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Studding The Microbial Contamination of the Bahmanshir River Water used Water Quality Index(NSF)

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Abstract: *The purpose of this study is to provide an accurate picture of the status of surface water quality to identify the amount of its pollution with contaminating substances so that the adoption of appropriate management practices for protecting water resources of the country at any point is determined. The objective of this study is microbial contamination of the Bahmanshir River based on water quality index in GIS environment. The method used in this study is quantitative-analytical, and to identify the impact of municipal, industrial, and agricultural wastewater and residential centers from the water outlet of the Bahmanshir River in 10 different stations, a study was conducted. River water quality parameters (fecal coliform, temperature, turbidity, PH, DO, BOD, nitrate, phosphate, Ts) in the summer and fall of 2015, in August and November in 10 to 20 of each month and three times- 6 am, 12 noon and 6 pm- were studied and evaluated. Sampling, preparation, and analysis of samples were done according to standard methods (Standard Method, 1998).. Investigation showed that monthly water quality index of the river during the study period is variable in range of 22_36 and is in poor to very poor group. Water Quality Index (WQI) gradually reduces from the first station to the last station. Station 5 on the Karun River and entry of the Bahmanshir with index 22 in summer has the worst and stations 2 and 3 on the Mard Canal upstream with an index of 36 in the fall have the best status. In upstream stations of the Mard Canal, due to lack of overflow of urban, hospital, and factory sewage, the index has high quality range. In downstream station like stations 5 and 8 due to the arrival of hospital wastewater, the status of riverbank bed has changed, WQI is low, and in station 9 due to the entry of the aggregate of urban wastewater, the lowest quality index was recorded. Studying water quality in autumn and summer showed that autumn has the best status due to the start of rainfall and reduction of the pollutants, and summer has the worst status due to lack of rainfall, high temperature and evaporation, increase in wastewater, suitable conditions for coliforms growth, and increased opacity.*

Key words: *water quality, zoning, Bahmanshir, geographic information system (GIS)*

INTRODUCTION

Wherever it comes to pollution, what preoccupies the minds more than anything else is the issue of water pollution. It is true that water has engulfed three-quarters of Earth's surface, and in the environment is the habitat of many aquatic organisms species, but water resources used by human are on the land man and so more limited and more likely to be polluted. On the other hand, due to the slow mixing and transformation of pollutant materials that enter the water, water pollution shall pass away much later than other pollutions such as air. According to the water circulation in nature, it is seen that if a substance or substances are added

to the water, they circulate with it in nature and if this substance is harmful to animals and human health, or disturbs the ecosystem balance, it will bring about irreversible losses (Younesi, 2007).

Water is an element that Earth and all the creatures' life on it depend on it.

note the importance of this chemical element. Now, if this critical element is contaminated for some causes and gets out of its standard health cycle, it becomes one of the pathogens devastating human life. Water pollution depends on various factors. These factors, in the modern era of today have developed more than ever.Man has started to destroy his environment with his own hands and by entering industrial, agricultural, urban wastewater, and most recently handmade chemical agents to surface and groundwater has called them to a gradual death (Mohseni et al., 2013).

Dumping trash and other municipal and industrial waste on the ground or burying it in the soil as well as importing industrial, agricultural, and urban wastewater to rivers can directly contaminate surface water. Surface pollutant substances either directly enter the rivers or indirectly as the result of being washed away or by precipitation and floods enter surface water and cause the transfer of harmful biological materials to there (Younesi, 2007).

Among the water sources, rivers are the main sources of water supply used for drinking, agriculture, irrigation, industry and so on. Rivers pollution is one of the most important problems of today's world, especially in developing countries, and Iran faces this problem as well.Population growth and increasing human activities in the river basin, domestic and industrial sewage discharges, agricultural activities, runoff, and leachate of waste disposal sites have reduced water quality of these resources. In fact, human activities along with the natural processes have had adverse effects on rivers water and increased the concentration of pollutants (Mohseni et al., 2013).

Zoning river water quality is the first and most important step in the management of surface water quality. Recognition of surface water for drinking, industry, and agriculture seem inevitable. Identification of microbial contaminated areas and pollutants of the area lead to optimum use of water for different purposes. Water Quality Index (NSFWQI) is one of the most commonly used indices to classify surface water quality determines based on the parameters of PH, BOD, TDS, DO, turbidity, temperature, phosphate, nitrate, and fecal coliform (Samadi et al., 2009).

