Water Quality Assessment of Taleghan River

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Abstract: There are several factors influencing the water quality based on its usage. The quality of drinking water is of the vital concern for human health and life. An essential attempt has to be done to develop a water quality index (WQI) corresponding with different conditions and characteristics of the relevant river or water body such as geographical, hydrological, discharge rate and pollution sources. The index is not specifically focused on human health or aquatic life regulations. However, a water index based on some very important parameters can determine a simple indicator of water quality. In the present study, the Taleghan water quality has been evaluated by available NSF water quality index. Subsequently, the nine present NSF parameters' weights have been changed and modified using the analytical hierarchy process (AHP) method as well as experts' opinions in the field in a way to satisfy local conditions. In the newly developed WQI, more weights are given to relation with these parameters it can be said that the factors like dissolved oxygen (Do), fecal coliform (F.c) and biological oxygen demand (BOD) when compared with NSF-WQI.

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1. Introduction

The access to "closer and cleaner drinking water" is still a distant dream for about one-sixth of humanity on this planet (Harvey et al., 2002; Smedley and Kinniburgh, 2002). It is predicted that this increasing scarcity, and competition over water resources in the first quarter of the 21st century will dramatically change the way we value and use water (Mroczek , 2005; Maqbool et al., 2011). Assessment of surface water quality can be a complex process undertaking multiple parameters capable of causing various stresses on overall water quality.

The requirement of water in all forms of lives, from micro-organisms to man, is a serious problem today because many water resources have been reached to a point of crisis due to unplanned urbanization and industrialization (Singh et al., 2002; Dixit and Tiwari , 2008). Water quality degradation through different sources as well as different monitoring methods have been widely considered in the literature (Ali et al., 2004 ;Nakane and Haidary, 2010; Bhatnagar and Sangwan, 2009; Taseli, 2009; Najafpour et al., 2008; Joarder et al.,2008; Rene and Saidutta, 2008; Monavari and Guieysse,2007; Jeong et al., 2010). Surface waters are most exposable to pollution due to their easy accessibility for disposal of wastewaters (Samarghandi et al., 2007). The consumption of different contaminants present in various industrial and agricultural sectors through biodegradation, or toxicity resistance to these pollutants by the microbial communities can provide information about pollutant exposure, metabolic diversity and the potential source of contamination and the potential for the ecosystem natural attenuation, thus may be a practical indicator of the water quality (Monavari and Guieysse , 2007). Both the anthropogenic influences such as urban, industrial and agricultural activities increasing exploitation of water resources as well as natural processes, such as precipitation inputs, erosion, weathering of crustal materials, degrade surface waters and damage their use for drinking, industrial, agricultural, reaction or other purposes (Jarvie et al., 1998; Simeonov et al.,2003; Mahvi et al., 2005; Nouri et al., 2008; Karbassi et al., 2008). Rivers play a major role in assimilation or transporting the municipal and industrial wastewater discharge constitutes a constant polluting source, whereas surface run off is a seasonal phenomenon, largely affected by climate within the basin (Singh et al., 2004; Karbassi et al., 2007; Karbassi et al., 2008; Najafpour, 2008). Due to increasing problem of deterioration of river water quality, it is necessary to monitor the water quality in order to evaluate the production capacity (Mishra et al., 2009).

Over the past few years, a number of different tests have been developed to determine the organic content of wastewater (Sawyer et al., 1994). Many environmental indices have recently been suggested by different organizations and institutes, so that at the last decade of the 20th century much interest has been created to improve control water quality indices.

One of the methods that has led to an improvement over the old indices is the comparison of these indices with each other. In this regard, the first comparison among quality indices of water was conducted by Ott in 1971; he compared two indices which had been created by Landor and Deninger and revised the quality indices in USA. Two indices which were presented by them belong to general and particular consumption indices. Such research has also been conducted in European countries. Brokel and Helmond proved through the results of their research about environmental indices that around 30 indices can be applied throughout the world to classify water quality. They showed that all indices include between 3 to72 variables which have been selected from NH4+N, PO4 + P, NO3+N, PH and total solid (Ramirez and Solano, 2004).

In Iran water quality indices are under consideration too, such as the research conducted by Tajrishi and Norouzian in 1998 using a fuzzy classification technique on the Karoon and Dez rivers whereby these rivers were zoned qualitatively (Norouzian, 1998; Parvizi et al., 2004).

2. Material and Methods

To analyze and interpret the kinds of parameters measured along the range of a river, there are various mathematical methods that are used such as water quality index. It is one of the simplest methods with wide applications. In this method a considerable amount of data resulting from measurements of water quality are converted to a single and dimensionless number in a rated scale with interpreted quality and conception.

In general, water quality indices are divided into many methods (Sobhani, 2003), and the public indices is one of these methods which ignores the kind of water consumption in the evaluation process, NSF WQI, is among public indices (Ott, 1978) (Horton, 1965).

Among the public water quality indices, NSF is the most applicable index in this regard. On the other hand, the parameters considered in this index are mostly the parameters that are measured in the river water quality monitoring programs and environmental assessment (Zandberg and Hall, 1988).

NSF Water Quality Index:

A Water Quality Index for the United States of America was developed by the National Sanitary Foundation (NSF) in 1970 to monitor the variation trend in river water quality. It has been used throughout the USA by the executive agencies. This index represents the general water quality status of monitoring stations using 9 quality parameters. This index has the capability of being estimated using existing data from water quality parameters, if data for some parameters are lost. Parameters that are required for this index are as follows: fecal coliforms, B0D5, turbidity, pH, TSS, D0%, N03, P04 and ΔT. Measured parameters according to the sub-index of each of them are achieved on conversion curves. Then, to estimate the final index the following equations are used (NSF, 2003):

$$NSFWQI = \sum_{i=1}^{n} Wi\, qi$$

qi= Sub-index of each parameters
Wi= Weighting factor
n= Number of sub-indices

Table one shows the ranking criteria of NSF water quality index and, in Table two, the weights of the water quality parameters are presented.

