

Study the effect of Gotvandoliyadam on the water Quality of Khuzestan Provinces and its Solutions

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Abstract : Rivers are the most important sources of water supply for drinking costs, agricultural and industrial purposes. Therefore, assessment of their qualitative conditions has always been considered from different aspects by the experts of the country's water engineering department. Gotvandaliya dam is one of the largest dams in Iran on the Karun River in southwestern Iran. The presence of domes and salt streaks around the reservoir of the dam creates a belief that it may lead to excessive water salinity at the bottom of the dam. In this study, the water quality of the Karun River in the upstream and downstream of the Gotvandaliya dam was studied by using EC index. The results showed that the main problem of decreasing quality of water in the upstream and downstream of the dam is the presence of saline rivers and water back from the industries and the cultivation of sugar cane and the sewage of cities around the river. The results of the studies indicate that the presence of Gotvandaliyadam elevation will improve the water quality index of the river.

Keywords: Gotvand dam, water quality, electrical conductivity, salinity

1. INTRODUCTION

Rivers are the most important sources of water supply for drinking, agricultural and industrial purposes, so evaluating their qualitative conditions from different aspects has always been considered by the experts of the country's water engineering department. [1] Today, one of the most important problems related to surface waters in catchment areas is the issue of water quality in rivers and the effect of reservoirs dams on it [15]. The quality of water resources is constantly changing as its quantity; in many cases these changes are repeated naturally or seasonally. Gotvandaliya dam is one of the largest dams in Iran on the Karun River in southwestern Iran. One of the most important challenges facing the dam was the debate about the presence of domes and salt streaks around the dam's reservoir, which, after draining the dam, was gone underwater and was believed it causes excessive salinization of the lower level of the dam.

1- The results of the environmental assessment of the construction of the Gotvand dam show that the construction of this dam can lead to salt drainage into the water, salinification of the groundwater in the region, dispersion of soluble materials, create toxic substances and contamination of organic materials. Surface water quality data of 23 hydrometric stations in Kansas province was investigated by Yue and his colleagues for the trend of 21 main components by using the Man-Kendall method in (1993). [2] The results showed that the concentration trend of 21 elements was descending. Boyacioglu (2008) Chloride, studied the Nitrate, Sodium, Sulphate and Total Soluble Changes in Seven Station of the Turkish Tahiti by Using the Man-Kendall Test and Estimator the slope of the age. [3] The results indicate a decrease in the concentration of most of the elements is in the rivers water. [4] Anbazhagan and Nair (2004) examined the spatial changes of groundwater chemical elements in the panol plain using the geographical information system [5]. Antonopoulos and his

colleagues. (2008) analyzed the trends of the monthly time series of some variables of quality and quantity of water by using the Spearman test. According to the results of this study, Dubai had a decreasing trend and an electric conductivity variable had an increasing trend. Kauffman and Belden (2010) analyzed the water quality of 30 rivers in America between 1970 and 2005. [6] The results showed that water quality remained constant or improved in 69% of the stations. Shokouhi and his colleagues in (2012) examined the water quality of the lake Aydgמושdam by using the NSFQI Water Quality. The results showed that the highest water quality index was obtained with 84.89 in July and the lowest in May. Reducing the index value was due to the loss of dissolved oxygen in the lake water behind the dam. Based on the results, the calculation showed that the water quality is good. [7] Al-Taani in (2011) examines the seasonal changes in the water quality of Lake Al-Wehda Dam in Jordan. [8] The results of the TDS and EC indicators showed that the water quality of the lake remained constant for many months. Several studies have been done on the quality of water behind the dam in the world: Kannel et al, Elhatip and Komur in 2007, Akin et al in 2010, Muller et al in 2008, Irenosen et al in 2011, Varol et al in 2012, [9-14] In the present study, the impact of the construction of the upper Gotvand dam on the water quality of Khuzestan province was evaluated by using EC conductivity index.

2. MATERIALS AND METHODS

Gotvandaliya dam is located 25 km north of Shoushtar city and 10 km northeast of Gotvand city in Khuzestan province. This dam is the last dam can be constructed on the Karun River. (Figure 1) The lake of this dam with a reserve of 4 billion and 500 million cubic meters is the second largest artificial lake in the country after the Karkheh. The height of the pebble dam with a clay core was a 182-meters, that is the highest earth dam in the country. This dam is located

between dams constructed and are constructing on Karun, and it's as the last reservoir dam at the end of the Karun River and upstream of the Gotvand Regulatory Dam.