In a study titled "Recognition of microbial contamination of water resources," (Jung et al. ,2014) have stated that microbial contamination in aquatic environments is one of the most important issues in relation to the water used is any country that needs attention of government authorities. Recreational activities and harvesting food from seas and rivers are of the causes of water pollution by pathogenic bacteria, protozoa, and virus.In this study, dangerous native gastroenteresis microbial

contamination is observed. Moreover, the use of optical methods used to monitor microbiological hazards has been suggested at the end of this article.

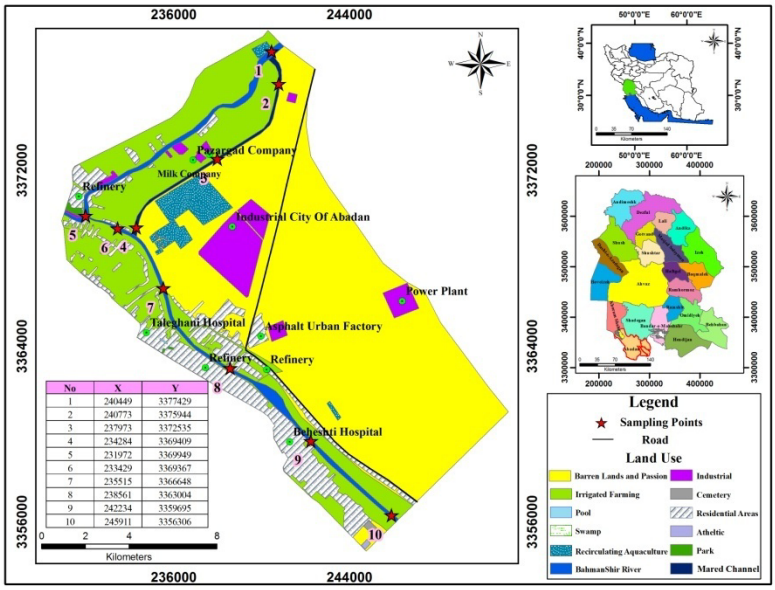
According to the World Health Organization announcement an annual four million children die from diarrhea caused by infection arising from contaminated water and providing clean water for washing and drinking are known as the main factors in the reduction of transmission of diarrheal diseases. Diseases that have water sources distribute by contamination of water source with urine and feces of humans and infected animals, and the dead bodies of animals and decaying plant debris can also be considered as a source polluting water.Of water pathogens causing diseases viruses (hepatitis A and polio), bacteria (coliform, salmonella), protozoa (Cryptosporidium, amebiasis), worms (Schistosoma), and toxins such as arsenic and cadmium can be mentioned. In addition, leakage of sewage pipes has a major impact on the quality of groundwater and surface waters.Leaking sewage contains a range of contaminants such as bacteria and organic and inorganic compounds that can cause serious pollution of ground and surface water and due to having contaminants such as pathogenic organisms and industrial chemicals like detergents can cause problems to public health (Parsania et al., 2011).

Bahmanshir- the modern Persian name of Pahlavi word Vahmanshir also Bahmeshir, Bahralmashir, and Bameshir- is the current name of one of the branches of Karun River in Khuzestan. After reaching Khorramshahr, Karun is divided into two branches; the first branch goes to the Arvand River on the border of Iran and Iraq, and most watery mouth or Bahmanshir, along the Arvand River pours into Bahmanshir Estuary and then into the Persian Gulf.The Bahmanshir River is about 90 km long, 600 meters wide, 4 meters deep, and has an area of over 877 square meters. This river is of the main sources of water supply for drinking and agriculture in Khorramshahr and Abadan. Since this river is diverted from its original river Karun, it should be noted that Karun River collects and empties water of large areas of the country into the Persian Gulf.Due to the topology and geology of watershed and river of Karun, the path at the end of which the river ebbs, Bahmanshir branch, has high volume of pollution density. From the initial source of this river, there are many residential and agricultural areas located in its route that provides a fertile ground for pollution. Surplus of agricultural inputs enter the rivers through the drainage system.In addition, development of industries and factories and the distribution of industrial and urban activities around the river lead to overflow of industrial pollutants into it. Given the importance studying microbial contamination of surface water, studying contamination of the Bahmanshir River is also of great importance that has been studied and statistically analyzed in this scientific research.

