human 5. Usable to the animal groups compatible with pollution 6. Destruction of almost the whole native live community is observed
1.Pollution at a very dangerous rate 2. Chemical pollution at very high extent 3. Conventional usages are not mostly possible 5. Some of the rivers may partly observed

RESULTS AND DISCUSSION

The results of calculation based on the regime of the water quality index at table 4 and Figure 1 show that at all stations and seasons studied the water quality is located at a bad position. Comparing the results of water qualitative index shows that in spring the highest rate of qualitative index is related to Pole- Panjom station and the lowest related to Omotomei station.

In summer, autumn and winter .The highest rate of qualitative index is related to Zergan station and the least to Pole-Panjom station. In general, the highest rate of the water qualitative index in winter has been observed at Zergan station and the lowest in summer at Pole -panjom station.In addition, comparing the results of annual

water qualitative index show that the highest quality of water is related to Zergan station and the least to Pole - Panjom station.

Table4. Seasonal and annual water quality index (WQI) in stations

Station	Autumn	Winter	Spring	Summer	Year
Zergan	38	42	35	40	463
Pole panjom	34	31	38	29	394
Omotomeir	37	40	34	32	428
Total Mean	36.33	37.66	35.66	33.66	428.33

Regarding table 3 and Figure 2, it is revealed that station Zergan is located at fourth group. Some features of this group include: making dangerous changes in aqueous system, substituted resistant group to pollution, mass losses of vertebrates and the other aquatic consumers, risk of disease prevalence and poisoning for human, usable for almost all the native live community.

Two stations Pole- Panjom and Omotomei are located at fifth group from the view of qualitative classification with respect to table 3. Pollution at a very dangerous level and chemical pollution at a very high extent are two remarkable features so that conventional usages are not completely feasible and some of the rivers may partly be observed.

The results of the samples chemical analysis show that at the path of Karoun river in Ahwaz, various factors affect on water quality. Some of the most important factors include ; the pollutant industrial units present at the path of river and the entering of industrial waste water of these factories to the river that the most important of them including, Zergan power plant , Khorram Noosh soft drinks manufacture , pipe rolling , steel national group ,Farcit and Ahwaz industrial slaughterhouse as well as agricultural lands and outflow of the wastewater , the presence of villages and different towns on the way and direction of river and entering of waste water resulted from these centers to the river.

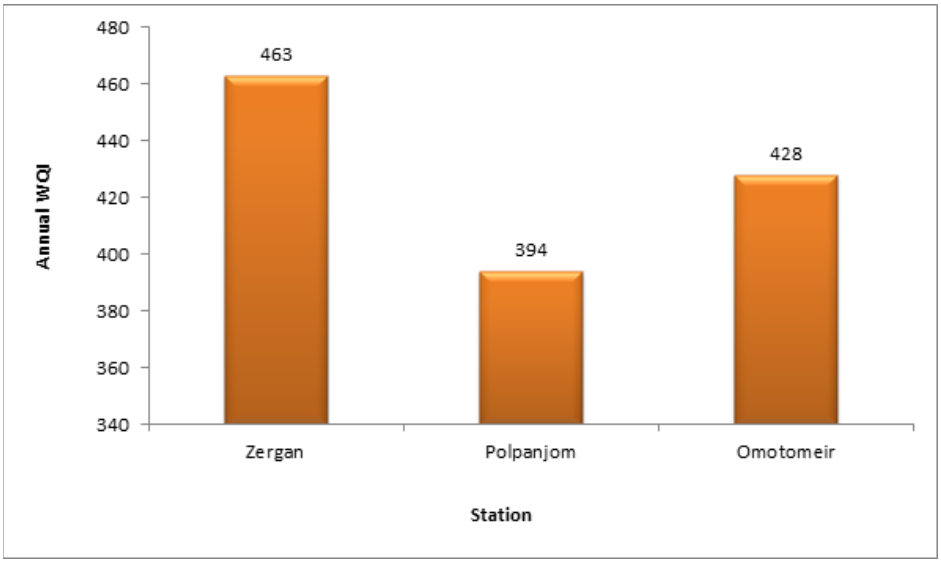

Figure1. Comparison of annual water quality index in stations

As shown in Figure 2, at all present stations in the way of Karoun River in Ahwaz especially Poli Panhom station, the quality of water has been dropped and is in a bad condition due to various pollutants above mentioned.

Moreover, comparing the seasonal index of water quality at study stations (Figure 2), shows that the water has had the worst quality in the summer and the best condition in winter due to increased precipitation and thinning the pollutants.

In sum, regarding the regime of classification the qualitative index annually, it is found out that Zergan station is located at fourth group from the view of classification of the water quality index, that is, making dangerous in aqueous system and two station of Pole -Panjom and Omotomei are located at fifth group, that is, making pollution at a very dangerous level.

Hence, the general condition of the river water is evaluated at a bad position regarding the stated cases. It is an indication of requirement to management policies and qualitative protection of water resources.

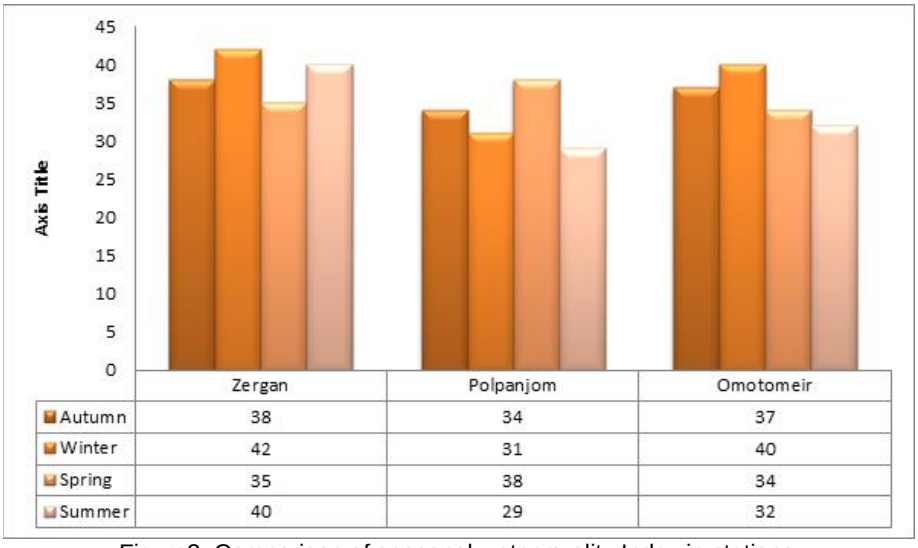

Figure2. Comparison of seasonal water quality Index in stations

Table5. Comparison of WQI in Karou River with other rivers

River name	WQI value	Country
Sg.Lagast	67-87	Malaysia
Cauver	50-70	India
Vrishabhavathi	25-50	India
Oregon	78.9-88.0	USA
Tajan	80-95	Iran
Dez	47-70	Iran
Karoun(present study)	29-42	Iran

The KarounWQI comparison with the other rivers in different countries showing that the mean of WQI in Karoun is lower than American and Malaysian rivers and some of the rivers in India.

In addition,comparing the quality of water in this river with Tajan and Dez rivers in the country showing that the quality average of Karoun water is lower than Tajan in Mazandaran province and Dez in Khoozestan province.

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