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Drought and the Impact of Natural Saline River on the Quality of Surface Water Resources In Karoon River(IRAN)

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Abstract:

Karoon River is one of the big important rivers in Iran. Goal of the study is to find a suitable solution to improve the water quality, and also to analyze the water quality in DBSR(Dasht-e-Bozorg salty river). The first aim is to analyze the effect of salty rivers on Karoon water quality mostly in Gotvand-Shushtar intervals. The results of physicochemical analysis of water quality in Gotvand, Dasht-e-Bozorg and Band- e- Mizan stationswere are also considered. The results show that the increased amount of salinity in the Karoon River downstream in 2006 compared to the time of dehydration in 2007 were respectively 154 and 42 µ mohs/cm. The qualitative effect of DBSR on the Karoon River in the Gotvand to Band- e- Mizan interval, if the salty water is to be reduced or totally disposed of, would improve the average water quality in terms of pH, electrical conductivity, TDS, chlorine, water hardness and turbidity, respectively to be 16.56, 34.26, 15.73, 15.09, 0.87 and 18.77percent. The increased amount of sulfate concentration to 18.29 would not play an important role in increasing or reducing the salt and it might possibly take effect as a result of drainage and sewage entering the city is in the upstream Band- e- Mizan.

Keyword: Karoon River; Dasht bozorg salty river; salinity; drought

1. Introduction

According to the World Bank report in 2008, the greatest challenges today, is to provide a healthy and fresh water supply for more than a billion people in Africa, South Asia and Middle East. Iran in the Middle East is in a more critical condition regarding its amount of water resources compared to the international standards and is among the arid and semiarid regions of the world.

Karoon River is one of the important and long rivers in Iran. Its Annual Estimated in Gotvand station which enters the plain is 12 billion cubic meters. Its rate of discharge is 64 percent compared to the province flowing waters and its ratio is 21.7 percent compared to the whole surface waters in the country [1].

But its critical situation due to the successive droughts, decreased river discharge in recent years, increasing consumption and withdrawals for new irrigation projects and agricultural developments, New sources of industrial pollutants, urban agriculture, and especially the transfer of water from the Karoon and Dez branches to the out of the province, the phenomenon of tidal rivers have all made it too complicated to provide a fresh healthy water.

Dasht-e-Bozorg salty river (DBSR) with an average salinity ratio of 20 ds/m is one of the most polluting sources of Karoon River. Its salinity is far more than the other pollutants in the middle parts of Karoon and it injects some minerals too (shor Morghab 3ds/m, shor Indica 15ds/m, and shor Lali 6ds/m) and it makes up to 65 percent [2]. Controlling and prevention of salt from entering the DBSR between compactness of Gotvand and Shooshtar are under the study in order to maintain Karoon River water quality. Karoon River and other existing rivers in Khuzestan Province along with their quantitative and qualitative states are presented in figure 1.

2. Methods

In the first step in order to evaluate the Dasht Bozorg qualitative and quantitative conditions and its possible effect on Karoon, the analysis of qualitative and quantitative features of water are needed first. They include statistics and information of water quality and quantity, EC and Q in the Karoon River in the upstream DBSR, and Gotvand and DBSR stations at the bottom of the river plain which all have been prepared. Gotvand station was chosen to allow for quantitative and qualitative data based on the Karoon River water quality stations prior to the confluence of river salinity examined [3]. Considering the fact that at the downstream of the Gotvand gauging station both rivers intersect, salinity of Dasht Bozorg River was chosen to be studied. In the present study gnomon period is observed and a statistical period 27 years, 1981-1982 (the year when hydrometric stations were established in DBSR) till 2008-2009 is applied. First

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annual trend rate of salinity changes in the statistical period of 27 years was prepared and then discussed.

First annual trend rate of salinity changes in the statistical indicators in the period of 27 years the station was prepared and then discussion on how the process changes were investigated. Considering that the next stage in the Karoon River downstream station after DBSR and Band- e- Mizan is located in northern Shushtar and also because of the fact that the quality statistics from the station after 2006 years are available, the qualitative and quantitative effects of salt on the Karoon River, the information and data from the stations related to 2006 and 2007 were used. The results will generalize to other years since the region is being exposed to high and low rainfalls.

The amount of salt water and discharge in DBSR station in 2006 equaled to 12.3 m^3/s, compared to 2.3 m^3/s in 2007 and this shows that in this year a severe drought occurred. Statistics from Gotvand quality stations and Band- e- Mizan (both belong to Khuzestan environmental Organization) and salty river water qualitative statistics (a branch of Water and electricity Organization of Khuzestan Province) for two years were collected and used. Geographical location of this active gauging station is shown in Table 1 and figure 2.