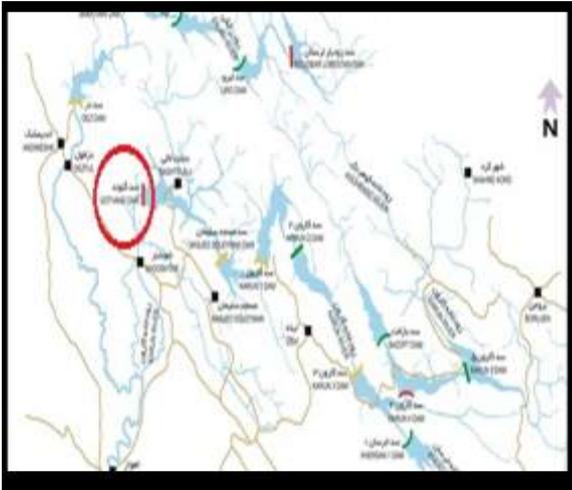


Figure 1. The catchment area of the Karun River and the position of the Gotvandaliya Dam

Several experts believed that near the salt mine to the Gotvandaliya dam site was not considered in the study project of the dam. And the existence of this mine that is located at a distance of 5 km from the dam, causes the huge salt mine, estimated at 100 million tons of salt, to dip under the lake completely during the dehydration and forming of the lake behind the dam, which causes water salinity Karoon River to the highest possible. But the plan consultant, after examining the physical model made at the site, stated that the existing streaks of salt can be covered and there are no problems in this area due to the large distances of the formation from the dam body. At the same time, the executive director, as the plan's employer, expressed concern about some circles that the plan will be done with a confidence coefficient higher than the required control activities, also by creating a cover on this formation, and by filling the holes that are even distant from the tank. Eventually, the operation was terminated and it is currently in operation. In order to evaluate the water quality, an indicator called TDS or the total weight of all watersoluble is usually used. To determine its amount, the total weight of salts is measured after evaporation of water and the maximum optimal water quality is 1000 mg / l. For ease of measurement of water quality, the electrical conductivity of the water is measured, and it can convertible into TDS by using some relationships. (figure 2)

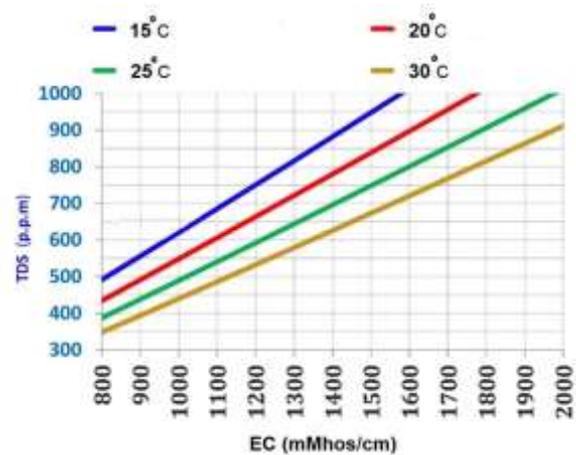


Figure 2- The relationship between EC and TDS

The MonoLine Cond 3310 IDS - Germany WTW Company has been used to determine the electrical conductivity of the water. (figure3)



Figure 3. Portable Portal Transmitter to determine the electrical conductivity of water

According to Iran's 1053 standard, the maximum recommended EC of drinking water is 1530 and maximum permissible is 2350 micrometers per centimeter. The Karoon River in Shushtar is divided into two branches of Gregor and Shatitand they rejoined in 60 kilometers north of Ahvaz at the site of Qir, in the same geographical area the Dez river also connecting to the Karoon River and the Karoon River and The Great Karoon River is formed. About 60 percent of the current water which is in the Karoon River comes from the Karoon River and about 40 percent of its comes from the Dez River. By using this introduction, factors affecting the water quality of the Karun River in the upstream and downstream of the Gotvandaliya dam are checked.

