Studying the quality and quantity status of agricultural drainage waters in irrigating networks for improvement and development of control management, discharge and recycling of the drainage waters

(Case study of the province irrigation networks)

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Abstract:

The increasing number of population and in consequence developing urbanism and competition in order to access water resources in urban and agricultural sectors, water demand for various kinds of consumption has boosted remarkably. On the one hand, the increasing notice to preserve the environment and the available sources in it to conserve water flows for wildlife habitat, recreational consumptions and also aquatic life and other aesthetic values presents another aspect of demand for preserving running waters. Hence, the competitive procedure of water quality and quantity has an ascending ever-increasing growth. Therefore, noting usage of water resources that are not of desirable quality can supply part of the consumption needs, especially in agricultural sector considering the desired quality limits, and it can also be a useful action in decreasing contamination of environmental resources. Reuse of returned water derived from agricultural activities in irrigation networks can be one of the abovementioned issues. Along this, a research on input backwaters to the province water basins in the province irrigation networks limits was

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carried out in terms of quality and quantity in 2010 - 2011. In this study, the discharge places of agricultural drainage waters, volumes and average quality of them in terms of electrical conductivity and salinity were measured. The amount of input and delivery water also the portion percentage of output water from drainers in relation to the total input and delivery water in the irrigation networks and the quality of their water has been investigated. With reference to the obtained quality and quantity results, the best choices for reusing different backwaters in irrigation networks considering the need and consumption type were studied. The amount of water taken from irrigation networks in Dez ,Karoun ,Karkhe basins of Khouzestan province were measured about 3345.2 million cubic meters in 2011 that the maximum amount of it was related to Dez basin with an annual value of about 2277.5 cubic meters . The drainage water from Dez networks with a value of about 1097.3 million cubic meters had the maximum amount of returned water to the receiving sources. The drainage water quality of the abovementioned networks in the mentioned basins has been investigated in terms of electrical conductivity and salinity considering the condition of different regions under study, by using similar activities in Asia and other parts of the world and based on the domain of the electrical conductivity and salinity, and different consumptions for reusing the province irrigation network drainage water.

Key words: irrigation networks, drainers, drainage water, quantity, quality

1-Introduction

In recent years increase in population and upswing amount of consumption especially in urban regions caused decrease in per capita portion of the individuals in the society and this event occurs when the needs in other sectors including industry which is also one of the important water consuming poles in the territory, is constantly increasing alongside. In this way, the portion of agricultural water which is very necessary for supplying the people food, in competition with other sectors is constantly in danger of decrease. On the other hand, using it in agricultural sector has been ever accompany with quality changes in water resources that for preventing contamination and its environmental impacts had some confinements in this sector too. Therefore, efforts to explore and use water resources of lower quality for irrigation in production of agricultural crops and even in industries can be one of the main alternatives. Nowadays using anomalistic waters with lower quality than running waters has developed rapidly in the world, because the issue that the extent of consumption of waters with desirable quality and suitable for different usages such as agricultural, industrial, wild life, or aquaculture etc. is confined and is not enough, is obvious for the public, hence one of the main strategies for increasing the usable and available is reusing agricultural drainage waters that their usage in irrigation field because of direct relation with foodstuffs production and satisfaction of stratums of the society and

preserving water resources with desirable quality can be more important. Besides developed countries such as the U.S. this strategy has been examined in Asian countries like India and Pakistan or in some of the African countries like Egypt and had an extensive usage specially in the agriculture of these countries that by role modeling and using their experiences considering the climatically similarities of Asian countries in tropical regions we can benefit by their useful experiences in the agriculture of the territory and specially in irrigation and drainage networks.

2-Reusing drainage water and its applications

Reusing drainage water in regions that are encountered with the shortage of water resources problem 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 (7). One of the most important criterions that is discussed about drainage water is its quality and quantity that in fact specifies usages of one of the determining indices and the extent of its application and considering the quality and quantity information and the relevant indices we can manage its applications. Generally, there are several factors in determining limits and usage, purification and discharge of drainage waters that include: the volume of produced drainage water in surface unit, the concentration of the chemical materials and the extent of their scatter in the environment. (7)

3-The affecting factors in drainage water quality

The most important factors that can have a role in determining the quality of the drainage water include: factors such as climate of the region, soil type, agricultural essentials that relating to the usage extent and also its type can have different impacts on the quality of the drainage water, also geology and hydrology, agriculture and type of the dominant plantation of the region and finally the quality of water used in irrigation and even irrigation methods and also approaches of management of water that farmers can traditionally and locally and empirically apply them among themselves in each region, can interfere in quality determination of the returned water and its quality and quantity.