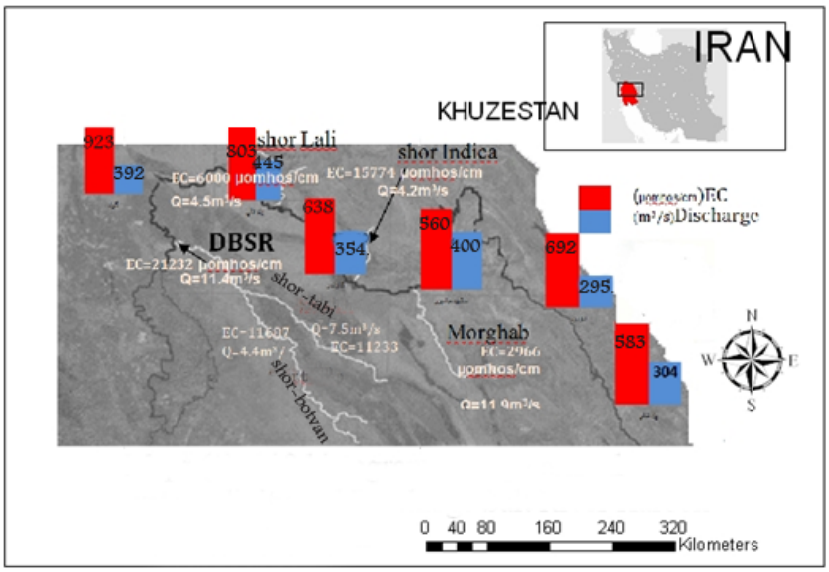

Figure1: shift histogram average annual water salinity and Discharge Salt River & Karoon River in Khuzestan

Table 1: Hydrometric station the position of study area

River	***Station***	***Geographical***				***Dependent***
		Latitude		Longitude		
karoon	Gotvand	32	13	48	49	**Environment**
salt	DBSR	32	31	48	55	**Water and Electricity**
karoon	Band-e-Mizan	32	3	48	51	**Environment**

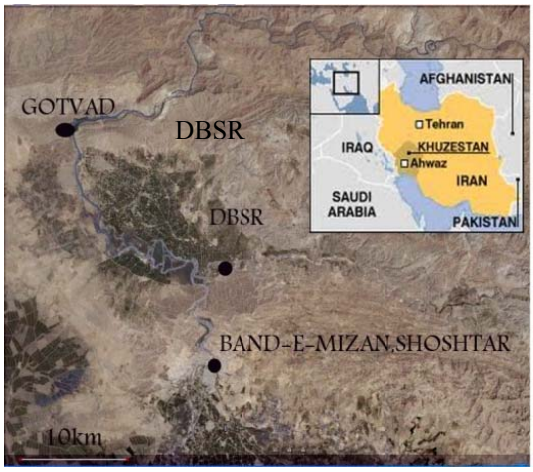

Figure2: Hydrometry station location studies ranges

3. Results and Discussion

3.1 Review of discharge in Karoon River and DBSR in recent years:

As the DBSR statistics, discharge, and other qualitative features of the water over 27 years shows Dsaht Bozorg river contains a high rate of soluble salts and electrical conductivity it is harmful for all the consumers Maximum salinity observed in the river exceeds thousand on µ mohs/cm Improving its quality or reducing its salinity is only possible at the times of spring and winter when there is too much

rainfall and it will reach more than 2000 µ mohs/cm . But with due to a high discharge, it contains more salt load and decreases the Karoon River water quality downstream is DBSR.

One of the effective parameters discussed in this study, is the salinity shown in figure 3. electrical conductivity of Karoon River in Gotvand over 27 years (1981--2008), had an increase trend. In 2008-2009 its highest value was (1612) showing an increase approximately as much as 63 percent compared to its annual amount of 940. The sole reason for its increase in this and successive years were the droughts and a severe reduction of rainfalls in the region, but compared to the DBSR, electrical conductivity of water over the years show a decreasing trend.

