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Study of water quality using the NSFWQI in the year 2014 case study: Chahnimeh reservoir of Sistan

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Abstract
Recently, as human population has been increased, water problems and its distribution have affected water storage, especially in arid and semi-arid areas like Sistan and Baluchistan province, Iran. The aim of this study was to investigate the water quality of Chahnimeh reservoir of Sistan, Iran during different seasons of 2014. The sampling was done in the spring and fall of 3 stations and polluted parameters such as PH, TC, BOD, DO, nitrate, phosphate, temperature, turbidity and fecal coliforms were measured. The collected data were used to calculate water quality index (NSFWQI). NSFWQI showed the good quality of water, except at station 1 in fall season where has moderate quality. Additionally, the studied parameters were within the standard of compliance for drinking purpose.

Keywords: Sistan and Baluchistan province, Surface water, Water quality index, Water pollution

1. Introduction
The exploitation of natural water resources is requires understanding of the quantity and especially the quality of them, due to water resources are the ultimate recipients of pollution that caused by various natural and human activities [1, 2]. Water in the path of the river transfers different materials which are made from stone (salts gypsum, salt and lime in the sedimentary and evaporates formations). Water quality depending on the length and frequency of dissolution material in the path can be found very different in different places. This phenomenon is especially important in our country [3]. So that problem most of the arid and semi-arid regions is not only droughty But also the poor quality of the available water is added to it [4]. Certainly only by knowing the qualitative features water can plan for better exploitation of water resources of the region. Since the Chahnimeh Sistan is as one of the water resources of Zabol city and used for the different purpose such as drinking water, agriculture, industry and livestock [5], therefore, the study water quality is necessary.
Considering the important role reservoirs Chahnimeh in economic development, social area, preservation and expand these water resources is necessary. The first step in order to the preservation of this resource is accurate identification physical and chemical properties and biological of these resources and determining the water quality reservoirs. The context for planning principles and scientific to improve the quality and quantity of the reservoirs; increase the efficiency of health and agriculture in Sistan plain [6]. Nowadays for monitoring and control the quality of surface water, water quality indices are used. Various water quality indexes have been developed in the past 40 years while one of the earliest efforts to develop a WQI was done in association with the National Sanitation Foundation (NSF) [7] that the express results in simple language and understandable important role play in the study of water quality. the application of this method, based on the parameters such as BOD, PH, DO, TS, turbidity, nitrate, temperature, phosphate and is fecal coliform, using this index very popular, for classification of surface water quality for drinking is complete and comprehensive index. For assessing the quality classification of various rivers some indices were used and its results showed the effectiveness those methods [8-10]. In Malaysia and Indonesia qualitative index NSFWQI and WQI were considered the best index for monitoring surface water quality [11]. Fabiano *et al* In a study in Brazil in 2008 during the two-year study on the water quality of the two Rivers, they were evaluated by using qualitative indices WQImoc،WQImin ،NSFWQI to have concluded that WQI index is an appropriate index for zoning water quality these rivers and critical stations in the two rivers have shown that requires to control and manage strong [12]. Based on studies in Iran and other countries in recent years, the water quality index (NSFWQI) for monitoring and evaluating the quality of

surface water such as rivers, lakes, ponds and tanks, this index are introduced as good, applied and best indicator of water quality index.

