Challenges, approaches and potentials of reuse of drainage water in Khuzestan province

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1. Introduction

Khuzestan province is located in south-west Iran and north of the Persian Gulf. The fertile plain of Khuzestan is part of the famous ancient region of Mesopotamia. The water resources of several rivers, which originate from the Zagros Mountains, have been the cause of agricultural development and ancient human communities in this plain. Figure (1), shows the general location of this province.

Fig.1. General location map of Khuzestan in Iran

About one third of Iran's surface water resources (28 billion cubic meters per year) enter the Khuzestan Plain through four main rivers, so that about 15% of Iran's agricultural products are produced in this plain. Currently, more than one million hectares of the agricultural lands are irrigated, of which more than 600,000 hectares are equipped with modern irrigation and drainage networks.

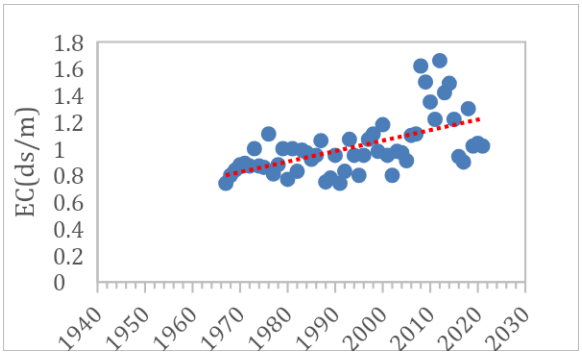
2-Unconventional water sources in Khuzestan

The main sources of saline and unconventional water in Khuzestan include rivers and springs of saline water, agricultural drains, urban waste water, industrial sewage and also sea water. About 90% of the water harvested from water sources in Khuzestan is for irrigation of agricultural lands, therefore, the largest amount of produced water is also from the source. Table (2) shows the amount of saline and non-conventional wastewater resulting from each of the activities.

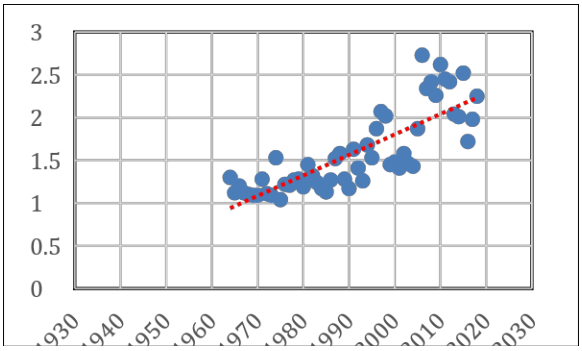
No.	consumer	Consumer subset	Volume (MCM)	urban waste water(%)	Estimated amount of returned water (%)	REUSE(MCM)
1	Agriculture	irrigation and drainage networks	6000	34.4	35	2100
2		Traditional channels and pumps	6228	35.7	30	1868
3		Sugarcane farming	3250	18.6	45	1462
4		Total agriculture	15478	89	----	5431
5	Urban waste water		870	5	80-90	740
6	Industrial waste water		303	1.7	20	61
7	Aquaculture waste water		788	4.5	75	591

Considering the return water cycle in the upstream and middle reaches of the rivers, it is concluded that more than 3 million cubic meters of agricultural water drains are left unused. This huge volume of unconventional waters causes challenges such as salinity of surface water resources, water drainage, environmental problems and impact on receiving resources. But by recognizing the potentials of production and use of environmental conditions and the development of science and technology, he turned these challenges and threats into suitable opportunities (production of agricultural, livestock and aquatic products). In the current situation, the agricultural water drains are divided into three categories, in the upper reaches of the rivers, the water returned to the river has good quality and returns to the river without restrictions. In the middle and final periods when the water quality of rivers and drains should be reduced, the drain is discharged to evaporation ponds or lands connected to the sea and wetlands. As an example, the volume of water entering the evaporation ponds west of the Karun River in the south of Ahvaz is about 300 million cubic meters

