RECYCLING OF DRAINAGE WATER FROM IRRIGATING NETWORKS (CASE STUDY OF THE PROVINCE IRRIGATION NETWORKS)

RECYCLAGE DES EAUX DE DRAINAGE DES RESEAUX D'IRRIGATION (ETUDE DE CAS DES RESEAUX D'IRRIGATION DE LA PROVINCE)

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ABSTRACT

Increased population and consequent development activities have tremendously boosted the demand for fresh water on the one hand and generation of waste water on the other. The possibility of reuse of the waste water up to a certain quality limits exists in the agriculture sector. Effluents from agricultural drainage works is one such waste water that could be considered for reuse. On this topic, a research was carried out on quality and quantity of waste water in irrigation networks during 2010 - 2011. The discharge points of agricultural drainage waters, and their volume and quality were measured. On the basis of study results, the best options for reusing the waste water from the irrigation networks were considered. The amount of water taken from irrigation networks in Dez, Karoun and Karkhe basins of Khouzestan province were measured as about 3345.2 MCM in 2011. The maximum amount of it was from Dez basin with an annual value of about 2277.5 MCM. The drainage water quality was investigated in terms of salinity.

Key words: *Irrigation networks, drainers, drainage water, quantity, quality.*

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RESUME

La croissance démographique et le développement des activités y relatives ont énormément stimulé la demande en eau douce d'une part et la production des eaux usées à l'autre. Il existe la possibilité de réutiliser les eaux usées jusqu'à une certaine limite de qualité dans le secteur agricole. Les effluents de drainage agricole est l'un de ces types d'eaux usées qui pourraient être envisagées pour la réutilisation. A ce sujet, une recherche a été effectuée en 2010-2011 sur la qualité et la quantité des eaux usées dans les réseaux d'irrigation.

Les points de débits des eaux de drainage agricole, et leur volume et qualité ont été mesurés. Sur la base des résultats obtenus, ont été considérées les meilleures options pour la réutilisation des eaux usées provenant des réseaux d'irrigation. En 2011, la quantité d'eau prélevée à partir des réseaux d'irrigation des bassins de Dez, de Karoun et de Khouzistan de la province de Karkhe était de 3345,2 MCM. La quantité maximum était prélevée du bassin de Dez, ayant une valeur annuelle d'environ 2277,5 MCM. La qualité de l'eau de drainage a été étudiée en termes de salinité.

Mots clés : *Réseaux d'irrigation, égouttoirs, eau de drainage, quantité, qualité.*

1. INTRODUCTION

In recent years population increase and high demand for fresh water in the urban areas has reduced per capita water availability, which has also resulted from the water demands from other sectors. Thus, the allocation of water for agriculture is in the danger of being curtailed. Therefore, efforts to explore and use water resources of lower quality for irrigation and even in industries can be one of the main alternatives. This alternative has been examined in developed countries and in the developing countries in Asia and Africa. In some of these regions, waste water has been extensively used in agriculture. Being located in the climatically similar regions as in Asia, we in Iran will stand to gain by sharing the experiences of similar countries in reuse of waste water in agriculture.

Reusing drainage water. Reusing drainage water in regions with shortage of water for irrigation is of great importance. The instances of reusing drainage waters include: traditional agriculture, culturing resistant plants against salinity, wild life habitats, lagoons and primary flushing of salty lands (Hashemi, 2004). There are several factors in determining limits and usage, purification and discharge of drainage waters that include: the volume of drainage water, the concentration of chemicals in it and their location (Akram, et al., 2007).

The factors affecting drainage water quality. The most important factors that determine the quality of the drainage water are: climate, soil type, agricultural practices, geology and hydrology, irrigation methods and the quality of water used in irrigation.

The impacts of drainage water reuse. One of the most important effects of reusing drainage water is salt accumulation, turning good soil into saline soil and contaminating local groundwater with salt. Contamination of soil and water may also occur due to the presence of high concentration of some mobile nutrients and herbicides and pesticides in agricultural

drainage water. Therefore, proper assessment of the quality of drainage water is important in deciding their possible reuse avenues.