2. Methods

2.1Study Area

The study area includes lakes number 1, 2 and 3 Chahnimeh Sistan where is located in Zabol city which includes50 Millions square meter extent. The first Chahnimeh is started from Afghanistan border parallel to Sistan River up to 6 kilometers from Zahak city. The second Chahnimeh starts from Afghanistan border and ends to the middle of first Chahnimeh and the third Chahnimeh is located at west of second Chahnimeh (Bandab Consulting Engineers, 2003). The geographical boundary of the region is from 30^0 45' to 30^0 50' northern latitude and 61^0 35' to 61^0 45' eastern longitude [13]. This study was a cross-sectional that was conducted in spring and autumn (in 2014) and sampling was taken from three stations first Chahnimeh reservoir. In order to check water quality Chahnimeh sampling was conducted in Parts of the input, middle, output reservoir and the samples were collected in a volume of 500 ml. The purpose of this study reviews the change in the parameters of the region in spring and autumn. After sampling to determine some of the physical and chemical parameters of samples were transported to the laboratory. Certain parameters are included DO, BOD TS, nitrate, phosphate, fecal coli form, PH, temperature and turbidity. Determine the amount of each of these parameters in the reservoir and comparison with Iran national standards specified the quality level of water to national standards. After measuring the physical and chemical properties, water quality was determined by using the Water Quality Index (NSFWQI). This index is useful tools for expression easier, water quality in order to public awareness and managerial purposes and summarizes large amounts of data on water quality and in a word is good or bad water quality. The parameters used in this index include: The biochemical oxygen demand (BOD), dissolved oxygen (DO) fecal coliform, nitrate, PH, changes in water temperature, total dissolved solids, total phosphorus and turbidity. In order to use the index, the above-mentioned parameters were measured by standard methods at different stations, and then results were analyzed by using the index. For using this index initially calculated values through physical experiments, chemical and microbial conducted in the laboratory, according to the desired unit on the NSFWQI standard curves. NSFWQI Supported by National Institutes of Health in America 1970 which reduced quality index based on a survey of a large number of professionals with diverse expertise in the field provided. Firstly they were introduced 35 qualitative parameters and according to experts, about 9 parameter selected for quality index (7). For calculating this index, the two weight parameters and qualities parameters are involve in it that are shown in Table(1). After the measured, by using converted curve or by using the related programs, the final amount of each sub-criteria of equation (1) is obtained. Ii in relation to the sub-criteria (quality parameters) and Wi is the weight coefficient of sub-criteria (7)

Equation (1)

$\sum W_i I_i$= NSFWQI

Table 1: The Classification of the Index (NSFWQI) based on the color and quality of numerical values.

NSF-WQI Score	Rating
91 - 100	Excellent(E)
71 - 90	Good (G)
51 - 70	Medium
26 - 50	Bad (B)
0 - 25	Very Bad (VB)

3. Results and Discussion

According to the results obtained of laboratory assays 9 parameter: DO, BOD, TS, nitrate, phosphate, fecal coli form, PH, temperature and turbidity, which is shown in Table 2, water quality index (NSFWQI) is calculated in two Season for three station determined and trends of water quality index during the study period are summarized in the form of Figure 1. The graph shows that the water quality index changes according to the same conditions were not very different

Table 2: The results of qualitative measured of reservoir Number One Chahnimeh

	Parameters	Spring			Autumn		
		Station 1	Station 2	Station3	Station 1	Station 2	Station 3
1	Temp(°C)	21	21	23	21	22	22
2	DO mg/L	7.75	7.65	7.7	5.08	4.83	4.7
3	pH	8.35	8.31	8.45	8.49	8.47	8.5
4	BOD mg/L	1	1	1	5	2	3
5	Nitrate mg/L	3.4	3.01	2.1	2	1.02	0.9
6	Phosphate mg/l	0.12	0.1	0.11	0.1	0.08	0.07
7	Fecal Coliform [MPN/100 nl]	2>	2>	2>	2>	2>	2>
8	Turbidity (NTU)	19	16	16.1	153	8.6	7.8
9	TS mg/l	807.34	795.04	793.8	1327.3	734.14	726.66

