April 2011, Volume 5, No.4 (Serial No.35)
Journal of Agricultural Science and Technology, ISSN 1939-1250, USA

Survey on Gamasyab River Water Quality in Nahavand Township, Iran

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Received: June 30, 2010 / Accepted: October 29, 2010 / Published: April 15, 2011.

Abstract: Gamasyab River, which is the biggest river of Hamadan Province, is sourced from Karstic Springs in Nahavand Township Southern Mountainous Region and supplies a major part of water needs of the region. In this research seasonal variation of water quality and also the degree of pollution related to Gamasyab River water have been assessed. First the general status of the river was studied and four sampling stations were determined. In this research, the quality of river water including Dissolved Oxygen (DO), five days Biochemical Oxygen Demand $(BOD)_5$, Chemical Oxygen Demand (COD), Nitrate, phosphate, temperature, Total Hardness(TH), Total Suspended Solid (TSS), Total Dissolved Solid (TDS) and PH have been determined and assessed on a monthly basis within a five years period. The results were reported as seasonally and presented using statistical tables and graphs. These results showed that Nitrate concentration in Gamasyab River is strongly depending on distance from Gamasyab spring. By increasing the distance from Gamasyab spring, nitrate concentration increased. The amount of DO in the river water is stable in each station within the year. Air temperature changes have had no effect in the amount of DO. Therefore, it is recommended that the river pollution control plans be implemented more serious than before, non point source pollution related to agricultural activities be managed and prevent from pouring untreated rural wastewaters to the mentioned river.

Key words: Environment, Gamasyab river, water pollution, water quality.

1. Introduction

Many towns are built near rivers so that they can use water from the river. But sometimes the water is not cleaned before it is put back into the river. Clean and safe water is necessary to sustain a high quality of life for residents, farmers and businesses in the near rivers. High levels of contaminants make fish caught in some areas. Farmers use fertilizers and pesticides on their farms so that their crops grow better. But these fertilizers and pesticides can be washed through the soil by rain, to end up in rivers. Rivers are considered as the main water suppliers for human uses. Discharging fertilizers, pesticides and other organic and inorganic pollutants are contributed as major causes of river water quality deterioration. Diagomanolin et al. have reported that the progress of industries has led to increased emission of pollutants into ecosystems [1]. Also, farming is a productive use of land, yet some farms can be a threat to water quality. Flow and water quality of rivers 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. It is essential to assess the water quality condition of the river even though the information and data availability is limited and there are various classification methods that have been used for estimating the changing status and usability of surface water [2].

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There is extended network of rivers in Iran most of which seasonally and some permanent rivers that run from the mountains area to the Caspian Sea, Persian Gulf and Oman Sea. Country wide 90% of Iran's fresh water needs are from ground water sources and only 10% from rivers [3]. Gamasyab, the biggest river of Hamadan province originates from Karst spring in southern mountainous regions of Nahavand Township and supplies a major part of water needs of the region.

Nahavand Township covering 1535 square Kilometers, is one of the cities of Hamadan province in west of Iran. This area has an old history, genuine culture and the economy is built upon the improvement of agriculture and aquaculture. Studied area with an annual average precipitation of 452 millimeters and evaporation ranging between 1,369 and 2,242 millimeters has a mountainous temperate climate and Garin Mountain, with a height of 3188 meters from sea level, is located in this area. Nahavand city, with vast agricultural lands, fertilized soil and numerous water resources has many capabilities and potentials in the field of agriculture.

Agricultural and industrial activities as well as urban constructions around this river during the recent years have made it unavoidable to study the pollutions of this river. Therefore the aim of this research is to identify the pollution of Gamasyab River water in the area of Nahavand Township, to assess the seasonal variations of water quality of the said river and also identify the degree of the water quality of this river is influenced by agricultural and industrial activities and urban constructions development. This research survey was carried out in Nahavand Township during 2003 to 2008.