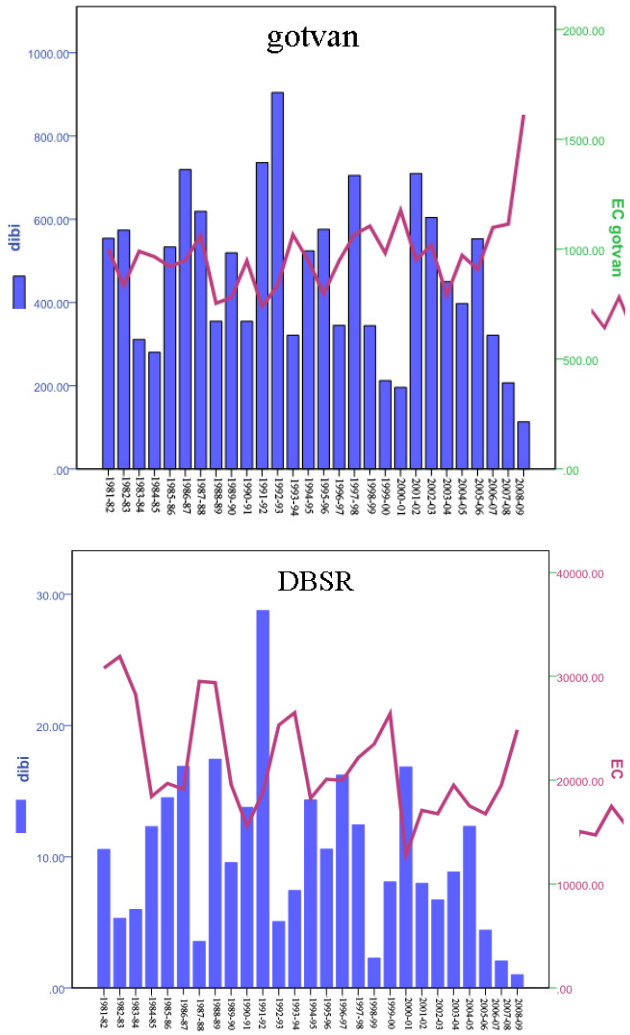

Figure3: Electrical conductivity when compared to the trend of change in annual water separation stations

3.2 Analysis of the salty Dasht Bozorg river water quality and its effect on the Karoon River water in the range of Gotvand and Band- e- Mizan

The Karoon River qualitative data located in the Gotvand Section (a dependent of Khuzestan environmental Organization) and Dasht Bozorg salty river (Khuzestan water and electricity organization) are provided here [4]. It includes statistical average, maximum, minimum and SD Criteria for both wet and drought years, in the table number 2. It should be mentioned that the DBSR in wet year was 12.3 m^3/s, and in the years of drought, 2.03 m^3/s, which shows a reduction over 80 percent.

3.3 Effect of electrical conductivity(EC) and soluble salt Materials(TDS)

Average salinity rate in Karoon River located in Gotvand in the wet year (2006) is equal to 888 µ mohs/cm and the average salinity of DBSR 17821µmohos/cm and Band- e- Mizan 1042µmohos/cm, which would show a increase by about 17.34 percent. But in 2008 by reducing the discharge of salty river, it reached 22240µmohos/cm, and average salinity rate in Karoon River in Gotvand and Band- e- Mizan were respectively 1772 and 1812 µmohos/cm which show an increase as much as 2.25 percent. These facts are related to saline Sewage and drainage in Gotvand.

According to the charts to number one in 2006, salinity (electrical conductivity) is the great salt plains in late summer to early spring, due to reduced river from discharge to reduce evaporation and precipitation above, shows an increasing trend. But in this period, salinity in the Karoon River downstream river salinity at section level to rise substantially Gotvand shows. Season with rainfall in 2006 (wet) salt river salinity Quality joins Great Plains, but improved and monthly river salinity in two places the Gotvand and Band- e- Mizan(G-B) particular change does not drift. In 2008, reducing the Shur River, monthly changes in river salinity is almost the same as 2006, but monthly changes in water salinity Karoon River G-B does not show any specific trend.

Electrical conductivity of water in the previous section were evaluated indicator of the amount of water soluble salts(TDS) is usually a certain ratio between the two parameters are established. According to the statistical calculation done in Table 2, the average TDS Gotvand Karoon River(GKR) in the year 2006 times and 530 mg/lit and Band- e- Mizan Karoon River(BKR) 625.68 mg/lit that 98.68 mg/lit of salt is added (18 percent increase compared to Gotvand). But in 2008, the average TDS the Karoon River in G-B that 1063 to 1087.65 mg/lit respectively, only 24.65 mg/lit of salt added to the Karoon River in comparison to 2006, 71 mg/lit of salt has decreased.

3.4 Effect of chloride

Chloride ion due to highly correlated with salinity or electrical conductivity and TDS salts as well as direct contact with the sodium ions are. Risk of chlorine ions with a lot of aerial plant that most of the ions on the plant, burning leaves is by irrigation.