According to the book Field Manual for Water Quality Monitoring, the National Sanitation Foundation surveyed 142 people representing a wide range of positions at the local, state, and national level about 35 water quality tests for possible inclusion in an index. Nine factors were chosen and some were judged more important than others, so a weighted mean is used to combine the values so that field measurements could be converted to index values, respondents were asked by questionnaire to graph the level of water quality (0 through 100) corresponding to the field measurements (e.g., pH 2-12). The curves were then averaged and are thought to represent the best professional judgment of the respondents.

When test results from fewer than all nine measurements are available, we preserve the relative weights for each factor and scale the total so that the range remains 0 to 100.

Taleghan with about 1300 square kilometers in area 36 degrees 12 minutes north latitude and 50 degrees is 47 minutes North West of Tehran and part of Alborz province (Figure 1).

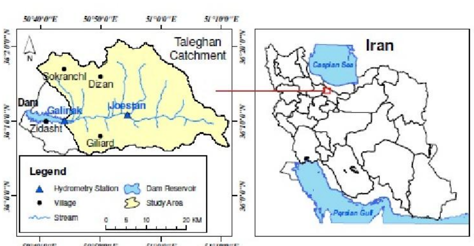

Figure 1. Location of Taleghan Watershed

In this study, sampling was done from 6 local streams in the study area. In order to consider the effect of flow quantity on the amount of different parameters, sampling was done in two year (August 2008 until July 2010).

In Figure 3 the values of the final index for each station have been shown separately based on measuring results in the water considered, after the calculate with NSF modeling.

3. Results

In this study, sampling was done from 6 local streams in the study area. In order to consider the effect of flow quantity on the amount of different parameters, sampling was done in two year (August 2008 until July 2010).

In Figure 3 the values of the final index for each station in each season have been shown separately based on measuring results in the water considered, after the calculate with NSF modeling.

4. Discussions

Due to the lack of expert study and inspection of the water quality of most rivers of Iran, using water quality indices for particular consumption is considered as a simple method for the primary recognition of river water quality. Due to qualitative evaluation along the river, all the urban wastewater of Taleghan city enters the Taleghan River at stations 5 and 6.But river water is appropriate for drinking water and agricultural consumption at all stations is good. According to the aforementioned issues, to improve the river water quality it is necessary that the relevant authorities build a wastewater treatment plant for Taleghan city and, because of reduction in the dissolved oxygen downstream of the agriculture complex, manufacturing re-aeration structures such as concrete spill ways in the river can contribute to promote its power of self-purification.

This table is based on an average of two years of design

Quality	Value
Very good	90-100
Good	70-90
Medium	50-70
Bad	25-50
Very bad	0-25

Table 1- Water quality value

Water Quality Factors and Weights	
Factor	Weight
Dissolved oxygen	0.17
Fecal coliform	0.16
pH	0.11
Biochemical oxygen demand	0.11
Temperature change	0.10
Total phosphate	0.10
Nitrates	0.10
Turbidity	0.08
Total solids	0.07

Table 2- Importance rate and parameters weight in NFSWQI
(NSF water quality index ranking).

Table 3- Water Quality monitoring along with Taleghan River

Table 4- Water quality index (NSF result)

Table 3- Water Quality monitoring along with Taleghan River

Season	Station	Water Quality index									Total result
		T	DO	NO_3	Turbidity	FC	pH	BOD	PO_4	TS	
Summer	1	93	59	95	73	91	92	15	75	53	72
	2	81	74	95	75	82	86	12	96	56	74
	3	67	72	95	73	70	85	16	94	55	66
	4	93	71	95	67	63	82	25	95	56	68
	5	93	58	95	60	55	88	40	92	48	69
	6	89	57	93	58	45	84	7	96	49	63
Fall	1	93	73	95	82	99	67	13	97	46	75
	2	93	71	94	78	91	68	7	98	51	73
	3	85	73	91	77	78	69	10	96	55	64
	4	89	59	92	76	65	58	20	98	50	66
	5	81	60	87	73	58	57	9	97	46	62
	6	89	71	91	70	49	54	18	96	47	64
Winter	1	93	56	91	56	99	90	11	95	67	74
	2	93	59	71	65	99	86	28	94	53	73
	3	89	60	67	62	80	84	12	96	57	68
	4	85	56	67	29	69	85	9	97	57	62
	5	85	42	86	24	63	84	23	98	50	61
	6	89	45	63	5	54	84	6	96	52	55
Spring	1	93	56	93	45	82	83	7	94	79	70

	2	85	55	92	35	82	79	11	98	68	67
	3	89	54	90	37	67	82	14	98	70	66
	4	89	59	89	33	60	79	10	98	70	64
	5	89	52	87	27	56	80	11	96	67	62
	6	89	40	66	24	46	76	7	95	68	55

Table 4- Water quality index (NSF result)

Station	Spring	Summer	Fall	Winter
1	Good	Good	Good	Good
2	Medium	Good	Good	Good
3	Medium	Medium	Medium	Medium
4	Medium	Medium	Medium	Medium
5	Medium	Medium	Medium	Medium
6	Medium	Medium	Medium	Fair

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