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Pollution and Water Quality of the Beshar River

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***Abstract*—**The Beshar River is one aquatic ecosystem,which is affected by pollutants. This study was conducted to evaluate the effects of human activities on the water quality of the Beshar river. This river is approximately 190 km in length and situated at the geographical positions of 51° 20´ to 51° 48´ E and 30° 18´ to 30° 52´ N it is one of the most important aquatic ecosystems of Kohkiloye and Boyerahmad province next to the city of Yasuj in southern Iran. The Beshar river has been contaminated by industrial, agricultural and other activities in this region such as factories, hospitals, agricultural farms, urban surface runoff and effluent of wastewater treatment plants. 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 analysed to determine the following physicochemical parameters: EC, pH, T.D.S, T.H, No2, DO, BOD5, COD during 2008 to 2009. The study shows that the BOD5 value of station 1 is at a minimum (1.5 ppm) and increases downstream from stations 2 to 4 to a maximum (7.2 ppm), 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 (3.4 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. 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, 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.The Beshar river has been contaminated by industrial, agricultural and other activities in this region such as factories, hospitals, agricultural farms, urban surface runoff and effluent of wastewater treatment plants.

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 confident decisions [1].

In water resource planning and management it is important to predict with accuracy and efficiency the flow and water quality of water bodies [2]. 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 [3].

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. The water samples taken from the Beshar river during the four seasons in 2008 to 2009 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.

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Fig. 1 The location of the Beshr stream stations

II. MATERIALS AND METHODS

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 analysed to determine the following physicochemical parameters: EC, pH, T.D.S, T.H, No2, DO, BOD5, COD during 2008 to 2009.

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 5	51,25,21	30,47,16

The water samples were taken from the Beshar river each season during the study period (2008 - 2009). Sampling, preservation and transportation of the water samples to the laboratory were as per standard methods[1]. 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 [4]. 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 [5].

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.

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, Turb., DO, BOD5, for the Beshar river are analysed .

The minimum T value was measured to be 11?C at station 1 in spring season and the maximum T value was measured to be 23.3 ?C at station 4 in summer. 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 and the maximum pH value was measured to be 7.8 at station 1 in summer season.

The minimum EC value was measured to be 312 mmS/m at station 1 in spring and the maximum EC value was measured to be 483 mmS/m at station 4 in autumn.

The minimum turbidity value was measured to be 20 NTU (Nephelometric Turbidity Units) at station 1 in spring and the maximum turbidity value was measured to be 52 NTU at station 4 in summer.

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

TABLE II
DO CONCENTRATION (MG/L) DURING FOUR SEASONS

Stations	Spring	Summer	Autumn	Winter
S1	9.5	6.9	7.2	6.7
S2	7.1	5.6	6.5	5.8
S3	6.7	4.9	5.3	5.1
S4	5.2	3.6	3.4	4.3
S5	6.9	6.7	7.1	6.8

The introduction of excess organic matter may result in a depletion of oxygen from an aquatic system. Prolonged exposure to low dissolved oxygen levels (less than 5 to 6 mg/l oxygen) may not directly kill an organism, but will increase its susceptibility to other environmental stresses. Exposure to less than 30% saturation (less than 2 mg/l oxygen) for one to four days may kill most of the aquatic life in a system

Low dissolved oxygen levels may occur during warm, stagnant conditions that prevent mixing. In addition, high natural organic levels will often cause a depletion of dissolved oxygen.

TABLE III
BOD CONCENTRATION (MG/L) DURING FOUR SEASONS

Stations	Spring	Summer	Autumn	Winter
S1	1.5	2	2.5	1.5
S2	2	2.5	2	1.5
S3	3.5	4.5	4	3
S4	5.5	7	7.2	6.5
S5	2	3	2.5	1.5

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. BOD can also be used to evaluate the efficiency of treatment processes, and is an indirect measure of biodegradable organic compounds in water.

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]. When nutrients such as nitrate and phosphate are released into the water, growth of aquatic plants is stimulated. 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 during the early morning hours just before dawn.

TABLE IV
NITRATE CONCENTRATION (MG/L) DURING FOUR SEASONS

Stations	Spring	Summer	Autumn	Winter
S1	1.62	1.73	1.9	1.57
S2	1.87	1.98	2.21	1.76
S3	2.08	2.16	2.37	1.92
S4	3.27	3.72	4.24	3.17
S5	1.67	1.74	1.97	1.62

IV. Conclusion

The study shows that the BOD5 value of station 1 is at a minimum (1.5 ppm) and increases downstream from stations 2 to 4 to a maximum (7.2 ppm), 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 (5.4 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.

In the Beshar river, summer is usually the most crucial time for dissolved oxygen levels because stream flows tend to lessen and water temperatures tend to increase.

Oxygen levels in station 4 are decreased by organic wastes and other nutrient inputs from sewage and industrial discharges of sugar factory, effluent of Yasuj waste water treatment plant to the Beshr river. Nutrient input often lead to excessive algal growth in Mokhtar village. When the algae die, the organic matter is decomposed by bacteria and Bacterial decomposition consumes a great deal of oxygen.

Fertilizer of agricultural farms net to the Beshar river is a major influence on nitrogen concentrations in the environment. Commercial nitrogen fertilizers are applied either as ammonia or nitrate, but ammonia is rapidly converted to nitrate in the soil.

If elevated levels of BOD lower the concentration of dissolved oxygen in a water body, there is a potential for profound effects on the water body itself, and the resident aquatic life. When the dissolved oxygen concentration of station 4 falls below 5 milligrams per liter (mg/l), species intolerant of low oxygen levels become stressed. The lower the oxygen concentration, the greater the stress. Eventually, species sensitive to low dissolved oxygen levels are replaced by species that are more tolerant of adverse conditions, significantly reducing the diversity of aquatic life in the Beshar river at station 4. If dissolved oxygen levels fall below 2 mg/l for more than even a few hours, fish kills can result. At levels below 1 mg/l, anaerobic bacteria (which live in habitats devoid of oxygen) replace the aerobic bacteria. As the anaerobic bacteria break down organic matter, foul-smelling hydrogen sulfide can be produced.

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. A long term watershed protection plan must be conducted for the Beshar river watershed with the purpose of all kinds of usage and preventing of pollution and erosion. Yasuj waste water Treatment plants must be developed for total area of the city. 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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