According to statistical calculations Table 2 shows that the average chloride ion Karoon river in 2006 at the Gotvand 162.12 mg/lit and 188.36 mg/lit at 18.16% the ward level Has increased percent. But in 2007, according to discharge is to reduce salt, the average chloride ion at the Karoon river G-B respectively 461 and 378 mg/lit , which has dropped 83 units.

According to Chart 3, diagram DBSR in 2005 of the Month APRIL increasing chlorine concentration, chlorine concentration at ward level is greater than Gotvand. But in 2007 by reducing the DBSR, changes in chloride ion concentration in the river downstream to upstream salt is joining do not show any specific trend.

3.5 Effect of sulfates

Sulfate ion effects on plants and soil is not great [5]. But it causes increased calcium sulfate precipitate dropper is causing clogging irrigation systems can be localized . Also increase the sulfate concentration in the water causes corrosion in concrete irrigation channels and water supply facilities are. Intensity of sulfate attack of concrete to water, usually up to 200 mg/lit does not happen, but more than 300 mg/lit probably will cause corrosion of concrete. Table 2 Maximum values, minimum and average annual water sulfate in the separation of 2005 and 2007 stations are presented.

According to Table 2 shows that in 2005, the average sulfate ion in GKR 69.7 mg/lit and in Year 2007, 219.62 mg/lit which is nearly 215 percent increase. 69.67 percent increase in sulfate ion is DBSR, sulfate ions in the Karoon River downstream DBSR at the site for 2005years against 89.7 and 2007 years against the 323 mg 259.8 percent increased And the limit is exceeded and the sulfate concentration in the Karoon River, 2005, of G on B increase 28.97 percent in 2007 years, discharge is by reducing , sulfate ions than G-B, 47.28 percent Has. Thus increasing the sulfate ion that no contact with the DBSR and usually along the river caused by urban and industrial sewage always has shown an increasing trend. To better understand the effect of sulfate ions is the great salt plains on the amount of sulfate ions in the range of Karoon River Gotvand – figures 6 &7 for the amount shown.

3.6 Effect of water hardness

Total hardness as calcium and magnesium bicarbonate and carbonate are called according mg calcium carbonate. Average hardness of the Karoon River in the location Gotvand in year 2005, against 274.6 mg/lit calcium carbonate and at BKR 294 mg/lit calcium carbonate that 7.6 percent increase, and if discharge of DBSR is reduced in 2007, the average hardness of the GKR and BKR, respectively, 299 270.8 is a 9.43 percent declined. DBSR is the type of water quality and quantity of water, barely average from years 2005 and 2007 respectively in 1906 and 2135mg/lit calcium carbonate has increased approximately 12 percent.

based on the standard of drinking water, water hardness in the Karoon River and the section between the interval Gotvand rates usually no adverse effects on human health. Karoon River as water hardness above 100 mg/lit and the urban consumer to use water only due to excessive sedimentation on the formation of soap and equipment, is undesirable. To better understand the effect of sulfate ions is the great salt plains on the amount of sulfate ions in the range of Karoon River Gotvand - Charts to 5 for the amount shown.

3.7 Effect of water turbidity

water turbidity direct proportion to the amount of is discharge a river [6]. Opacity of Karoon River in winter is usually caused by floodwaters is created. Average turbidity at Gotvand Karoon River in the 2005, 77.66 mg/lit respectively. Karoon River downstream of the DBSR, the place for the amount of about 86.19 mg/lit, 7.53 units has increased. In year 2007 at the time of drought, reducing the average Q_{DBSR} turbidity 14.68 mg/lit the mean opacity and GKR in order for the amount of 8.81 and 8.01 to 8 mg/lit Reduction Unit has.

Graphs 7, turbidity levels in the Karoon river monthly interval GKR , BKR and DBSR show. Given these figures, increasing turbidity in DBSR in winter 2005 and in spring 2007years (especially months of April) has occurred. Increasing turbidity of Karoon River in 2005 due to high water is being compared to Discharge is negligible salt does not show any specific trend. But in 2007 years, Turbidity DBSR equal to 57 mg/lit has been the amount of opacity of Karoon River in the interval G-B order 7.75 and 11.6 mm/lit to 3.85 units have increased is. However, turbidity DBSR is due to low compared with the $Q_{\text{Karoon River}}$ has not had much effect.

3.8 Effect of pH

Considering the amount of water after her geographical location, especially depending on some rocks and soil in the region varies. Following changes in pH of water in rivers due to discharge of municipal and industrial wastewater treatment and not occur. Statistical results follow DBSR on the Karoon River is the table number 2 shows that due to the low salinity and lack of river water pollution, little effect on water pH does not change much after the water temperature quite biological activity, and microbial resources Water pollutants to rivers, especially the urban sewage city depends.

