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Evaluation of Water Quality of the Beshar River

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***Abstract*—**The Beshar River is one aquatic ecosystem, which is located next to the city of Yasuj in southern Iran. The Beshar river has been contaminated by industrial factories such as effluent of sugar factory, agricultural and other activities in this region such as, Imam Sajjad hospital, drainage from agricultural farms, Yasuj urban surface runoff and effluent of wastewater treatment plants ,specially Yasuj waste water treatment plant. In order to evaluate the effects of these pollutants on the quality of the Beshar river, five monitoring stations were selected along its course. The first station is located upstream of Yasuj near the Dehnow village; stations 2 to 4 are located east, south and west of city; and the 5th station is located downstream of Yasuj. Several water quality parameters were sampled. These include pH, dissolved oxygen, biological oxygen demand (BOD), temperature, conductivity, turbidity, total dissolved solids and discharge or flow measurements. Water samples from the five stations were collected and analyzed to determine the following physicochemical parameters: EC, pH, T.D.S, T.H, No2, DO, BOD5, COD during 2008 to 2010. The study shows that the BOD5 value of station 1 is at a minimum (1.7 ppm) and increases downstream from stations 2 to 4 to a maximum (11.6 ppm), and then decreases at station 5. The DO values of station 1 is a maximum (8.45 ppm), decreases downstream to stations 2 - 4 which are at a minimum (3.1 ppm), before increasing at station 5. The amount of BOD and TDS are highest at the 4th station and the amount of DO is lowest at this station, marking the 4th station as more highly polluted than the other stations .This study shows average amount of the water quality parameters in first year of sampling (2008) have had a better quality relation to third year in 2010 because of recent drought in this region and pollutant increasing .As the Beshar river path after 5th station goes through the mountain area with more slope and flow velocity ,so the physicochemical parameters improve at the 5th station due to pollutant degradation and dilution. Finally the point and nonpoint pollutant sources of Beshar river were determined and compared to the monitoring results.

***Keywords*—**Beshar river, physicochemical parameter, water pollution, water quality, Yasuj

I. Introduction

THE province of Kohkiluye and Boyer Ahmad is one of the 30 provinces of Iran. It is in the south-west of the country, the province divided into five counties include Boyer-Ahmad, Kohkiluyeh, Gachsaran, Dena and Yasuj as its capital. The province covers an area of 15,563 square kilometers, and in 2006 had a population of 634,000. The Beshar river is located next to the city of Yasuj.The Beshar river is the unique and most important streams in the city of Yasuj because of its high water quality in comparison with other water resources in the region, its important roles on tourism attractive and sustainable development city projects. The Beshar stream flow recharge to groundwater aquifers and supplies drinkable water for urban and rural populations. It is being used for a variety of agricultural, industrial and recreational activities thus largely contributing to the economy of the Yasuj counties [1].The Beshar river has been contaminated by human activity ,industrial, agricultural and other activities in this region such as Yasuj sugar factory, other factories, Imam Sajjad hospital, agricultural farms next to the river, urban surface runoff of city and effluent of wastewater treatment plants near to Boloko industrial city as have been shown in figures no.1 and no.2 .

Fig. 1. Effluent of yasuj waste water treatment plant

Fig. 2. Effluent of sugar factory in yasuj

Water resources management has become an important issue due to anthropogenic effects by increasing population, agricultural and industrial activities. Decision Support Systems (DSS) should be developed and executed properly in water resources management practices to achieve reliable and

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confident decisions [2].

In water resource planning and management it is important to predict with accuracy and efficiency the flow and water quality of water bodies [3]. Flow and water quality are important in predicting the pollutant load within the water bodies. In managing water quality it is important to determine aggregate of point and non point source pollution loads in order to set maximum allowable loads from each source that contribute to pollution of a river [4].

Monitoring and determination of the Beshar surface water quality is an important aspect for evaluating variations of water quality and river pollution due to anthropogenic and natural inputs of point and non-point sources[1]. The water samples have been taken from the Beshar river during 2008 to 2010 seasonally ,then they were analyzed for some water quality parameters. The aim of this study was to determine the effects of point and non point pollutant sources on the Beshar water quality parameters and evaluation of temporal changes in the Beshar water quality.

Fig. 3. The location of sampling stations on the river.