4-The impacts of drainage water reuse

One of the most important effects that reusing drainage water can have is salt accumulation and further salinity of soils that the issue of salinity is one of the most important causes of road construction in agricultural lands and making them uncultivable, and in other words permanent agriculture is directly dependent on the soil fertility. Containing a great deal of different types of toxic ions, heavy metals, and organic remains and many sorts of herbicides and pesticides and chemical fertilizers existing in agricultural drainage water, are

of the other factors of contaminating that needs considerateness about their use extent in different consumptions. Accordingly, management of the agricultural drainages and their cyclic and renewal usage because of importance of quality and quantity and the economical value of the limited water resources in the country is very necessary.

5- Using drainage water in production of agricultural crops

Drainage water can be recycled for agricultural, urban, and industrial consumptions that practically agricultural drainage water can be used again in the farm. And this method is one of the conventional cultivation actions in places where there is shortage of water. Drainage water has some confinements according to the renewed consumption case and the quality of water. For agricultural consumption the water which is used should accord the acceptable standards regarding total dissolved solid materials,B,Mo.(4)

6- Study Scope

Catchment areas of Dez including: east and west networks of Dez and the relevant drainers, Karoon including: Gotvand, Aghili and Dimcheh networks and the relevant drainers, Karkhe including: modern networks of Karkhe, Koot, and hamoody and the relevant drainers were investigated in terms of quality and quantity during 2010 - 2011.

7-The materials and methods

As it is stated this study was done in the limits of irrigation networks taking from catchment areas of the Kouzestan province and main drainers relevant to them and the extent of their quality and quantity in 2010 - 2011, that some of the obtained results will be investigated in discussion and results section. The quality assessments including electrical conductivity and salinity parameters in the relevant stations on the abovementioned drainers using portable gauges, that can be carried to different places in the networks, in weekly time periods also discharge by Moline in the same period were measured and by converting into volumes, quantity was also obtained weekly and finally monthly and yearly. Then with field surveys and the results of measurement and comparison with some standards for some applications, their usage was investigated and evaluated for some consumptions.

8-The results and discussion

Table 1: the input water to the province irrigation networks based on million cubic meters in (2010- 2011)