Using drainage water in production of agricultural crops. Drainage water can be recycled for agricultural, urban, and industrial consumptions. In agriculture particularly, this is one of the conventional cultivation practices in places where there is shortage of water. For agricultural consumption, the water which is used should have acceptable standards regarding total dissolved solid and Boron and Molybdenum (Hashemi, 2004).

Scope of the Study. Catchment areas of Dez including: east and west networks of Dez; Karoon including: Gotvand, Aghili and Dimcheh networks and Karkhe including: modern networks of Karkhe, Koot, and Hamoody and the relevant drains in all of the above were investigated in terms of water quality and quantity during 2010 - 2011.

2. MATERIALS AND METHODS

This study was done in the limits of irrigation networks in the catchment areas of the Kouzestan provinceduring 2010 – 2011. The quality assessments were done using portable gauges at weekly interval. Discharge in the drains were also measured and were converted to weekly, monthly and annual volumes of water. Field surveys were conducted and utilizing all the information the suitability of drainage water for certain applications were investigated.

3. RESULTS AND DISCUSSION

Table 1: Water input water to the irrigation networks in 2010-2011 (MCM)

Irrigation networks	2011
Dez (Dez basin)	2277.53
Gotvand, Aghili and Dimcheh (Karoon basin)	873.7
Modern networks of Karkhe, Koot, and Hamoody (Karkheh basin)	194
Total	**3345.2**

Table 2: The quality and quantity of the drainage water from the irrigation networks (MCM) in 2010 – 2011

Irrigation networks	Volume	Average EC (µ mhos/cm)
Dez (Dez basin)	1097.3	782
Gotvand, Aghili and Dimcheh (Karoon basin)	403	2669
Modern networks of Karkhe, Koot, and Hamoody (Karkheh basin)	98.8	9314
Total	**1599.1**	**-**

The drainage water inflow to Dez River of 1097.3 MCM is the maximum which is of a desirable quality. The soil irrigability class is I, which is one of the most important factors for high quality of drainage water in north of Khouzestan. In Ajiroub of this region drainage water is of desirable quality and it is reused for agriculture.

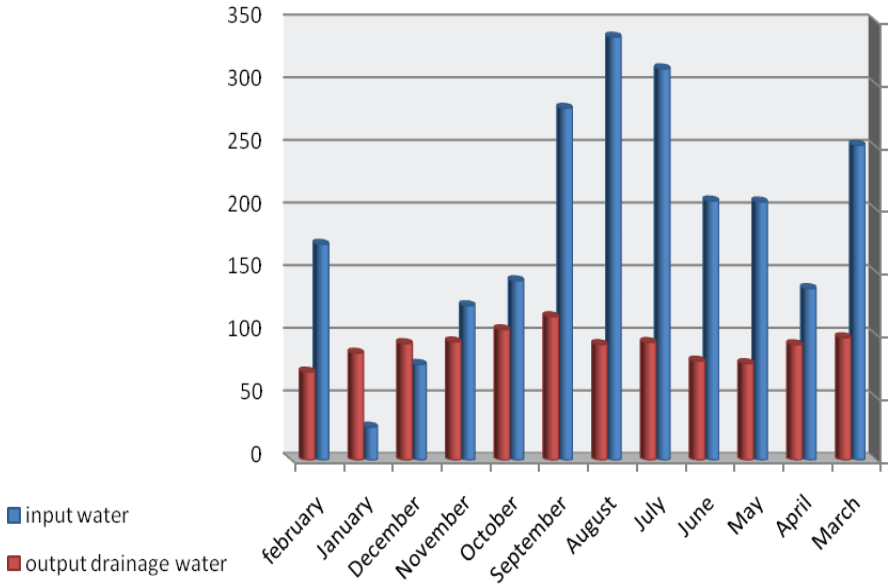

Fig. 1. Monthly volume comparison of input water with output drainage water from Dez basin networks (2010 - 2011)

