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Assessment of surface water quality using Water Quality Indexes: A case study of the Baba Aman River, Bojnord

Somayeh Iranmanesh[1], Azadeh Atabati[2], Ghasem Zolfaghari[3]

1.Faculty of Geography and Environmental Sciences, Hakim Sabzevari University; somayeh.iranmanesh.62@gmail.com
2.Faculty of Geography and Environmental Sciences, Hakim Sabzevari University; a.atabati@hsu.ac.ir
3.Faculty of Geography and Environmental Sciences, Hakim Sabzevari University; g.zolfaghari@hsu.ac.ir

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ABSTRACT

Baba Amman River is the major sources of water for agriculture, industrial, and household in the city of Bojnord. Water quality monitoring is necessary to ensure that waters can continue to use for many different ways. In this study, surface water quality data for 9 physical and chemical parameters collected from 7 different stations thereby after, before and from city of Bojnordon the rivers were analyzed during the spring season of years 2016. Parameters included dissolved oxygen, fecal coliform, PH, temperature difference, biochemical oxygen demand, nitrate, turbidity, total phosphorus, total dissolved solids, were measured according to standard methods. Water quality index was then calculated using water quality index (WQI) given by National Sanitation Foundation (NSF) information system.WQI showed that the index for all the 7 stations ranges between 52 and 64 during period of study. Therefore the studies are classified as medium class based on WQI. This category shows that water quality of Baba Amman River is

suitable indifferent sectors such as breeding fish species, animals and domestic uses after suitable treatment. Overall, comparison of water quality index in different sampling stations of Baba Amman River showed that 2 stations are nearly poor water quality due to the proximity to the slaughterhouse and wastewater area that indicated with lowest quality and most pollution.

Keywords: water quality, Baba Amman River, Water Quality Indexes

1. INTRODUCTION

Rivers are as one of the most important sources of water and a natural resource which has been widely used for many purposes, namely for irrigation, drinking, domestic, and industrial. The value of surface water lies not only in availability but also in its consistent good quality, which makes it an ideal to use drinking water. The rapid urbanization in the past has more influence on the surface and groundwater quality due to over exploitation of resources and improper solid waste management. For this reason, monitoring of surface water quality to identify main causes of pollution is very vital to man's existence (1, 2). Population growth, industrial development and agricultural activities are the emission of pollutants into the aquatic environment (3).Maintaining natural water quality requires a good understanding of its characteristics and identify the sources of water pollution are causing. Today, water resources, especially rivers, are faced with serious problems of pollution. Such as rural and urban sanitation, drainage and waste water discharge into rivers agricultural, consumer industries of some of the water in rivers and streams can be mentioned in the privacy of construction operations have not been studied. Water pollution occurred as a result of sewage urban and rural households and public places such as hotels, restaurants and medical centers. This type of sewage have a lot of nutrients and pathogens. Source of waste is from gardens and farm fields contain chemical fertilizers, pesticides, herbicides and other pesticides. Feed water from drains and rivers is increasing nitrate concentrations. Nitrate fertilizers, the most important source of agricultural pollution in surface water and groundwater are (4).land use are also significant elements in relation to water quality. Different types of land use affect the water quality for example agricultural and household fertilizers contain different chemicals such as nitrogen and phosphorus.

Urban and agricultural land use has significant effect on water quality, so that the basin with agricultural land use and urban high compared to the basins that these users are less, the salinity and pH is higher. Electrical conductivity and total dissolved solids water to urban and agricultural areas due to the arrival of soluble salts from urban and agricultural areas is higher compared with other users(5).The importance of organic materials because oxygen compounds discharged from various sources over the river and the subsequent depletion of dissolved oxygen in the river and one of the most important reasons for the study of nutrients which consists mainly of nitrogen and phosphorus, it is the drain-containing compounds this materials, would be river Eutrophication and subsequent aging. The problem with the production of algae toxins in river water quality both aesthetically and from a loss both in terms of health (6).

One of the easiest methods for determining water quality conditions is water quality indicators (e.g WQI) that can be used as a decision making tool for managers and professionals (7). One of these indicators is water quality that introduced by the National Health America. This index was developed in the nearly 1970s and widely used to monitor water quality changes around the world. Various parameters of physical, chemical and biological parameters including dissolved oxygen, pH, total solids, biochemical oxygen demand, turbidity, temperature, phosphate, nitrate and fecal coliform taken into WQI method. Water quality index is a comprehensive and efficient tool to determine the condition of water quality that more applications than other indices (8, 9).Based on the results of WQI, river water can be classified into 5 classes for the purpose of various uses.