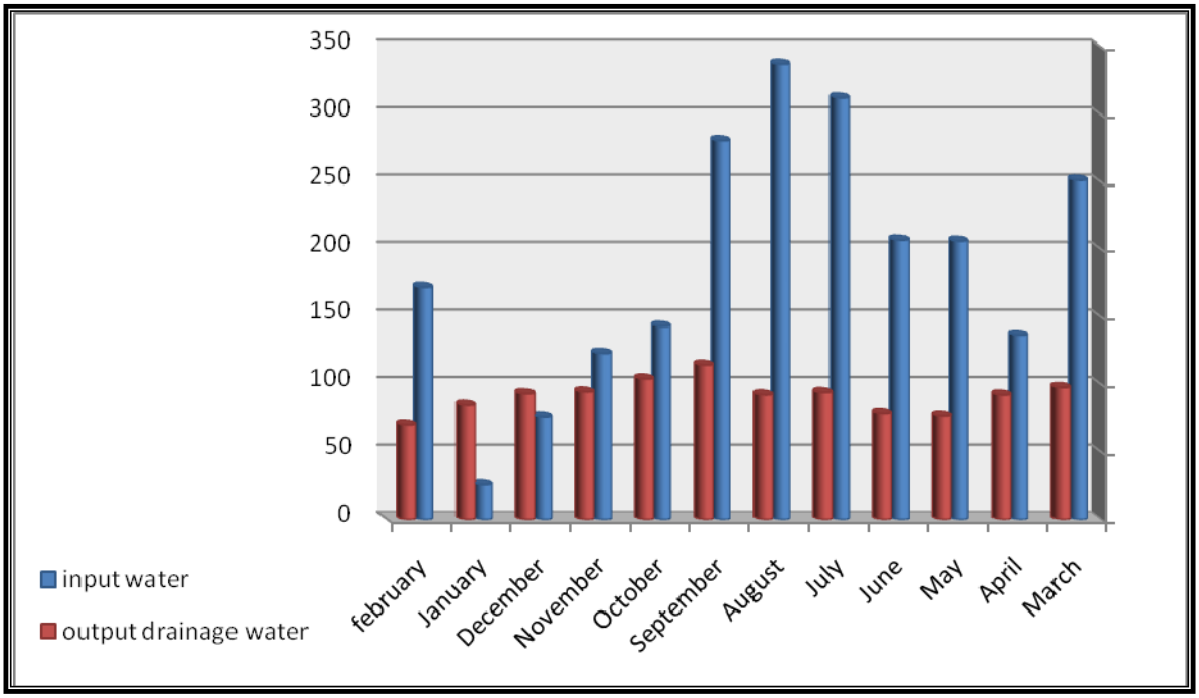
Irrigation networks	2011
Dez (Dez basin)	2277.53
Gotvand, Aghili and Dimcheh (Karoon basin)	873.7
modern networks of Karkhe, Koot, and hamoody (Karkheh)	194
Total	**3345.2**

Table2: The quality and quantity of the output drainage water from the province irrigation networks based on million cubic meters in(2010 – 2011)

Irrigation networks	volume	Average electrical conductivity (micro mousse/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**	**-**

Also the input drainage water to Dez River with an amount of 1097.3 is the maximum which is of a desirable quality. The soil suitable class is one of the most important factors of high quality of drainage water in north of Khouzestan. In north of Khouzestan in a region called Ajiroub by operating drainage water of desirable quality in the region, it is reused for agriculture.