4. Conclusions

To investigate the effect of Saline River on Karoon, the data from two stations , Gotvand and Band E Mizan (a branch of Khuzestan environment protection organization) and hydrometric station in Dasht Bozorg (a branch of Khuzestan water and electricity organization) in 2005 and 2007 was gathered. The sole reason for this selection was the fact that the water discharge from Saline River was 12.3 m^3/s in 2005 based on the relevant statistics and patterns. It is almost more than the annual water discharge average (about 10.5 m^3/s). In 2007 it reached about 2.03 m^3/s which is the least amount through the whole statistical year. So the main purpose of this study is to investigate its qualitative impact on Karoon (in GB) and also to improve the water quality by regarding and eliminating it.

The results of analyzing water qualitative parameters including salinity, soluble salts, chloride, sulfates, total hardness and turbidity are all given in table no 3.

The findings indicate that the average water quality in GB regarding PH, Electrical conductivity, TDS, Chloride, hardness, and turbidity would show an improvement as much as 0.87, 15.09, 15.73, 34.26, 16.56, and 18.77 percent respectively if the discharge from Saline River is to be decreased or eliminated. The concentration of sulfate would increase as much as 18.29. It can not have a significant effect on the reducing or increasing the discharge from Saline River. Its effect might be obvious in upstream areas following the urban ooze.

Since Chloride ion has a high power of correlation with sodium ion in water (as much as 9.81 percent) and its type is chloride sodium. If the chloride concentration in water decreases as much as 34.26, sodium concentration would drop too and would show an improvement as much as 33.6 percent.

The total amount of Calcium and Magnesium which is in form of Carbonate and bicarbonate is called Water Hardness and is usually calculated on ml/gr. if the are to be multiply by 50, the equal would show the amount of water hardness on Bicarbonate Calcium on ml/lit units. If the concentration of calcium and magnesium decrease, the total water hardness would drop too. So if the water discharge from Saline River is to be decreases, the total water hardness would show an improvement as much as 16.56 percent and the total of calcium and magnesium would drop as much as 0.33 percent.

SAR is the ratio of sodium intake in water. It is calculated through $(SAR = \frac{Na}{\sqrt{\frac{(Ca+Mg)}{2}}})$ [7]. Since the variations in the total amount of calcium and magnesium are so slight the ratio of sodium intake would drop or even improve that much too. This would lessen the risk of sodiumification of soil as a consequence of irrigation.

The results show that the degree of salinity in Karoon in GB had an ascending pattern. The average salinity in Gotvand in 2005 and 2007 was 1772 and 888 respectively and in Band E Mizan it reached 1812 and 10423 micromous/cm. The river was the saltiest in winter and its best quality was in spring and summer. The impact of Saline River on Karoon depends on the degree of salinity and water discharge from Saline River. The highest amount of water discharge was in 2005 and the worst water quality was through the summer. In this season, Saline River had a serious effect on the water salinity in Karoon in the range of Gotvand – Band E Mizan. In 2007, at the time of draught and as a result of reduction in water discharge, there was no direct effect on water quality in Karoon.

So the only way to improve the water quality in Karoon (in GB) is through reducing or even eliminating the flow of water from Saline River in time of draughts.

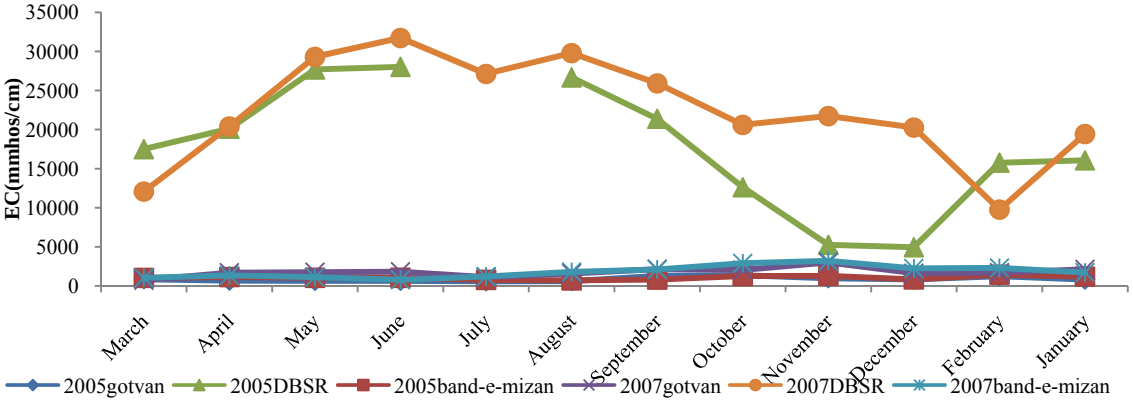

Figure 4: Monthly changes of salinity (electrical conductivity) in 2005 and 2007 water separation stations (µmohs /cm)