3. RESULTS AND DISCUSSION

3.1 Effective Factors are existing on the Quality of Karoon River water from ShahidAbbaspour Dam (Karoon I) to Gotvandaliyadam. In different seasons the EC of the output water from ShahidAbbaspour Dam (Karoon I) is about 500 micrometers per centimeter and from MasjedSoleiman dam power plant

varies from 600 to 800 Micromass on centimeter. The reason for this, is the arrival of salt Dulab water that is on the right bottom of the dam and about a kilometer upstream of it. Based on the data of Khuzestan Water and Power Organization, the EC of the Karoon River in the Gotvand Regulatory dam was Varied over a period of 14 years before the Gotvand Dam damping in 1390 to

1376, during the months and seasons of the year, and its average was 1102 micromasses per cm. The average EC of the Karun River water in the Gotvand Regulatory Dam during dry years from 1350 to 1905 were 1330 micromasses per cm. The EC data of the Karun River at the Gotvand dam regulatory before the construction of the Gotvand dam for months and years from 1390 to 1376 are listed in [Table 1](#).

Table 1. The EC data of the Karun River

Watery year	octobor	November	December	January	February	March	April	May	June	July	august	September	average
77-76	1010	957	-----	1352	1346	1064	----	750	---	993	---	---	1067
78-77	880	1365	1104	1166	1818	775	---	740	---	---	775	1326	1105
79-78	1297	---	1039	1096	1056	823	1115	750	907	862	---	886	983
80-79	1199	1243	1937	1330	1175	1226	1702	706	796	642	747	985	1141
81-80	---	1551	1460	915	789	1206	847	526	739	741	882	786	949
82-81	713	1089	1053	637	930	745	604	890	613	544	965	---	798
83-82	878	1190	1623	1110	795	776	652	711	637	515	614	1580	923
84-83	961	934	1173	1560	1068	997	645	1327	526	598	610	691	924
85-84	1112	1150	1294	1254	795	680	665	664	585	685	673	880	---
86-85	---	1255	1210	2595	991	1847	1135	520	529	613	939	525	1105
87-86	819	910	880	1074	865	1004	1118	---	1604	1735	1069	1180	1114
88-87	1888	2215	2323	2308	1658	1466	1571	1217	1336	620	1000	1222	1568
89-88	1529	2120	2700	1800	1389	1053	1064	770	2230	629	1707	989	1498
90-89	824	1232	1633	1579	1614	1734	2230	887	1391	1368	1059	678	1352
Average	1093	1313	1483	1415	1196	1108	1114	805	998	803	921	960	1102

According to [Table 1](#), the annual average of EC waters of the Karun River in the Gotvand Regulatory Dam was 1300-1600 micromas per cm in the dry years with Given the fact that the Gotvand dam began to dehydration in August 2011, and from dehydration time till now the Karoon River Basin has Drowsy times. However, the average annual EC water output from the Gotvand Dam since dehydration time till now has been less than 1,300 micromos per cm. Therefore, it is noted for the dry period of Gotvand dam, Downstream water has been provided better quality than before the construction of the Gotvand dam. [Figures 4](#) and [5](#) show the comparison of water quality before and after dehydration.

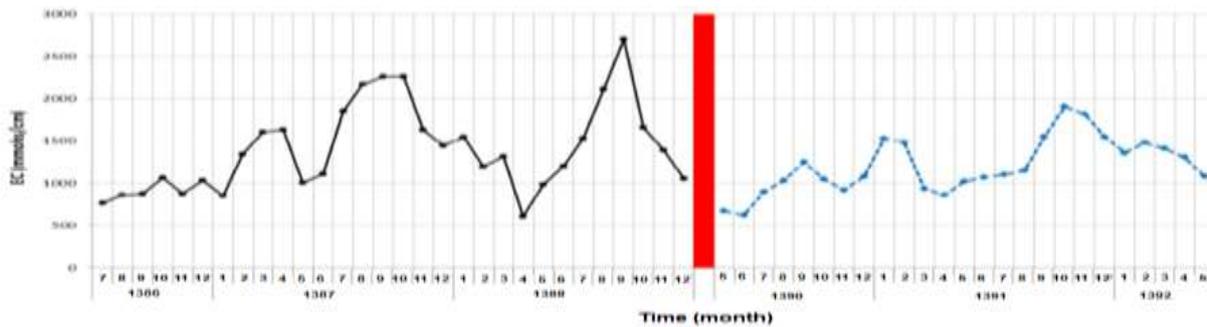


Figure 4: Water salinity level at the bottom of the upper Gotvandaliya Dam before and after the dehydration of the reservoir (red column shows the start time of dehydration).