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

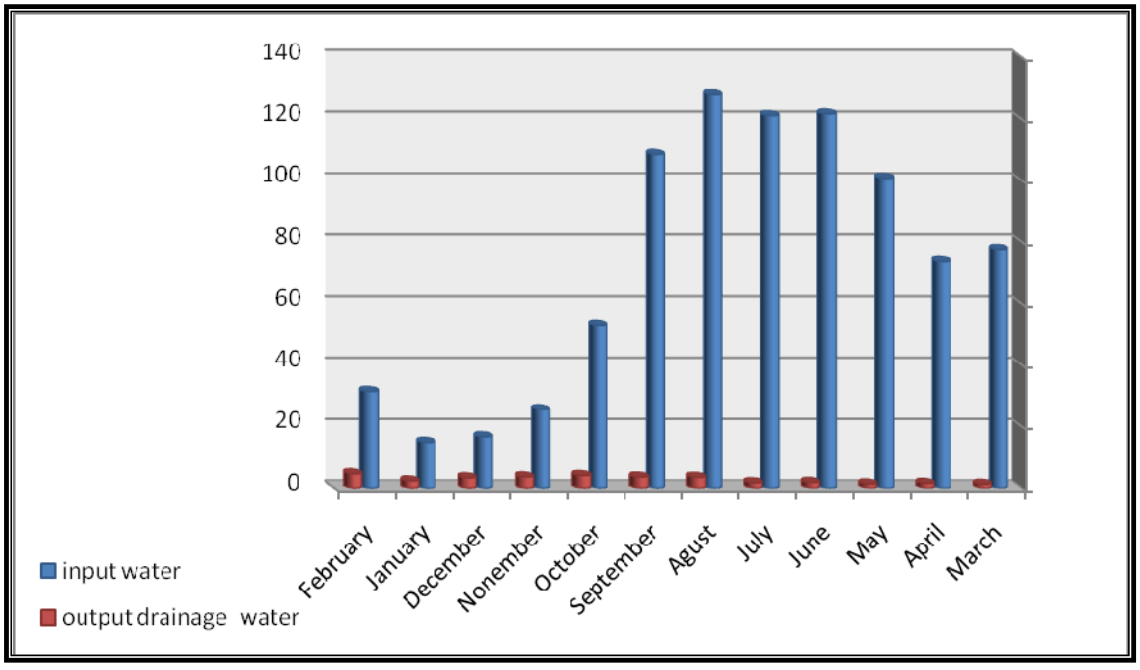


The volume of produced drainage water in relation to the input water to the existing networks in Dez basin that are studied is calculated about 48.2.Good quality of soil is one of reasons of suitable passage of extra water of the soil and finally drainage water in this region. The amount of input water for irrigation and agriculture is affected by elements such as evaporation, absorption in the ground, and rainfall and also part of it discharges from network lands in form of output drainage water. Difference in extent of the abovementioned elements in different seasons can cause change in quality and quantity of the discharge. The percentage relation between the output drainage water and network input water for all basins is merely carried out for obtaining a relative insight for quality and quantity of the result source and in other words drainage water and its usages in every basin. And the difference and affect of the different abovementioned elements especially in various seasons can be observed by change in quality and quantity of the drainage water. In the manner that the maximum volume of drainage water in September is an amount of about 114.77 m.cm and its minimum in February is 70.6m.c.m that the affect of different factors in various seasons such as rainfall or amount of irrigation has developed these differences. The desirable quality of Dez River which is operated in irrigation of the region networks also the high class of the region soil and its suitable drainage caused that the output drainage water of the region networks have a very good amount of electrical

conductivity and salinity. Yearly average of electrical conductivity of the above region output drainage is an amount of782 micro mousse/cm and salinity of 0.2 mgr/l that this amount in comparison with the guidelines of interpreting water quality for irrigation which is presented by the consultants committee of California University (2,4) has introduced the amount of electrical conductivity of water in the domains of 700_3000 micro mousse/cm with low to average limitation for irrigation and agriculture, can be used in this field. Also based on the manual presented by FAO for drinking of livestock and fowls in terms of salinity that believes amount of salinity less than 1500 in terms of proportion is great, and can be used for drinking of livestock and fowls.

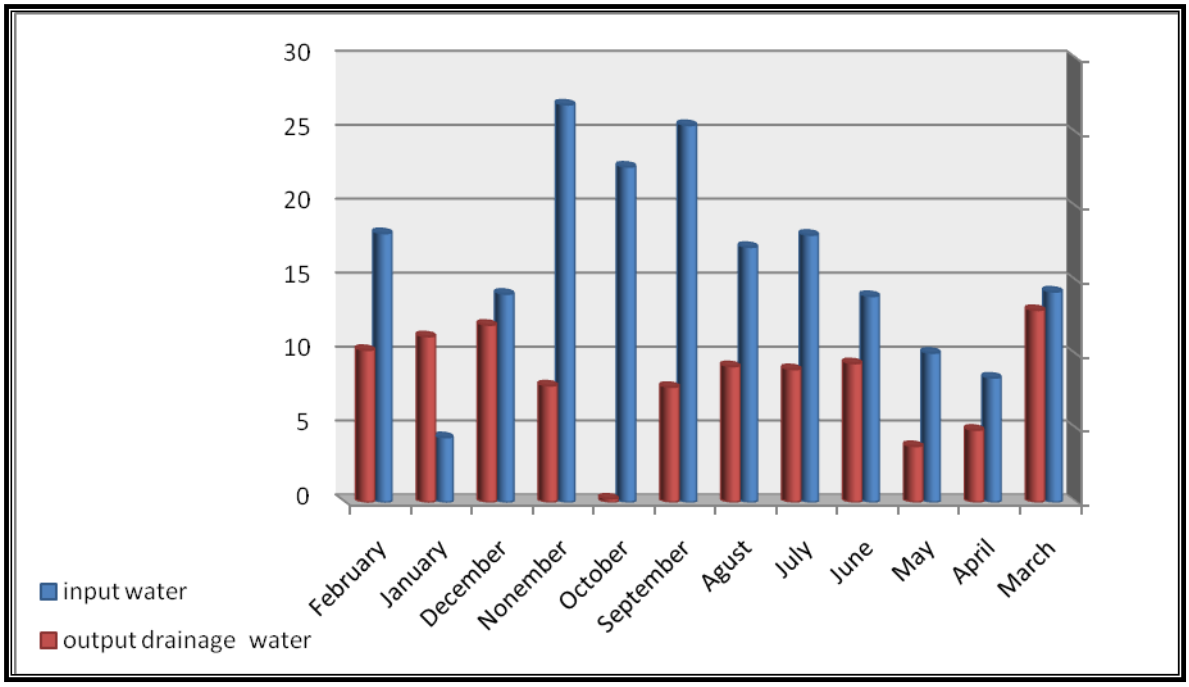
Considering the purpose of this study which is investigating the usage of produced drainage water from networks for irrigating in agriculture and recycling it for optimal operation of the source also preserving the receptive water resources and preventing more contamination of them, the important factors in irrigation are the amount of electrical conductivity and salinity that were measured and considering their domain some usages were suggested for it. Generally, the under study quality indices in drainage water noting the relevant usage should be measured and assessed.