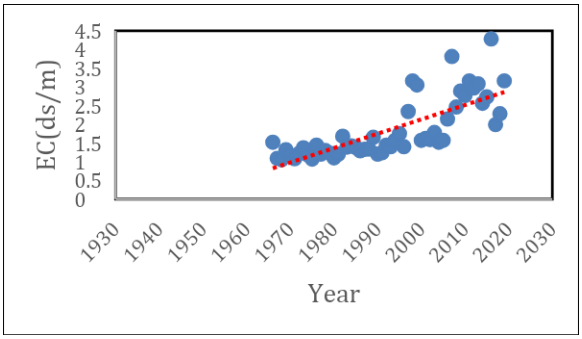
annually. Figures 2 to 4 shows the increase in salinity of the Karun River) the largest river in Khuzestan (, in three water measuring stations in the upstream, middle and downstream reaches of this river. Also, figure 5 shows the changes in the salinity of the drainage water from about 30,000 hectares of sugarcane cultivated land in the south of this province (downstream areas of the Karun River).



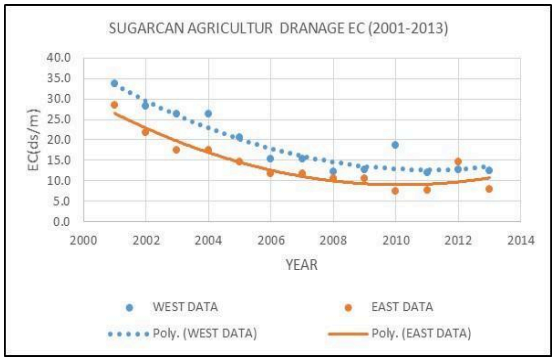
Figur(2). Diagram of salinity changes of the Karun River in the upper reach



Figur(4). Diagram of salinity changes of the Karun River in the lower reach



Figur(3). Diagram of salinity changes of the Karun River in the Midel reach



Figur(4). Reducing the salinity of the sugarcane drain in the lower reaches of the Karun River

According to the diagram, although the salinity of sugarcane drains in the early years of soil amendment and leaching of accumulated salts in the soil is more than 30 ds/m, but gradually the salinity of the agricultural drains of these lands has reached less than 7 ds/m.

The modeling of drainage changes in the south-west of Khuzestan province in the catchment area of the Karkheh river by the consultant Sas Ab Pardazhan also showed that the salinity of the drainage water after about 15 to 20 years from about 30 ds/m to about 7 to 8 ds/m will decrease. As a result, in the analysis and investigation of the potential, the use of agricultural drainage, the temporal analysis of the qualitative and quantitative changes of the drainage should be taken into consideration.

Approaches to reduce the challenge of agricultural water drainage in Khuzestan

Approaches to reduce the challenges of disposing of unconventional water and especially the drainage water of agricultural lands in the early 1960s, that is, from the beginning of the development of modern irrigation networks, have changed over time, towards the reuse of drain water as a valuable water source. , has been changed. The following table shows the approaches to dealing with agricultural water drainage from the past 60 years**.**

priod	The location of irrigation network	The quality of the drainage water	Suggested location of drainage	Is the current situation	Reason for continuing the current method or	Advice for improvement