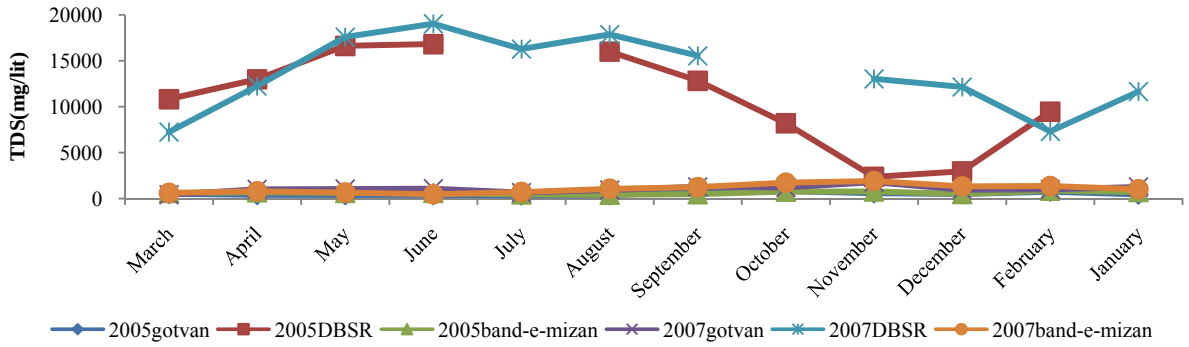

Figure 5: material changes in total solute separation stations studied monthly in 2005 and 2007(mg/lit).

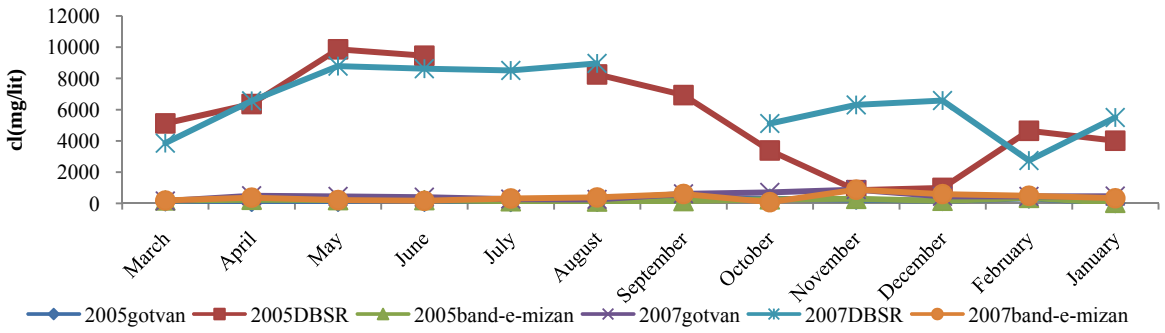

Figure 6: Changes to the separation of chloride stations studied in 2005 and 2007(mg/lit).

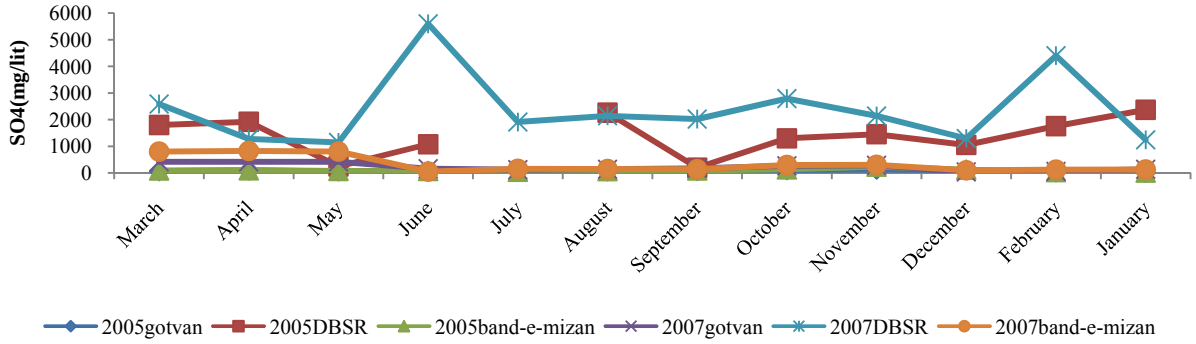

Figure 7: changes monthly sulfate separation stations studied in 2005 and 2007(mg/lit).