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



The percentage of the produced drainage water in relation to the network input water in Karoon basin was calculated about 46 percent. The maximum amount of drainage water volume considering the above diagram has been about 4.7 m.c.m in February and the minimum amount of that in March has been 1.3 m.cm. The difference in seasons, amount of rainfall, and also evaporation extent, amount of irrigation and type of cultivation in each season are of the factors of change in drainage water volume in different seasons. Difference in class of soil and different regions of the province also the quality of the irrigation water causes difference in amount of the output drainage volume between different regions such as Dez with other spots like Karoon or Karkhe that are investigated in this study. The yearly quality of drainage water in average in Karoon basin and under study networks was calculated about 2669 and the amount of salinity was 1.7 mgr/l. Considering the obtained amount of electrical conductivity and salinity in compare with the guidelines of interpreting water quality for irrigation which is presented by the consultants committee of California university (2,4) .the amount of electrical conductivity which is introduced on the domain of 700_3000 with low to average confinement for irrigation of agricultural crops can be used in this field. Also for drinking of livestock and fowls based on the FAO quality guideline it is placed in ratio of so appropriate. However considering the type of livestock or fowls that may not be accustomed to this rather salty water, may cause some problems for some of them.

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



Percentage of the produced drainage water in relation to the input water to Karkhe basin was calculated about 50.8 percent. The maximum amount of drainage volume considering the above diagram was about 13 m.c.m in Marchl and minimum amount of it in October was about 0.25 m.c.m. the difference in seasons, amount of rainfall, and also evaporation extent, amount of irrigation, and cultivation type and the under plantation surface in each season are of the factors of change in drainage water volume in different seasons. Difference in class of soil and different regions of the province, also the quality of the irrigation water can cause difference in volume of the output drainage water between different regions such as Dez with other spots like Karoon or Karkhe that are investigated in this study. The average yearly quality of drainage water in Karkhe basin and under study networks was measured about 9314 and salinity was about 5.24 mgr/l. Considering the extent of obtained electrical conductivity and salinity in comparison with water quality guidelines for irrigation which is presented by Consultant committee of California University (2,4) electrical conductivity extent in domains of more than 3000 micro mousse is introduced with severe confinement for irrigation of crops and agriculture, it cannot be used directly in agricultural field but by some alternatives which are used in application of

salty waters such as salty drainage waters of the world including suitable amount of mixture with a water of good quality in order to balance the minerals and salinity of such waters to be used in agriculture of the region. Also the salty waters such as the abovementioned drainage water can be used in cultivations with salinity preference and resistant to salinity. Also for livestock and fowls drinking based on the quality guidelines of FAO is placed in limited use rate for livestock provided that they are not in pregnancy or milking period, and for fowls is not suitable.