Research Methodology

In order to study the status of microbial contamination of one part of the water of the Bahmanshir River, located in the province of Khuzestan(Figure 1), in this study, which is an analytical cross-sectional study, sampling was done in 2015 during two months from six stations and several samples were collected several

times in different months. Sampling was composite sampling. Thus, in each stations samples were collected from three widths (Left Bank, Right Bank and center) and two depths (0.2. and 0.8) using Van dorn containers and after mixing the samples the final sample was taken. In order to increase the accuracy of data measurement, this process was repeated three times and was done every day at 12, 3 and 6 pm in two months in summer (August) and fall



No	X	Y
1	240449	3377429
2	240773	3375944
3	237973	3372535
4	234284	3369409
5	231972	3369949
6	233429	3369367
7	235515	3366648
8	238561	3363004
9	242234	3359695
10	245911	3356306

(November

Figure 1. Bahmanshir River location - Khuzestan province .(Provide from GIS software, 2016)

Quality parameters including temperature, dissolved oxygen, BOD, fecal coliform, nitrate, phosphate, calcium, magnesium, ammonia, PH, conductivity, total dissolved and suspended solids, and pathogens were studied.

1) Collecting relevant data (meteorology, hydrology, etc.) and visiting the area and determining the sampling stations

2) Sampling from the designated stations in dry and wet seasons

3) Analysis of samples

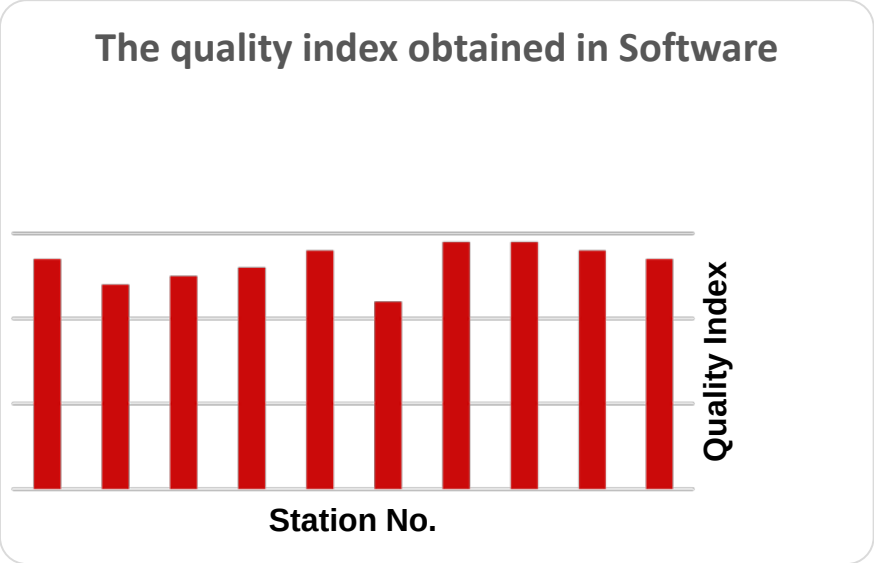
4) Data analysis (statistical analysis)

5) Determining NSF index and microbial contamination

6) Zoning of microbial contamination in GIS environment

Research findings

According to the results of laboratory measurements, 9 parameter of DO, BOD, TS, PH, nitrate, phosphate, fecal coliform, temperature, and turbidity, NSF water quality index in each sampling period from 10 designated stations was calculated using water quality index software of Wilkes University. The process of changing of water quality index during the study period is summarized in graphs (1 and 2).



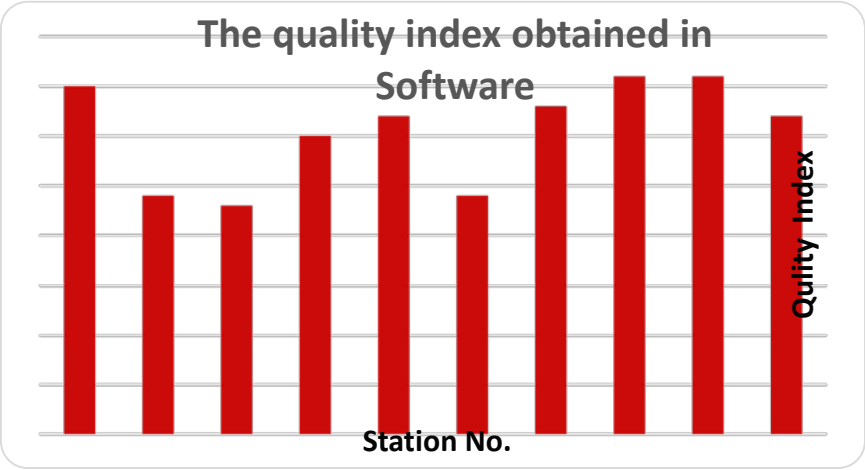
Graph 1: Overall chart of quality index of sampling parameters in 10 tested stations in summer