II. MATERIALS AND METHODS

In order to evaluate the effects of the mentioned pollutants on the quality of the Beshar river and evaluation of temporal water quality changes during 2008 to 2010, five monitoring stations were selected along its course as have been shown in figure no.3. The first station is located upstream of Yasuj near the Dehnow village; stations 2 to 4 are located east, south and west of city in the Behar bridge, the Boloko industrial area and the Mokhtar bridge respectively; and the 5th station is located downstream of Yasuj next to the Talegah bridge. Several water quality parameters include pH, dissolved oxygen, biological oxygen demand (BOD), temperature, conductivity, turbidity, total dissolved solids and discharge or flow measurements were sampled. Water samples from the five stations during the 2008 to 2010 were collected and analyzed to determine the following physicochemical parameters: EC, pH, T.D.S, T.H, No2, DO, BOD5, COD.

TABLE I
SITUATION OF FIVE STATIONS ON THE BESHAR RIVER

Stations no.	LONGITUDE	LATITUDE
Station 1	51,38, 16	30,37,45
Station 2	51,38, 23	30,39,03
Station 3	51,33,34	30,39,07
Station 4	51,31,40	30,43,21
Station 5	51,25,21	30,47,16

The water samples were taken from the Beshar river each season during the study period (2008- 2010). Sampling, preservation and transportation of the water samples to the laboratory were as per standard methods[2]. All samples were collected in the same fashion and within the specified conditions in a standardized operating procedure.

Raw water samples were transported to the laboratory in Shiraz. All the glassware and plastic containers were cleaned with 1 M HNO3 and rinsed with double distilled water prior to use in order to prevent the contamination of the sample. DO samples are collected using a special BOD bottle: a glass bottle with a turtleneck and a ground glass stopper [5]. The bottles were full directly in the stream, or you can use a sampler that is dropped from a bridge or structure deep enough to submerge the sampler. Samplers can be made or purchased. The sample bottle should be submerged and allowed to fill without allowing air to mix with the sample. The bottle should be completely filled and held submerged until the cap is firmly in place [6].

Fig. 4.Water sampling from effluent of yasuj waste water treatment plant before mixing with the Beshar river and upstream the station 4.

Fig. 5.Feild measurement of water quality parameter on the station 3.

BOD is determined by measuring the dissolved oxygen level in a freshly collected sample and comparing it to the dissolved oxygen level in a sample that was collected at the same time but incubated under specific conditions for a certain number of days. The difference in the oxygen readings between the two samples in the BOD is recorded in units of mg/L.

Total solids (also referred to as total residue) is the term used for material left in a container after evaporation and drying of a water sample. Total Solids includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids, the portion that passes through a filter [1].

The field monitoring equipment in this study includes turbidity meter, dissolved oxygen meter, pH meter and EC meter. Temperature is shown on the EC screen.

Fig. 6. Portable measurement instruments for water quality parameter.

III. RESULTS AND DISCUSSION

Water quality parameters provide important information about the health of a water body. These parameters are used to find out if the quality of water is good enough for drinking water, recreation, irrigation, and aquatic life. The seasonal values of T, pH, EC, TDS, Turbidity, DO, BOD5, for the Beshar river are analyzed .

The minimum T value was measured to be 11 degree centigrade at station 1 in winter season of 2008 and the maximum T value was measured to be 25 degree centigrade at station 4 in summer season of 2009 . Water temperature affects on DO value of water, because increased temperature not only reduces oxygen availability, but also increases oxygen demand, which can add to physiological stress of organisms .

The minimum pH value was measured to be 5.7 at station 4 in autumn season in 2009 and the maximum pH value was measured to be 7.8 at station 1 in summer season in 2008.

The minimum EC value was measured to be 312 mmS/m at station 1 in spring(2008) and the maximum EC value was measured to be 675 mmS/m at station 4 in autumn(2009).

The minimum turbidity value was measured to be 20 NTU (Nephelometric Turbidity Units) at station 1 in spring(2008) and the maximum turbidity value was measured to be 78 NTU at station 4 in summer(2009).

The seasonal values of DO, BOD5 and nitrate of five stations of the Beshar river are illustrated in tables 2-4 as following as.