The volume of drainage water in relation to the input water in the Dez network is 48.2%. The water quality is good, as the soil of the land through which the drainage water comes is also of good quality. The amount water needed for agriculture is affected by evaporation, absorption in the ground, rainfall and drainage outflow from the region. Difference in the abovementioned components in different seasons can cause change in quality and quantity of the discharge. The percentage of inflow into the basin that flows away as drainage outflow was calculated for all the basins to get a relative insight of the quality and quantity of the waste water planned for reuse. Differences could be observed between them to varying extent in different seasons. The maximum volume of drainage water in September is about 114.77 MCM and the minimum is about 70.6 MCM in February. Annual average of electrical conductivity of the output drainage water is 782 µ mhos/cm. This is within the permissible ranges of water quality standards, as presented by the consultants committee of California University (Ayer and Scott, 2007 and Hashemi, 2004). The permissible standard for EC is between 700- 3000 µ mhos/cm with low to average limitation for irrigation and agriculture. Also based on the manual presented by FAO for drinking by livestock and fowls, EC less than 1500 µ mhos/cm is permissible.

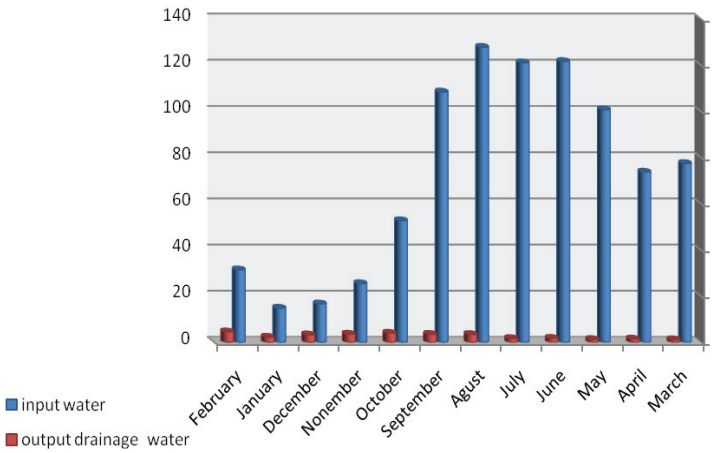

Fig. 2. Monthly volume comparison of input water with output drainage water from Karoon basin networks (2010 - 2011)

The drainage water is about 46% of the water input to the network in Karoon basin. The maximum volume of drainage water is about 4.7 MCM in February and the minimum is 1.3 MCM in March. The drainage volume varies due to variations in seasons, rainfall, evaporation, volume of water used for irrigation and cultivation practices. Differences in soil class, region and in the irrigation water quality cause difference in the output drainage volume. The average annual EC of drainage water in Karoon basin was 2669 μ mhos/cm and the salinity was 1.7 mg/l. These are also within the permissible standards for use in irrigation and for drinking by livestock and fowls.

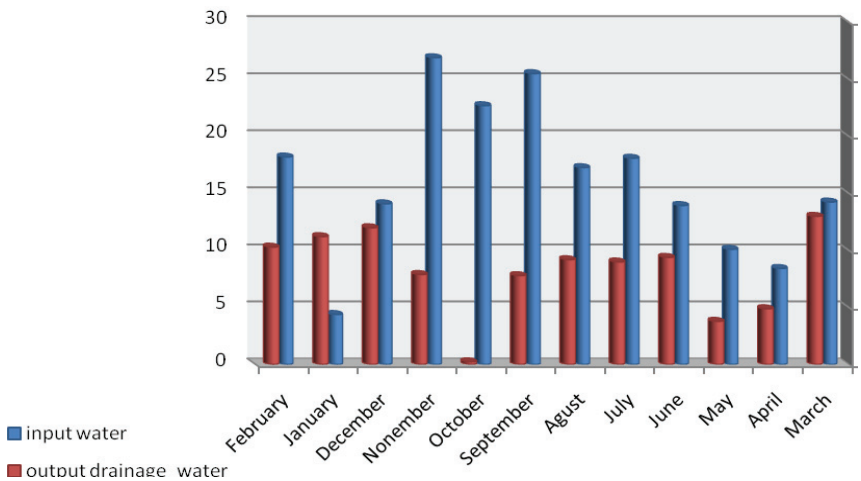

Fig. 3. Monthly volume comparison of the input water with output drainage water from Karkhe basin networks (2010 - 2011)