2. Materials and Methods

First, the general status of the river was studied by conducting library studies and field visits. Then according to the river length and status of its adjacent villages and cities, and also according to the industries and farms of the region, 4 sampling stations were determined as follows:

Station 1 (Sarab): is in the highest and closest point to the natural spring which is the major supplier of river water.

Station 2 (Moradabad): is located adjacent to Moradabad village, 12.5 Km from Station 1.

Station 3 (Dehfool): is located behind the Dehfool village, 9 Km from Station 2.

Station 4 (Cheshmeh Mahi): is located near the Cheshmeh Mahi village, 30 Km from Station 3.

The location of the sampling stations is shown in Fig 1. Water quality grab Samples of the river water were made approximately every month between 2003 and 2007 in the four stations. All samples were transported to the laboratory under standard conditions [4].

In this study, the river water qualities including Dissolved Oxygen (DO), five days Biochemical Oxygen Demand $(BOD)_5$, Chemical Oxygen Demand (COD), Nitrate, phosphate, temperature, Total hardness(TH), Total suspended solid (TSS),Total Dissolved Solid (TDS) and PH as the key variables used to evaluate the quality of river water and measured. Sample collection and measurement of water quality parameters followed procedures described in Standard Methods for the Examination of Water and Wastewater [4]. Water grab samples were kept in the dark at 4 ℃ until analyzed or further processed and preserved. All analyses were run within the allowed holding time applicable to the preservation method used.

To identify and define sampling stations of the region, digital maps were used and on this basis the topology situations as well as ground cover of studied area have been accomplished. In addition, Geographic Information System (GIS) has been used to determine the sampling stations. The software used was Arc View (version 3.2a) with the Universal Transverse Mercator (UTM) projection, WGS84 was used as a datum and ellipsoid plan for the Global Positioning System (GPS) and scale was 1/50,000. The position of sampling stations in the studied area was determined by GPS device and implemented in GIS.

3. Results

The results of this research are presented in two parts as follows:

3.1 The Results of Library and Field studies

Gamasyab River, which is about 200 Km in length, is one of the longest rivers of Iran [5]. The watersheds of this river are about 11200 square kilometers, width is 20 m to 50 m, and depth is 2 m to 5.5 m and it is the major branch of Karkheh River. The water flow of this river is permanent and it originates from southern of Alvand Mountain and northern of Garin Mountain.

The major branch of Gamasyab River, Gamasrood, originates from northern of Garin Mountain in south of Nahavand and after irrigation of Nahavand plain, receive Heramabad river in Aminabad village and Gelgelrod river in Gerdian village and leaves Hamedan province. But Khoramrod River, which originates from Hamadan Province, joins Gamasyab River after leaving this province. After entering Kermanshah province, Gamasyab River receives several branches and finally it joins Qarahsoo River in Galleh- jar and forms Karkheh River. Finally, it runs to Khoozestan province and emptying into the Persian Gulf. The amount of water supply of Gamasyab when leaving Hamadan province in Doab Hydrometric station at the beginning of entering Kermanshah province has been measured between 1969 and 1997. This river has a permanent regime and their average annual flow rate is about 19.14 cubic meters per second. Also seasonal variations of water flow in this river between 1969 and 1997 have been shown in Table 1. It should be noted that during recent years, due to droughts and increased consumption of underground water sources, at least 25%-30% reduction has happened in river water flow. Pollution sources that threaten the quality of water in Gamasyab River may be classified in to two sections namely Non-point and point sources. Non-point sources pollutions whose wastewater is considered as a distributed load consist of agriculture-related pollutants which are drained towards the river. Point pollution sources are those wastewater is discharged in to the river from a specific point such as Nahavand Traditional Slaughterhouse wastewater, Alimoradian hospital wastewater, open fish farming wastewater, Nahavand municipal wastewater, urban and rural pollutants and wastewaters which are discharged into the mentioned river.