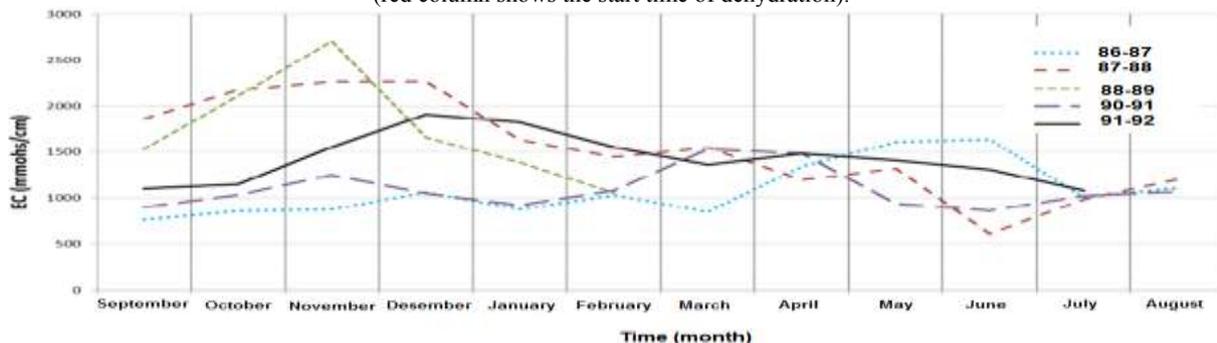


Figure 5: EC values at the bottom of the Gotvandaliya Dam before and after dehydration

Rivers and springs from the downstream of MasjedSoleiman dam enter the Karun river till the Gotvand dam position, which has an average discharge of about 30 cubic meters per second with an EC of about 3000 micromhos per cm and the reason for the increase of the Karun River EC from the MasjedSoleiman Dam to the Gotvand Regulatory Dam. According to the studies, action is not feasible to prevent the entry of the springs and rivers into the Karoon River.

2-3 Effective Factors on the water quality of the Karun River from Gotvand Regulatory Dam to Ahwaz and Abadan

The difference in EC water from the Gotvand dam to the sixth bridge of Ahwaz is double and tripled to Abadan. Constructing of fish pools with an area of 1700 hectares and the return of water from them to the Gregor River, as well as the entraining the wastewater of the Shushtar and the surrounding rivers, are the reasons for increasing the EC of the Karun River from the Gotvand Regulatory Dam to the position of the Qir Dam. Also, in the Shatit river shrine, the entrance of a part of Shushtar city sewage and about 70 percent of the return water from Karun cultivation and industry has caused an increase of about 600 units of the EC from the Gotvand regulatory dam to the point of Qir in position of Shatit river. The EC of the Dez River water at the site of the Ali-kale dam in the upper reaches of the Dezful city has been about 500-400 micromhos per cm. Unfortunately, the EC of the Dez river water rises to 4 to 7 times, or in other words its EC, to about 3000 micromhos per cm, before it enters the Karoon River at the site of the Qir. And it is the most important source of influence on the water quality of the Karoon River to the sixth bridge of Ahwaz and Abadan. Entering the amount of wastewater of the Dezful and Shoosh cities, and in particular the return water from Imam Khomeini sugarcane industries, between water, seven hills and 30 percent of the Karun industry are the reasons for increasing the EC of the water in the Dez river. The reason for the increasing of EC water from Ahwaz to Abadan was mostly wastewater of the Ahwaz city and returned water of the sugarcane industries such as Khazaei Dabal, Farabi, Salman Farsi, Amir Kabir and Mirza Kuchak Khan. It should be noted that, unfortunately, in the development of cultivating industries between Ahwaz and Abadan before construction, there was not enough study on the quality of Karoon River water from Ahwaz to the next. Regarding this fact, the organization of the Karun River from the Gotvand Regulatory Dam and Dezful to Abadan for improving the water quality of the Karun River has been an inevitable necessity and no action has been taken so far.