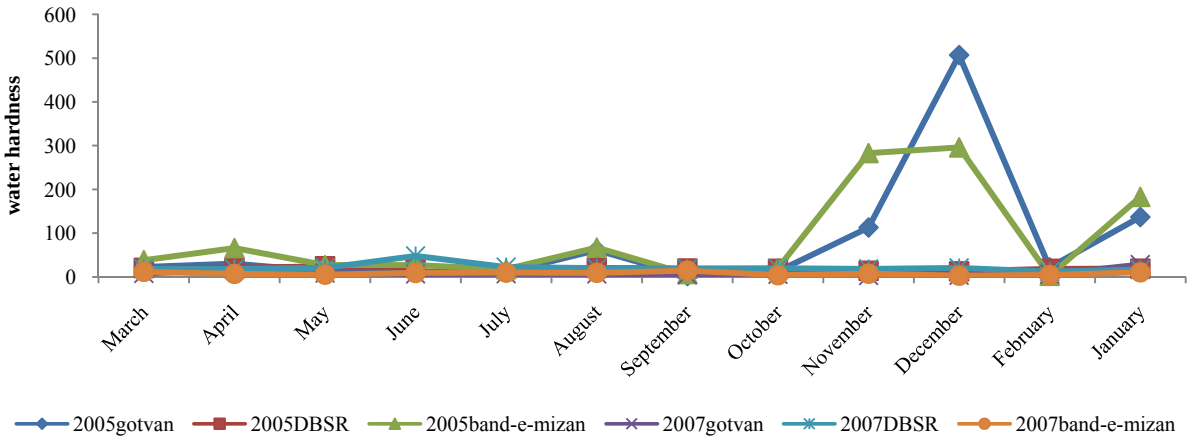

Figure 8: Monthly changes Hardness to separate stations studied in 2005 and 2007(mg/lit).

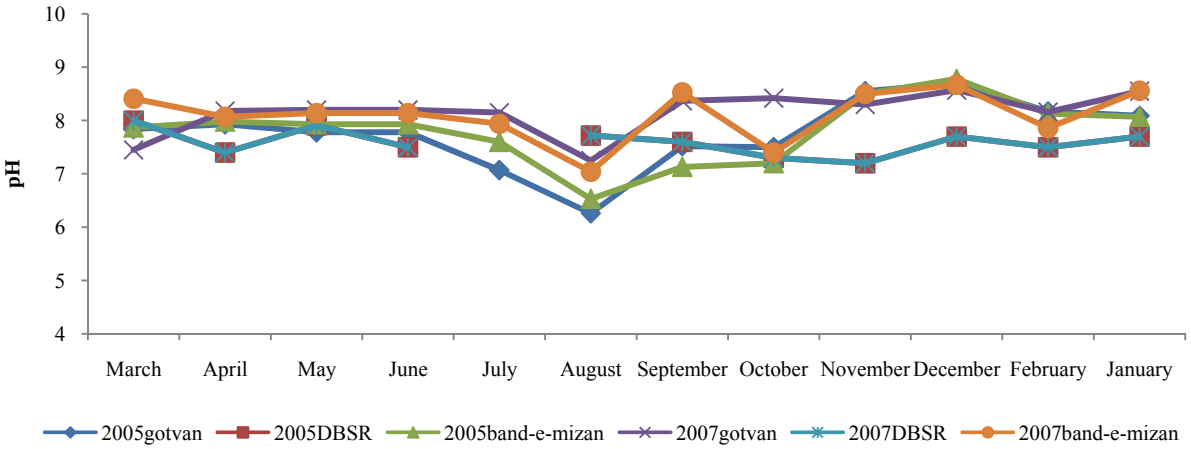

Figure 9: Monthly changes pH to separate stations studied in 2005 and 2007.