Table 1 The flow rate variations of Gamasyab river in different seasons (mean of 29 years).

Season	Flow rate (as m^3/s)
Spring	33.14
Summer	3.16
Autumn	11.70
Winter	28.54
Ave	19.14
Reference:	(HPMPO, 2003)

According to the previous findings and studies, the quality of this river water classified in the group of C2-S1 based on Wilcox classification. On this basis, the water of the said river has been identified as having no limitation for ordinary cultivations. The average electrical conductivity (EC) and Sodium Adsorption Ratio (SAR) of river water has been measured and reported about 0.385 mmhos/cm and 0.8 mmhos/cm, respectively [6].

3.2 Tests Results

In this research, water quality of Gamasyab River was assessed and measured in different months within 5 consecutive years in 4 stations. These results have been summarized and reported seasonally. A brief result of this research has been mentioned in Table 2 and the locations of sampling stations in Gamasyab River in Nahavand Township are presented in Fig. 1.

Also the changings of water pollution of this river are presented in Figs. 2 to 9.

4. Discussion and Conclusion

The obtained results indicate the change of water quality and its characteristics. These changes are presented in several parts as follows:

4.1 Nitrate Concentration

According to Figs. 2-5, Nitrate concentration in

Table 2 The results of laboratory Analyses of Gamasyab River water samples collected from St.1 to St. 4 (mean of 2003 to 2007).

ST.	Season	DO as mg/L	BOD as mg/L	COD as mg/L	NO3 as mg/L	PO4 as mg/L	PH	T^0	TH as mg/L	TDS as mg/L	TSS as mg/L
	Spring	7.3	.2	1.4	8.48	0.11	7.9	9.58	143.2	176.5	92.75
	Summer	7.15	.65	1.78	11.64	0.15	7.98	11.96	141.5	184.5	96.7
1	Autumn	7.36	.06	.54	9.86	0.12	7.88	8.98	155.2	172.8	26.5
	Winter	7.11	1.1	1.8	16.58	0.09	7.78	8.4	154.3	191.2	61.95
	Ave	7.23	0.5	1.38	11.64	0.12	7.89	9.73	148.6	181.3	62.48
	Spring	6.65	8.1	20.4	10.3	0.13	7.85	13.4	229.9	269.2	127.1
	Summer	4.98	8.53	21.38	17.66	0.36	7.9	17.88	278.7	350	221.9
2	Autumn	5.75	7.71	16.93	11.74	0.36	7.9	10.86	268.1	308.3	103.6
	Winter	5.87	6.79	14.4	17.28	0.5	7.77	7.82	251.4	308.5	190.8
	Ave	5.81	7.78	18.28	14.25	0.34	7.76	12.49	257	309	160.9
	Spring	3.8	11.3	35.4	16.95	0.35	7.71	15.74	277.2	331.6	123.6
	Summer	1.78	31.89	79.66	15.48	0.66	7.52	19.06	364.5	436.7	248.5
3	Autumn	3.64	22.98	64	15.8	0.56	7.76	11.07	301	394.5	148.5
	Winter	5.9	11.5	24.89	14.36	0.32	7.83	11.07	254.2	307	161.3
	Ave	3.78	19.42	50.99	15.65	0.47	7.71	14.24	274.2	367.5	170.5
	Spring	6.63	1.3	6.57	19.5	0.11	7.97	17.2	278.6	316.1	116.9
	Summer	5.76	3.17	7.72	15.35	0.12	7.89	22.94	281.6	332.1	238.2
4	Autumn	6.85	1.75	4.29	14.16	0.13	7.72	11.56	264	329.2	54.4
	Winter	7.14	1.9	4.93	15.3	0.25	8.05	8.74	257.3	297.4	84.8
	Ave	6.6	2.03	5.88	16.08	0.15	7.91	15.11	270.4	318.7	123.6