Rosli et al. in 2012, water quality Salek located in Malaysia using the examined indicators. The results show that the amount of low dissolved oxygen and high levels of chemical oxygen demand and lead to its water according to the index in polluted waters classified categories (10).

Samantrayet al. in 2009 using NSFWQI indicator, was assessed of Mahanadi and Atharabanki Rivers in India. The results showed that water quality indicators used by industry has decreased due to human activities (11). Hosseini P. et al in 2013 examined Karun River water quality in the years 2007-2011 using water quality index in the range NSFWQI Zergan stations to Kot Amir. The results showed that the water quality of the river, over the last 5 years from the category of good and average in 2007 to the category of bad 2011 declined and the river on the 3rd floor Classification System Annual water quality is in this range of self-purification of river is too low(12).

In another study in Iran by Khairallah et al., 2011, Karkheh Lake using water quality index, were studied based on the results of this study, the value of this indicator in the worst situation relating to the first station, Seymareh, in summer season 54/40 equivalent calculated that concluded that the situation is bad qualities (13).

Baba Amman river flows in East Bojnoord city. Tues main branches of the river, the Chenaran, Bazkhane and Firoze Rivers, respectively. Bazkhane and Firoze Rivers after joining together, in a place called Baba Amman to join Chenaran River. Baba Amman output Bojnoord river plain to the river joins Atrak. Baba Amman River supplies drinking water and agriculture demands. This study aimed to evaluate the water quality Baba Amman in the range of Bojnoord by the NSF Water Quality Index was conducted in the fall of 2016.

2. MATERIALS AND METHODS

Firozeh River, one of the most important rivers of Bojnoord, is located in the northwest of this city. The study area locates. The most important population center of this plain, the city is the center Bojnoord North Khorasan Province as well. In this plain, Firozeh River from Southwest, Bazkhane of South and Chenaran River basin to the northeast Prairie flow. Baba Aman River from the confluence of these two channels are formed which, after crossing the plains output Atrak joins the river. The survey was conducted in this field and river sampling sites on the major sources of pollutants upstream, seven stations were identified. Figure 1 shows the position of the stations studied. The sampling sites were: (1) The beginning of the Baba Amman (2) The entrance waste water purification (3) Station3 (4) Chenaran river is connected Baba Amman river (5) Station 5 (6) Station 6 (7) Baba Amman is connected to Atrack River. Season autumn, December 2016 in each station after the registration of geographical location, temperature and conductivity thermometer and conductivity meter in the same sample was measured and water samples in standard bottle was collected and stored at 4 ° C to Lab trusted environment, city Bojnoord, was transferred. In the laboratory, nitrate, phosphate, total dissolved solids, fecal coliform, turbidity, BOD5 were analyzed according to standard methods (14).

Figure 1 The sampling sites

Water quality index

According to Equation 1, the index NSFWQI is calculated the sum of the weight parameter Qi and quality Wi parameter. In this study in order to precisely calculate the index, online software is used to calculate NSFWQI (15).

$$NSFWQI = \sum W_i Q_i \qquad (1)$$

The amount of dissolved oxygen, based on water temperature and height the location of the software solution has turned to the percentage of oxygen saturation(16).And then by putting the value of each parameter in the online application calculates NSFWQI, the index value was calculated for each parameter and finally calculating the mean values for each station or months. This index has a value between 0 and 100 which ranked in the excellent water quality (100-90), good (90-70), average water quality (70-50), fair water quality (50-25) and poor water quality (25 -0) (17).

3. RESULTS AND DISCUSSION

Parameters for calculating NSF WQI includes 9 parameter dissolved oxygen, fecal coliform, BOD, pH, temperature, phosphorus, nitrates, turbidity, total dissolved solids, and the results from this study include the index NSF WQI according to various parameters stations Baba Aman studied river in table 1 is shown.