According to the study, the main reason of water quality reduction in the Karun River that are pollutants deliberately drained into the Karun and Dez and big Karun rivers. The mentioned cultivation and industry are the main consumers of Karoon and Doz rivers, without neglecting the harmful effects of destructive water and environmental returns. One of the methods for controlling the water quality of the Dez and Karun rivers can be the allocation of water to

major water users, and if it is possible EC water returns to the river at a maximum of 1.5 times EC water. That the EC returns to the river at a maximum of up to 1.5 times EC water and until don't solve this issue, it is not expected to improve the water quality of the Dez, Karoon and big Karoon rivers.

Considering that about 40 percent of the Karoon River water is from the Dez river and Dez river is one of the influential sources among the many contamination sources on the quality of the Karun river water. Therefore, it is necessary that the organization / organizations take the responsibility for providing water for consumers and for quality controlling of the Karun River water and focus on organizing the Dez River. The implemented strategies for controlling water quality in the Karun River at Gotvand Dam were predicted to control the rate of salt dissolution and management of the reservoir in order to reduce the risk and provide water with optimal quality. The most important measures were as follows:

- Determine $EC \approx 2000$ micromhos per cm as the red line of the design
- The construction of a fuzoplag in concrete blugs deviations tunnels of the right and middle water.
- Construction of lower discharge drainage structure at two levels of 123 and 158 meters
- The possibility of closing the down drainage craters with the vertex
- Construction of a water discharge pipe from the bottom of the reservoir at two levels of 90 and 110 meters
- Provide of behavioral and qualitative reservoir water system
- Stage water intake
- Performing curative operations on Gachsaran Formation (drilling and embankment)
- Filling the pits in the constructions. According to [Figure 6](#), based on the understanding between the Water and Power

Organization of Khuzestan and the water and power company, the red line in the diagram was set as the maximum allowed EC for the discharge water from the reservoir of the dam at different times, and the green line shows the quality of water drained out of the reservoir during the operation period.

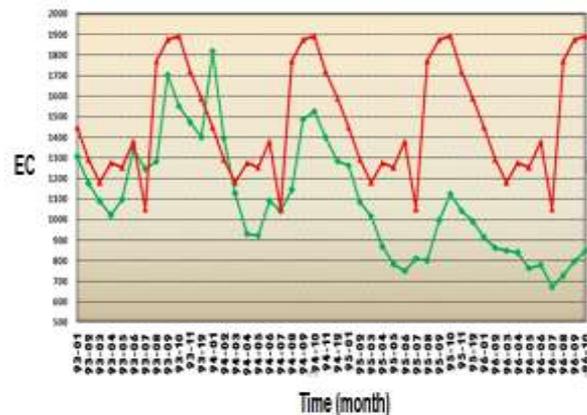


Figure 6: EC values allowed and Measured EC of the output Water from the Gotvandaliya dam

4. CONCLUSION

In this study, the water quality of the Karun River in upstream and downstream of Gotvandaliya dam was studied by using EC index. The results of the studies showed that the water quality of the Gotvand dam was improved after operation. And the main reason for the reduction of water quality in the Karun River is the large amount of pollutants that are deliberately drained into the Karun and Dez and Karoon rivers. The reason for the increase of the EC of the Karun River from Gotvand Regulatory Dam to the position of Qir Dam, the entrance of the sour water of Aghili River and the construction of fish ponds and also the entrance wastewater of the Shushtar and surrounding villages and Shushtar city and the return water from the Karun cultivation and industry have been caused to increase the 600 units of EC from the Gotvand regulatory dam. The reason for the increase of EC water from Ahwaz to Abadan is mainly the Ahwaz urban wastewater and the return waters of the cultivation and sugarcane industries. One of the methods for controlling the water quality of the Dez and Karun rivers can be the allocation of water to major water users, and if it is possible EC water returns to the river at a maximum of 1.5 times EC water. That the EC returns to the river at a maximum of up to 1.5 times EC water and until don't solve this issue, it is not expected to improve the water quality of the Dez, Karoon and big Karoon rivers.

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CONFLICT OF INTEREST

The author (s) declared no potential conflicts of interests with respect to the authorship and/or publication of this paper.

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