	developme nt			**appropr iate?**	**changing the approach**	
1960-1990	The upper reaches of the rivers	Good and acceptable for sensitive and semi-sensiti ve plants	Rivers and natural channels	YES	Water without quality restrictions to return to surface water sources	Improving irrigation efficiency and avoiding over-irrigation, reuse of drainage water for agriculture
1990-2000	Middle and lower reaches of rivers	Acceptable to severe limitations for salinity-toler ant and semi-toleran t crops	Rivers and natural channels	NO	Severe decrease in river water quality in the middle and lower reaches, especially during drought periods.	Improving irrigation efficiency and avoiding over-irrigation, reuse of drainage water for agriculture and Changing the drainage outlet from the river
2000-2010	Middle and lower reaches of rivers	Acceptable to severe limitations for salinity-toler ant and semi-toleran t crops	Drainage of water to barren lands, evaporation ponds, wetlands and the sea	No	Degradation of soil resources, environmental environmental limitations and the possibility of water reuse	Improving irrigation efficiency and avoiding over-irrigation, reuse of drainage water for agriculture and Changing the drainage outlet from the river
2010-2024	Middle and lower reaches of rivers	Unusable for any type of agricultural plants, usable for pasture plants of saline lands, beneficial halophytes and saltwater aquatic plants.	Reuse of agricultural, industrial and aquaculture water drains, water drain management according to river flow, floods and wetlands environmental capacity.	No	The potential of reusing agricultural water to produce salt-resistant plants, the use of salt water for specific industries such as injection into oil wells, the use of salt in the production of raw materials for petrochemicals active in the region.	Prioritizing the use of water for the production of plants that are not in the food cycle, such as the production of wood by cultivating eucalyptus, continuous control of water salts. Using saltwater springs or seawater to produce saltwater aquatic animals such as shrimp and seabass

Unconventional water use potentials

Since about 20 years ago, the severe decrease in the quality of river water caused restrictions on the entry of drainage water in the downstream rivers of Khuzestan province and created critical conditions for drinking and agricultural consumers downstream of the rivers and the environment. The most important ways to reduce the challenge of agricultural drainage is to first improve irrigation management, reduce the volume of drainage and then reuse the drainage water. Reducing runoff volume is related to improved on-farm water management, which is beyond the scope of this paper. The following proposed strategies and potentials for the reuse of non-conventional saline drainage water in Khuzestan have been investigated.

- Modifying the cultivation pattern of agricultural crops with the approach of cultivating crops resistant to salinity. For example, the use of sugar beet cultivation in the model of land cultivation for sugarcane cultivation and industry (tolerance to sugarcane salinity of 2 ds/m and sugar beet about 7 ds/m).

- Reuse for planting salt-resistant plants. Production of wood by cultivation of Eucalyptus tree and other salt resistant products from sugarcane water or combining salt and fresh water is being done as a project under study by Khuzestan Sugarcane Company.

- Reuse for the production of fish and other aquatic animals such as shrimp in saltwater. In the Abadan region of Abadan Island, which is the junction of the Karun River with the Persian Gulf, with changes in water salinity between 15 and 30 ds/m, sea bass production pilots have been successfully carried out by the local people and have brought significant income to the producer. The comprehensive studies of Khuzestan Water and Electricity Organization have also shown that the lands adjacent to the sea in this region for the development of salt water basins and agricultural water drains also confirm the suitable conditions for the construction of fish breeding ponds using sewage and salt water. Of course, continuous studies to check the amount of nitrogen or toxins for the cultivation of aquatic animals by agricultural drains should be done more carefully.

-Using very concentrated water to extract salt for petrochemical industries and regional production by building evaporation ponds, for chemical products such as PVC raw materials, or injecting salt water into oil wells to increase the efficiency of oil wells.

REFERENCE

1- Sazab Pardazhan consulting engineers, 2013. Drainage management studies and executive solutions in the lands of West Karun and Lower Karkheh. Phase I ,Volume 7, Part 2.(in Persian)

2- Minaei.s, & et.all, 2024, Challenges and Opportunities for Development information transmission technologies in Irrigation Networks (CASE study: Abadan Island Irrigation Network). 14 th international Drainage workshop, Dushanbe, Tajikistan.

3- Mokhtaran, And et و .all, 2020, The effect of using sugarcane field drainage on soil chemical properties and quinoa plant yield in Khuzestan province. The first national conference on low irrigation and unconventional water use in agriculture in dry areas. Ferdowsi Uniwesity of Mashhad. Mashhad, Iran..(in Persian)