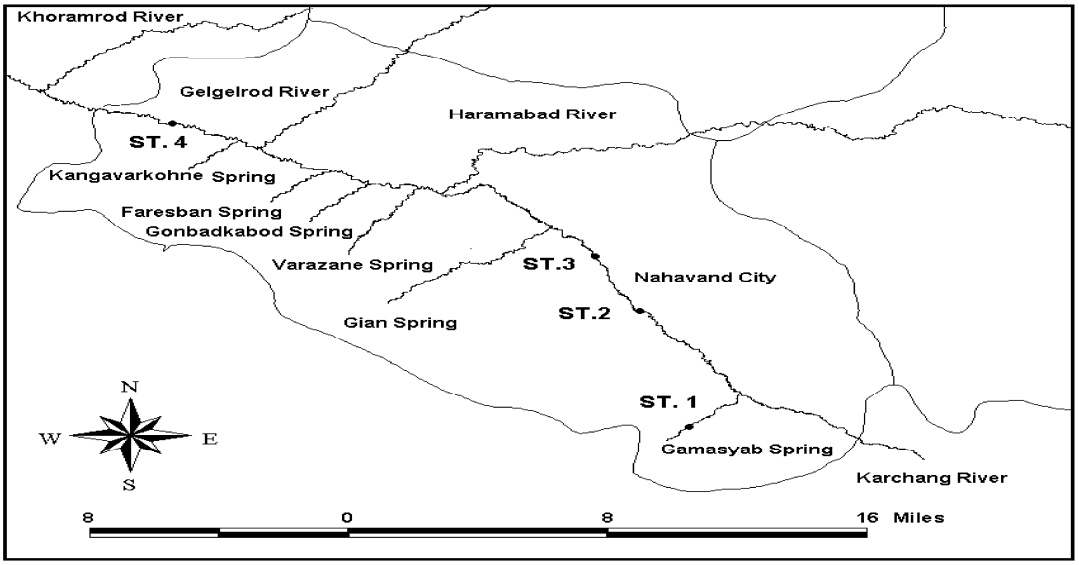

Fig. 1 Location of sampling stations 1, 2, 3 and 4 in Gamasyab River in Nahavand Township.

Gamasyab river are strongly depend on distance from Gamasyab spring. By increasing the distance from Gamasyab spring, nitrate concentration increased. This pollution is more tangible in spring, summer and autumn. But, Nitrate concentration is stable and high in winter. The variations of Nitrate concentration from station 1 begins from 10 mg/L in spring, summer and autumn and increase to about 30 mg/L in station 2. But this concentration is 18 mg/L in all stations in winter. Based on the obtained results, although river water flow increases in winter due to precipitations and non consumption of water in agricultural activities, but

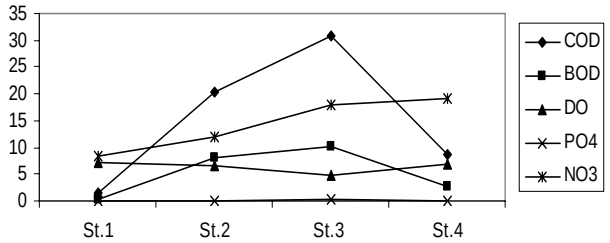

Fig. 2 variations of water quality factors of Gamasyab river in the spring in different stations (mg/s).

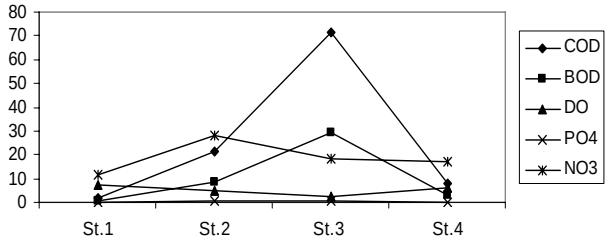

Fig. 3 variations of water quality factors of gamssyab river in the summer in different stations(mg/s).