Table 1: The results of quality indicators in the summer in all sampling stations

Station number:	The quality index obtained in Software
1	27
2	28
3	29
4	29
5	22
6	28
7	26
8	25
9	24
10	27

Graphs (1 and 2) show that the water quality index changes in different stations are different and fluctuations of quality index are between 22 and 36. In general, based on water quality index, water quality of

the Bahmanshir River in all points is in poor and very poor ranges. According to graphs (1 and 2), the highest WQI is related to stations 2 and 3 in November 2015 with quality index of 36 and the lowest is related to station 5 in August with quality index of 22. On average, during sampling months, station 3 upstream before discharge of various wastewater with index of 36 in the fall and station 9 in downstream of discharge of urban and hospital sewage with index of 24 have, respectively, the best and worst conditions in the river quality among the other stations.



Graph 2: Overall chart of quality index of sampling parameters in 10 tested stations in fall

Table 2: The results of quality indicators in the fall in all sampling stations

Station number:	The quality index obtained in Software
1	32
2	36
3	36
4	33
5	24
6	32
7	30
8	23
9	24
10	35

In general, Bahmanshir River water quality decreases from upstream to downstream due to a variety of uses such as the existence of a large number of agricultural, industrial, and urban wastewater along the river.

Moreover, by comparing the sampling months, it became clear that the best quality of river water quality is in November with index of 36 and the worst is in August with index 24.

The Bahmanshir River water-quality decline in August is due to increased summer temperatures and evaporation of water, lack of rainfall, and increased input of runoff and thus increased turbidity of river water.

The results of measuring water quality parameters of the Bahmanshir River have shown that the extent of some parameters including turbidity, nitrate, and phosphate in the downstream of the river is higher than other places. Moreover, the amount of microbial contamination in upstream station, the place of entry of urban, hospital, and industrial sewage, has been high.

Conclusion

One of the determinants of microbial quality in aquatic environments is coliform group bacteria, and the existence of these bacteria indicates fecal contamination of water and thus coliforms are used as one of the most important indicators of microbial contamination of water. The number of these bacteria varies in different seasons- in autumn minimum and in the summer maximum. The highest number of this group of bacteria is seen in stations 1 and 5 with quality index 20 and the lowest at stations 3 and 4 with quality index of 29. Contamination of river waters with coliforms with human origin and some other living creatures, including dogs, cats, wild carnivorous animals (foxes, wolves, and jackals), and farm animals such as cattle, sheep, etc. seems natural, because municipal and urban sewage easily enters the river. This type of pollution enters the river in conditions of proper temperature and humidity, especially in the summer, and the sewage of villages and towns around the Bahmanshir River enters the water of this river and pollutes it without considering any environmental issues, using antiseptic, or organizing. Given the importance of indicator bacteria in water and virulence potential of this group of bacteria in humans, it is essential to identify the primary source of these bacteria and to minimize their ways of transmission to aquatic ecosystems. Some natural events are outside of the control (floods) and therefore a high load of contaminants enter into the rivers among which are indicator bacteria that is inevitable, but self-purification properties of the river are effective in reduction of pollution load in the river and minimizes this group of bacteria. One of the main ways of the entry of indicator bacteria to river water is the discharge of waste of homes and nearby restaurants into Bahmanshir River that are discharged into the river without any environmental considerations. Weather and water temperature is higher in summer and lower in the fall and with rising of temperatures, a suitable environment is created for the growth of coliforms. Thus, metabolic activities increase and with an increase in water temperature, oxygen solubility reduces as well. Biomass volume and total number of bacteria in the rivers depend on the temperature, so that in relatively polluted river of Albiin Germany, the highest contamination has been reported in summer (Yagouhbzadeh and Safari, 2013)