Low dissolved oxygen levels occurred during warm, stagnant conditions that prevent mixing and drought condition in summer of 2009. In addition, high natural organic levels have caused a depletion of dissolved oxygen in station 4,becease of mixing of river flow with effluents at upstream . Biochemical Oxygen Demand, or BOD, is a measure of the quantity of oxygen consumed by microorganisms during the decomposition of organic matter. BOD is the most commonly used parameter for determining the oxygen demand on the receiving water of a municipal or industrial discharge.

TABLE I I
AVERAGE CONCENTRATION OF DO (MG/L) DURING FOUR SEASONS IN 2008 T0 2010

Stations	Spring	Summer	Autumn	Winter
S1	9.3	5.7	6.8	5.9
S2	6.8	4.9	5.8	5.3
S3	6.4	4.5	4.8	4.7
S4	4.4	3.4	3.3	4.0
S5	6.6	6.4	6.5	6.3

TABLE I I I
AVERAGE BOD CONCENTRATION (MG/L) DURING FOUR SEASONS IN 2008 T0 2010

Stations	Spring	Summer	Autumn	Winter
S1	1.7	2.3	2.8	1.8
S2	2.3	2.8	2.4	1.7
S3	3.9	4.8	4.4	3.5
S4	6.2	8.8	8.9	7.7
S5	2.2	3.3	2.6	1.8

BOD can also be used to evaluate the efficiency of treatment processes, and is an indirect measure of biodegradable organic compounds in water. Average amount of BOD concentration have been increased during 2008 to 2010,because of decreasing in stream discharge due to drought problem.

Concentrations of nutrients sometimes have a distinct seasonal pattern in streams. Concentrations are often highest during storm events soon after fertilizers are applied upstream[6]. Nutrients such as nitrate and phosphate from pollutant sources were released into the Beshar stream specially downstream the station 2 ,then aquatic plants were growth and increased at station 4 . Eventually, the increase in plant growth leads to an increase in plant decay and a greater "swing" in the diurnal dissolved oxygen level. The result is an increase in microbial populations, higher levels of BOD, and increased oxygen demand from the photosynthetic organisms during the dark hours. This results in a reduction in dissolved oxygen concentrations, especially near the Mokhtar bridge.

TABLE IV
AVERAGE NITRATE CONCENTRATION (MG/L) DURING FOUR SEASONS IN 2008 T0 2010

Stations	Spring	Summer	Autumn	Winter
S1	1.67	1.77	1.98	1.63
S2	1.94	2.04	2.27	1.84
S3	2.13	2.19	2.45	1.99
S4	3.32	3.77	4.29	3.21
S5	1.72	1.78	2.10	1.68

IV. CONCLUSION

The study shows that the BOD5 value of station 1 is at a minimum (1.5 ppm) in 2008 and increases downstream from stations 2 to 4 to a maximum (11.6 ppm) in 2009, and then decreases at station 5. The DO values of station 1 is a maximum (9.55 ppm), decreases downstream to stations 2 - 4 which are at a minimum (3.1 ppm), before increasing at station 5. The amount of BOD and TDS are highest at the 4th station and the amount of DO is lowest at this station, marking the 4th station as more highly polluted than the other stations. The physicochemical parameters improve at the 5th station due to pollutant degradation and dilution. The Beshar river basin has occurred with hydro meteorological drought phenomena during 2008 to 2010 same to another region in south of Iran then hydrological drought has affected on stream flow, and average discharge of the Beshar stream has decreased in recent years.

AS stream flow were decreased and water usage were growth and pollutant sources were increased , the water quality of the Beshar stream has been reduced .

A greater understanding of processes and patterns in the Beshar basin where there are different pollutant and sewages , is produced by monitoring quality of the Beshar river. Monitoring programs can help to build local awareness of water quality issues and may play an important role in decision making by private agencies and local, state and federal governments [1].

A long term watershed protection plan with appropriate monitoring quality network must be conducted for the Beshar river watershed and the stream with the purpose of all kinds of usage and preventing of pollution and erosion.

The yasuj Sugar factory, other factories and Imam Sajjad hospital have to treatment and control their effluents according to environmental standards.

Yasuj waste water Treatment plants must be developed and established for total area of the city and urbane surface runoff have to collect ,then treatment before entrance to the stream .It can keep levels of dissolved oxygen in their effluent high by proper aeration. This is accomplished by adding bubbles of oxygen, or running the water over rocks or "steps" to increase the transfer of oxygen across the air-water interface in other effluent.

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