The drainage water in Karkheh basin was about 50.8 percent of the water input to the basin. The maximum drainage volume was about 13 MCM in March and the minimum was 0.25 MCM in October. The difference was the result of variation in relevant parameters, as mentioned for the Karoon basin. The average annual EC of drainage water in Karkheh basin was 9314 µ mhos/cm and salinity was about 5.24 mg/l. Therefore, the EC is much above the permissible limit for safe use in agriculture. However, there may be an alternative to mix it with fresh water in calculated proportion to bring the quality of the mixed water within the desirable limit of EC. Such water are also to be use restrictively for drinking by livestock and fowl.

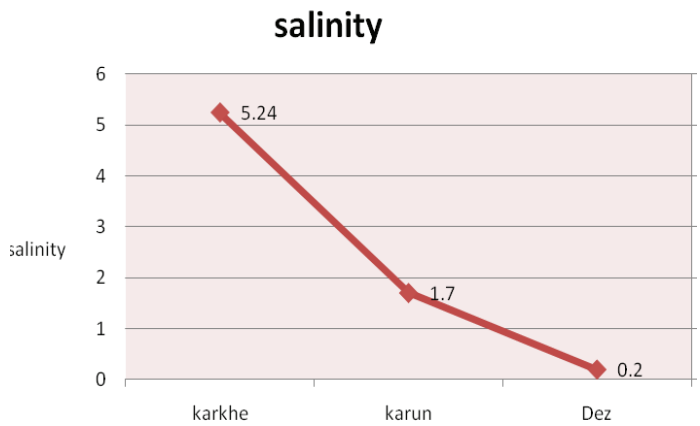

Fig. 4. the comparison of output drainage salinity in under study basin networks (2010 -2011)

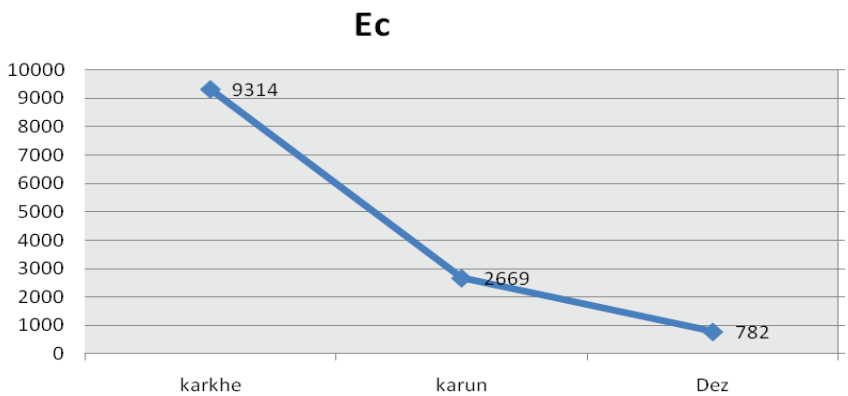

Fig. 5. Comparison of electrical conductivity of the output water in under study basin networks (2010 - 2011)

4. SUGGESTIONS

- In determining the usage of drainage water for different consumptions health and hygiene of the society should be considered.

- In order to use drainage water in different fields in the province the quality indices relating to important applications be monitored.
- Considering the contamination of the urban and industrial sewages it is necessary that their discharge places become separated from main agriculture drains because to avoid contamination.
- In order to decrease air pollution and to develop green space, drainage water in the province networks, it can be used in growing salinity resistant plants in places that have salty drainage water.

ACKNOWLEDGEMENTS

I appreciate all the managing directors of operating companies and the coworker experts in these companies that had a good corporation with us regarding irrigation networks. Also I acknowledge KWPA researches and standards office that always had collaboration with experts as a supportive of designs and I wish the success of these dear ones.

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