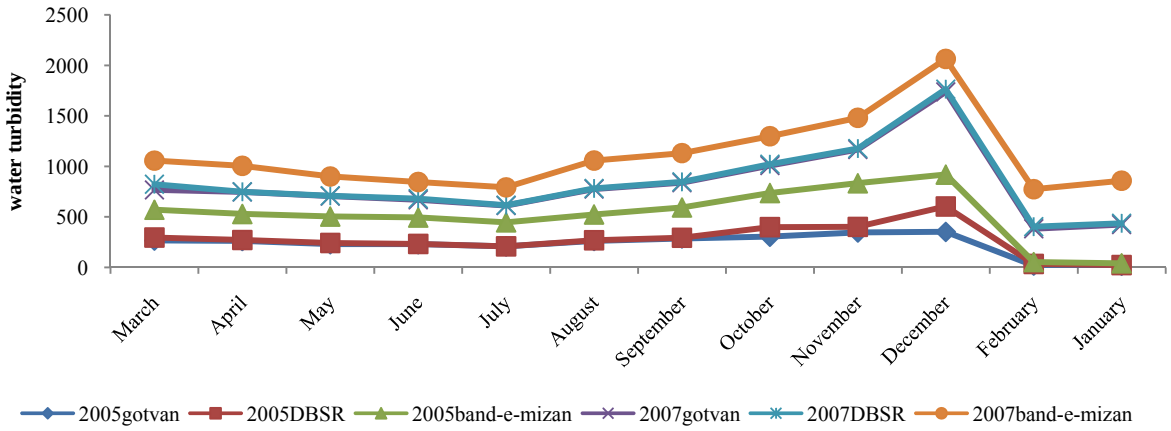

Figure 10: Monthly changes water turbidity to separate stations studied in 2005 and 2007.

Table .2. Some statistical parameters of river water quality in 2005 and 2007

Station	*Statistical parameters*	*pH 2005*	*pH 2007*	*EC 2005*	*EC 2007*	*TDS 2005*	*TDS 2007*	*Cl 2005*	*Cl 2007*	*SO_4 2005*	*SO_4 2007*	*Hardness 2005*	*Hardness 2007*	*turbidity 2005*	*turbidity 2007*
Gotvand	max	8.7	8.27	1374	3000	824.40	1800	326.00	876.00	125.4	418.5	352	818	507.	28.2
	mean	7.77	8.15	888	1772	530/01	1063	162.12	461.67	69.7	219.6	274	299.5	78.66	8.81
	min	6.25	7.25	596	724	357.60	434.40	16.50	150.00	4.2	38.4	208	166	2.03	3.14
	sdv	0.65	0.4	278	559	168.49	335.51	102.99	198.82	34.75	138.7	48.1	176.8	141.6	7.01
DBSR	max	8.00	7.8	28030	31720	16818	19032.	9860.0	8960.0	2370	5596.8	2428	4800	251	56.00
	mean	7.59	7.38	17821	22340	10908	13633	5437.6	5966.5	1401	2376.6	1906	2135	44.18	14.66
	min	7.2	6.8	4946	9763	2367	7245.0	840.70	91.00	192	1140	1274	1227	2.00	2
	sdv	0.24	0.24	8101	6815	5237	4028.6	3075.0	2724.2	727.2	1360	336.6	876.3	74.03	14.91
Band-e-mizan	max	8.78	8.67	1434	3200	860	1920	188.36	875.00	233.6	824.45	432	420	296	14.51
	mean	7.8	8.11	1042	1812	625.68	1087.6	188.3	377.90	89.89	323.4	293.8	270.8	86.19	8.01
	min	6.53	7.04	703	793	421.80	475.80	26.30	69.80	13.6	51.2	238	164	2.64	2.93
	sdv	0.67	0.49	231	757	138.62	454.79	84.09	227.43	56.91	301.1	57.5	75.5	106.43	3.49

Table.3. Comparison of percentage changes in some parameters of the rivers in 2005 and2007

turbidity		*Total hardness*		*SO_4^{-2}(mg/lit)*		*Cl^-(mg/llit)*		*TDS*		*EC*		*pH*		*station*	*river*
2007	**2005**	**2007**	**2005**	**2007**	**2005**	**2007**	**2005**	**2007**	**2005**	**2007**	**2005**	**2007**	**2005**		
8.81	78.66	300	274.6	219.66	69.7	461.7	162	1063	530	1772	888	8.15	7.77	Gotvan	karoon
14.66	44.18	2135	1907	2373.64	1410.2	5967	5437	12633	10906	22240	17841	7.38	7.59	DBSR	saline
8.01	86.19	271	293.8	323.46	89.89	377.9	188	1088	625.7	1812	1042	8.11	7.8	Band	karoon
-0.8	7.53	-29	199.2	103.8	20.19	-83.77	26.1	24.65	95.68	40	154	-0.04	0.03	Difference G-B	
-90.8	9.69	-9.57	6.99	47.25	28.96	-18.14	16.12	2.32	18.05	2.25	17.34	-0.49	0.38	Percent%	
-18.77		-16.56		18.29		-34.26		-15.73		-15.09		-0.87		Percentage change in dsicharge is done to reduce salt	

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