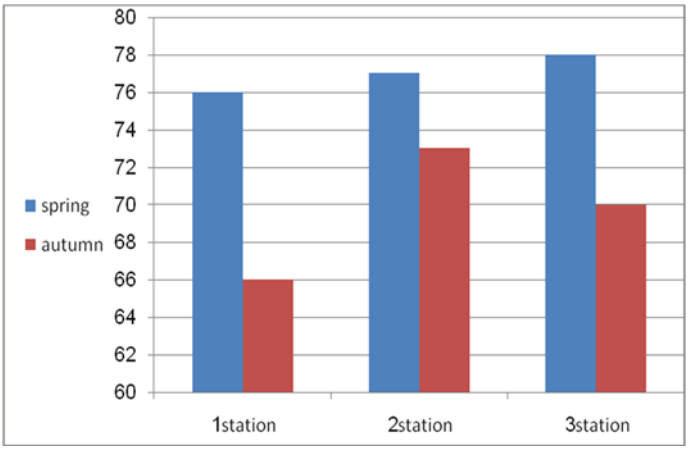

Fig 1: Water quality index NSFWQI of three stations at Chahnimeh

As can be seen from the graph fluctuations quality index is between 66 and 78. Water quality index is in good range, except in station 1 that medium quality has in autumn season. The results of measurements of water quality parameters Chahnimeh reservoirs show that the amount of turbidity and TS more than other parameters NSFWQI index affect on reservoir quality and its rate has decreased. Generally water quality in reservoirs Chahnimeh because of closed environment and lack entry wastewater, industrial and

agriculture is almost identical. Seasonal changes amount turbidity, which is in the range of 6.7 to 153 shows that the amount of turbidity in autumn is more than spring, that in autumn season has been observed highest in station 1 and in station 3 lowest amounts which was higher than the WHO standard which 5 was determined and is not suitable for drinking. The numerical values obtained in Table 1 shows that the highest amount of nitrate in spring and lowest amount is in autumn season. According to the maximum allowable nitrate in drinking water is 10 mg/l, the quality of this parameter is appropriate amount. These parameters were in good condition in the sampling period. Since the entry source of nitrate in the water is, organic materials or chemical fertilizers probably pollution sources are not in upstream reservoirs. According to a study conducted by Homayonzad *et al*. in Chahnimeh reservoir sistan it has been shown that Nitrite and nitrate do not cause particular problems in the reservoir [14]. This indicates that at the time of the study, there was not considerable pollution in reservoir. WHO standard amount phosphate in drinking water has announced 5mg/l. that the amount of phosphate in station is less than this value. The data shows the highest and lowest concentrations of dissolved oxygen are to respectively in spring and autumn. The importance of dissolved oxygen in this is that with suitable concentration dissolved oxygen in water is preserved aquatic life. In the European standard minimum dissolved oxygen to preserve a variety of aquatic life is 4 mg/ l. In a survey Sanchez *et al* did about assessment NSFWQI index on the river Guandarrama [15]. As well as in study of Samarghandi *et al* using NSFWQI index on Ekbatan Lake reservoir in Hamadan city, the dissolved oxygen have reported a during the months of wet more than dry months that with results obtained in this study are similar [16]. Amount PH and TS during the sampling period is lower than the standard allowed. Amount TS in station 1 is in autumn more than other stations. Coli form index one of the main microbial indicators of water that by determining it can be realized to water pollution to human or animal waste. Considering that the drinking water standard, for mentioned parameters based on WHO has been zero so this parameter is a good situation. NSFWQI index were used for zoning Zohre river, results of the studies showed that the river's water has been good quality [9]. Mirzaee *et al* assess the quality of Jajrood River using the WQI index. The results showed that water quality have dropped because of area nearby population centers and due to the entry of microbial contaminants and increased turbidity [8]. Samadi *et al* assess the quality water of Moradbeyg River, Hamadan based on NSFWQI index that results showed from entry pollution to river [10]. The results showed that water quality in desired area is considered of component from waters with medium quality.

3. Conclusion

In the end, we conclude today with severe droughts and reduced rainfall and increasing population from one side and human activities on the other side, water quality have changed. Chahnimeh water resources in Sistan and Baluchestan Province, due to the fact that are in dry area, from this rule are not exception.

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