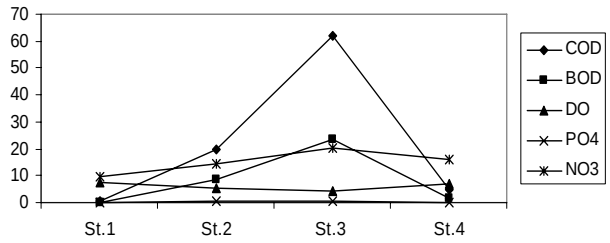

Fig. 4 variations of water quality factors of gamasyab river in the autumn in different stations(mg/s).

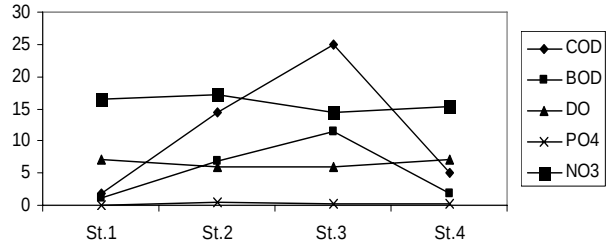

Fig. 5 variations of water quality factors of Gamasyab river in the winter in different stations (mg/s).

Nitrate concentration does not decrease. Because in autumn and winter, the nitrated fertilizers remained in agricultural lands are resolved in flowing surface waters. According to land slope, these waters move toward the river and transfer pollutants named non point source pollution to the river. Non-point sources are defined as diffused sources such as agricultural activities and surface runoffs. Figs. 6-9 show that nitrate concentration in all stations increase during 2003 to 2007, so

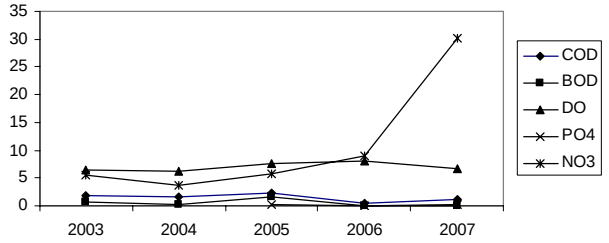

Fig. 6 Annual variations of water quality factors of Gamasyab river in station 1 (mg/s).

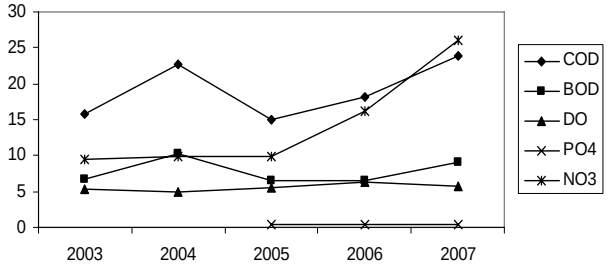

Fig. 7 Annual variations of water quality factors of Gamasyab river in station 2 (mg/s).

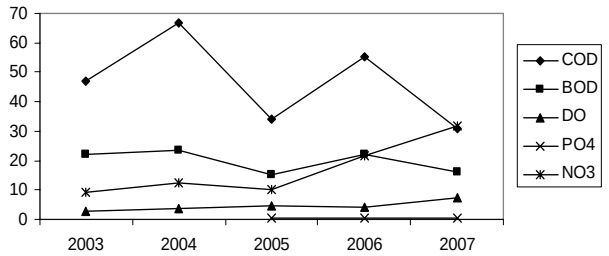

Fig. 8 Annual variations of water quality factors of Gamasyab river in station 3 (mg/s).

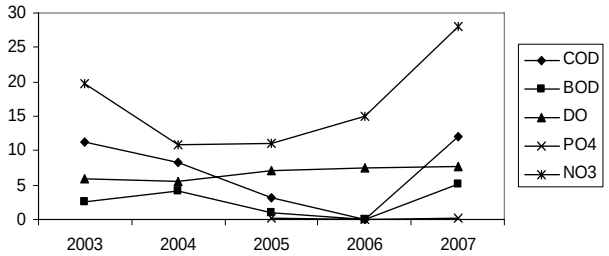

Fig. 9 Annual variations of water quality factors of Gamasyab river in station 4 (mg/s).

that nitrate pollution in station 1 begins from 5 mg/L in 2003 and increase to 30 mg/L in 2007.