Since not several different studies have been done on assessing water quality of Iran Rivers in terms of the quality grading in a comprehensive and systematic way, the use of indicators of water quality, as a simple method for initial recognition of the status of water quality, is suitable. Managers and engineers can also use it to plan quality protection. In this study, for simplicity of calculation and the high number of parameters measured, NSF Water Quality Index was used. By a comparative analysis of water quality indicators, Shamsaie et al. (2005) concluded that due to the direct intervention of the parameters measured in the structure of sub-index and total index and considering the effect of weight in paying attention to these sensitivities, using the NSFWQI is better than the other indices. This study shows that water quality of the Bahmanshir River downstream is reduced due to discharge of wastewater of treatment plants, hospitals, and other drains: like station 8 due to increased amounts of nitrate, phosphate, turbidity and microbial characteristics. In addition, station 3 had the best quality. Station 3 is located on the Mard Canal upstream. The distance of this station to the entrance of effluents from different land uses along the Bahmanshir River is one reason for the high quality of this station. Moreover, river has a better status in autumn than in summer. In the summer due to lack of rainfall the turbidity of the river reduces. By studying qualitative changes of Karun and Dez rivers and with emphasis on microbiological indices in dry and rainy seasons in 2003, Hamid concluded that in seasons with more rainfall microbial contamination is reduced. Despite the negative effects of pollution load into the river from upstream to downstream along it, especially because of hospitals and treatment plant, the results of indexing river indicate high self-purification power of the river. For example, microbial contamination in station 3 had the lowest among the sampling sites. Hence, the quality index at the last station downstream of the river is medium, and after the first station, had the highest amount. This result is consistent with the result of a survey conducted by Yousefi on the Cheshmeh Koliyeh River in Tonekabon in 2006, and the results of using water quality index and low dissolved oxygen as simple indicators of watershed pollution in 2006 by Enrique et al. on the Guadarrama and Manzanares rivers France. Since the outlet water of Bahmanshir enters the Arvand River, upstream, so stable quality of the Bahmanshir River has a significant impact on water quality of the Arvand River in Khoramshahr.

Based on the results of the study by Mousavi et al. in 2012 on Bahmanshir River, it has been shown that low-quality drainage in the middle of the river that flows in Abadan reduces water quality of the river, in such a way that COD amounts reaches about 81 mg per liter. Moreover, 6 km after discharging effluent of Khorramshahr in the bridge of station 12, values have changed and in the downstream section of the river due to soil salinity, return of drainage and indirect discharge of villages around Bahmanshir riverbank, water quality has changed again, and sulfate and chloride parameters increase. In the same study conducted by researcher, at Station 10, owing to the arrival of salty and barren lands waste, especially in the rainy season, the river water salinity increases and phosphate levels rise.

Data obtained from the tests, the data collected were classified, and after analyzing the results, NSFWQI index was obtained for each 10 stations in summer and autumn, and the index was determined based on

standard qualitative- classification table that is presented in Chapter III. It should be noted that in this study, EC index range is determined for the 10 sampling stations and their range whose results are expressed in the following.

* Based on the results obtained from the analysis of data collected at 10 stations in August and November, during summer and autumn that was done from 10 to 20 of each month, it is in the range 22-36 indicating poor quality of water in these rivers.

* Moreover, EC index in the 10 stations was studied that was higher than 2250 (3964.33), which according to the standard table it is classified in bad range.

* Water quality at 10 stations in August, both in summer in terms of both NSFWQI and EC indices is very low and in October in the autumn in days or hours has been of poor quality.

* All 10 stations are fairly similar in terms of NSFWQI index, but regarding EC at the station 1 in August, quality is poor and November at station 3, it is of average quality.

Moreover, the results of studying fecal coliforms in this study, according to international standards, indicate that the majority of the stations studied in the Bahmanshir River, in terms of quality are at a low level and not suitable for human consumption. The number of coliforms in the river is indicative of the criticality of the situation.

It can be said that in the Bahmanshir River path, several factors affect water quality. These factors can be divided into two groups of time and space. Time factors are related to precipitation in different seasons of the year. Due to the arid climate of Khuzestan province, rainfall is mainly in winter, autumn and sometimes in the spring. In addition, runoff from rainfall leads to the river. Therefore, most measures of water quality parameters have the greatest value in the mentioned seasons.

Of spatial factors affecting the quality of river water are sewage and industrial effluents discharged into river, the most of which during the study period are untreated urban wastewater, agricultural land drainage, villages sewerage, slaughterhouse of Abadan, recirculating aquaculture systems, sewage of Pasargad Plant, and Shahid Taleghani and Beheshti hospitals.

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