Table 1 NSFWQI Index (these numbers are indicators that the model output has been calculated by Equation 1

Parameter / Station	DO	FC	PH	BOD	TS	T	PO_4^{3-}	NO_2^-	Turbidity	WQI
Station 1	60	47	63	53	20	92	81	80	89	64
Station 2	56	49	87	11	20	92	17	96	74	56
Station 3	53	22	87	14	20	91	17	95	77	52
Station 4	60	47	87	51	20	88	16	95	85	61
Station 5	59	40	83	45	20	92	30	94	86	60
Station 6	57	42	87	34	20	91	24	95	70	58
Station 7	70	36	80	39	20	89	25	95	89	60

The results of the study showed that, based on this indicator for all the stations varies between 52 and 64 and According to the Index, the middle class (70-50) are placed and water quality is moderate (Figure 2). According to Figure 2 the highest water quality index to Station 1 (of joining Bazkhane and Firoze Rivers) index 64 the least amount of Station 3 (range slaughterhouse) with an index of 52 and Station 2 (the entering wastewater treatment plants Baba Amman urban river) is the index 56.

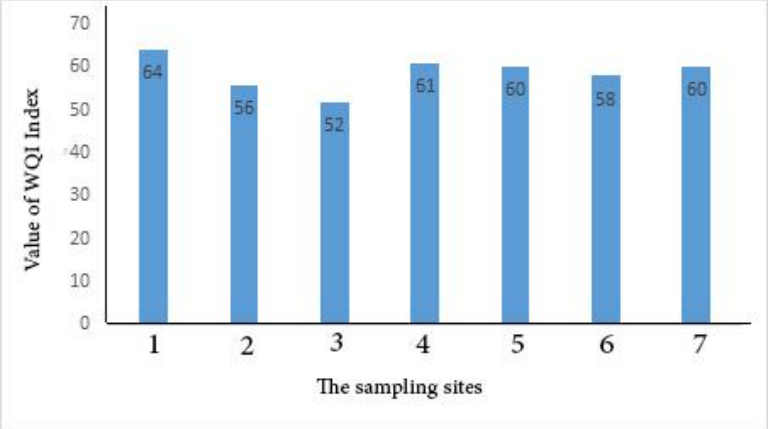

Figure 2 NSF WQI Index at different stations

The total dissolved solids in all stations more than 500 mg/L is the minimum standard in accordance with the Index 20, for which purpose the resulting changes had no effect on the water quality index.

Parameters measured in this Index between 9 parameters that reduce this indicator is fecal coliform, BOD and phosphate, respectively. Because the water quality of the middle class, relatively large quantities of nutrients, particularly phosphate and coliform is caused by the discharge of wastewater treatment plants in urban, industrial slaughterhouses, wastewater agriculture (resulting from the application of chemical fertilizers animal), animal husbandry and traditional Dad is safe recreational activities along the river. The parameters listed as nitrogen and phosphorus nutrients if not controlled, will cause Eutrophication risk.

Phosphates in surface water mainly from municipal wastewater containing synthetic detergents based on phosphate, Industrial wastewater and runoff of agricultural land which is being used for mineral fertilizer derived (18).

The results showed that the activities of agriculture, livestock, industrial, recreational and urban wastewater entering the river water quality is impressive. So that the upstream station (Station 1), better quality was observed. Station 2, due to the arrival of wastewater and proximity to the slaughterhouse station 3 has the lowest quality and most were contaminated. Bykan et al in their

study on the river Kzylyrmak came to the conclusion that the high organic loading and unloading of nitrate River drainage basin is home villages (19).

Evaluation of water quality interval Ahvaz Karoon River using Water Quality Index showed the monthly water quality index in this period varied in the range of 70-57 placed in the middle group. At the station upstream, because of flooded sewage various municipal, hospital and factory index from a range of quality, higher and at stations downstream of entering effluent hospital and the condition of the substrate, water quality index rivers are low and the last station reasons login total municipal waste lowest quality index were recorded. Water quality in different seasons showed in the autumn due to rainfall and reduce emissions best in spring because of reduced rainfall, suitable conditions for the growth of coliforms and increased turbidity worst is that the results our consistent (20).

4. CONCLUSION

According to the index obtained, it was found that the water of the river in the middle, and the feature category, the suitability of water for breeding fish species resistant blue, suitable as drinking water, livestock and if you use it to provide drinking water requires advanced treatment. In few sites, it was moderately polluted in the study area. To protect water resources and prevent declining water quality Baba Aman, identification of pollution sources (the output of livestock and fish farms), pollution control input and also promote agriculture clean (without use of pesticides Vkvdhay Nitrogen and phosphorus to prevent contamination of the river nutrients and prevent eutrophication of rivers) and using biological control and natural and necessary to maintain the required quality. According to the Baba Amman of the most important rivers and drinking water supplies needed for agriculture in Bojnord is, therefore, monitoring, simulation and control of pollutants entering the river is a must.

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