4.2 BOD and COD Variations

According to Table 2, BOD and COD in station 1, the place of water supplied by springs, is almost negligible. But these amounts show increase in the next stations. Local visits show that Nahavand Traditional

Slaughterhouse wastewater, without any treatment is introduced Gamasyab River in the area before station 2. This factor is effective in increasing BOD and COD concentration in station 2. Also, Fig. 9 shows that the amount of pollution around station 3 increased about 80 mg/L. This status is associated with urban and rural pollutants and wastewaters which are discharged in to Gamasyab River in stations 2 and 3, without any treatment. Fig. 9 shows that due to precision in environmental monitoring and control of industrial factories by the officials of Department of the Environment (DOE) and closing down of dairy units around Dehfool area, the amount of BOD and COD in station 4 has decreased. But, in 2007, due to decrease of climatic precipitation and the problems occurred during environmental monitoring and also construction of new industrial units and open fish farming units, the pollutions have increased in 2007.

Table 2 shows that in all seasons the amount of BOD and COD increase in stations 2 and 3 and these factors are decreased again in station 4. This indicates that, the amount of discharge of raw wastewater is high in near stations 2 and 3. The pollutants entering the river are treated as self- purification process that occurs in the river. Therefore BOD and COD concentration reduces in station 4. The results of this study may be compared with another study done related to Karaj River in near Tehran (the metropolitan of Iran) and has been reported that the average of COD was 23.6 mg/L with 16 water sampling. The mentioned study shows that villages are main sources of pollution in this river that discharge their waste in to the Karaj River [7].

In another study conducted on Rasht Zarchub River in Iran revealed that river pollution in the spring reached to its maximum and that also the pollution had shown incensement from the first station towards the river's last station which the cause had been known to be arising from emergence of the pollutants caused by agro industries and city sources [8].

4.3 DO Variations

According to Table 2, the amount of DO in the river water is stable in each station within the year. Air temperature changes have had no effect in the amount of DO. The above information shows that the amount of DO in the river is high in station 1 but decreased in station 3 and becomes negligible. Also the amount of DO increases to 7 mg/L due to river water turbulent flow.

4.4 Phosphate Changes

According to Figs. 3 to 5, the amount of phosphate is very low in station 1 throughout the year (about 2/0 mg/L) but in stations 2 and 3, it reaches more that 2/0 mg/L and is diminished again in station 4. The changes in phosphate in the said stations indicate the capability of self-purification related to Gamasyab River. Therefore, it is recommended that the self-purification of mentioned river be studied in the near future.

This study has shown that using the water of this river has no prohibition for agricultural activities at the present time. Quality of Gamasyab river water is equivalent to the present standards of (DOE) in Iran. It is recommended that Gamasyab River should be managed by an organization with strong academic roots so that it will be able to anticipate the future characteristics of mentioned river and prevent from worsening the water quality of this river in the future. It is recommended to accelerate the Preparation and Implementation of the Nahavand wastewater treatment plant and approve the guideline for the preparation of management plans. Because of environmental management, it is recommended that the authorities Preventing Discharge of Pollutants such as any kind of wastewater and solid waste into river and Natural Water Bodies in the mentioned area.

Acknowledgments

This research was supported by DOE of Islamic Republic of Iran, to which the authors' thanks are due. The authors also thank Mr. Adel Arabi, Miss. Marzieh Hashemi, Miss. Maesumeh Parchian and Mr. Saayed Rasoli, Experts in DOE in Hamadan Province, for their collaboration in this study.

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