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

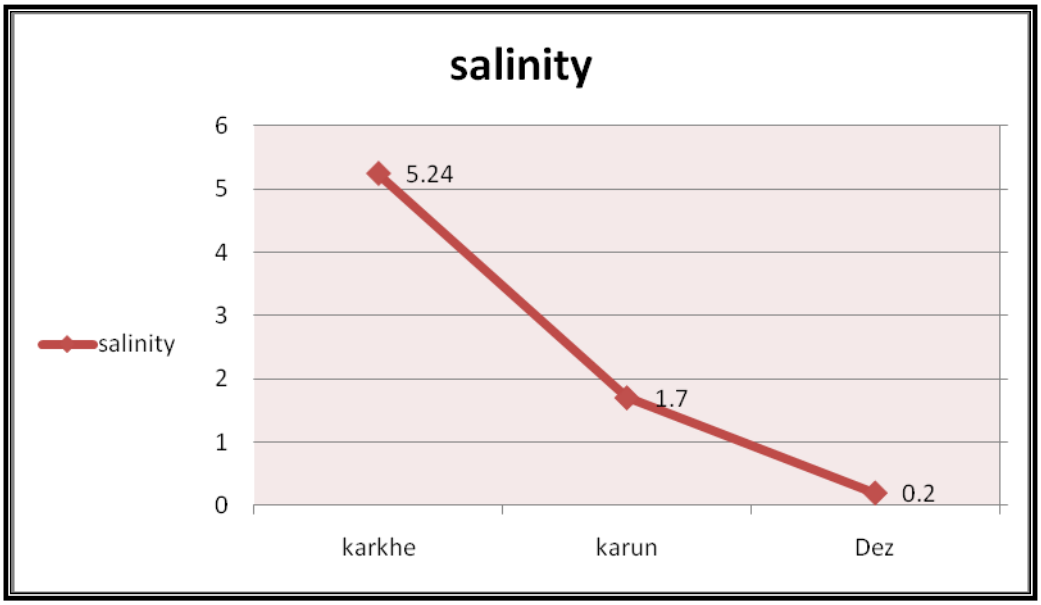
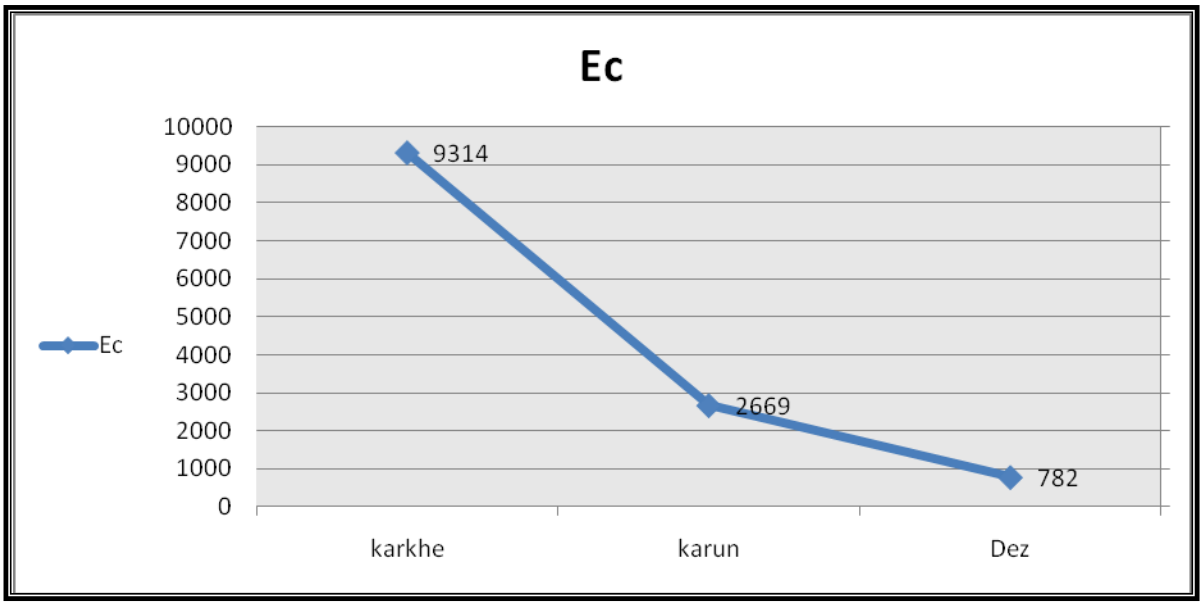


Diagram 5: the comparison of electrical conductivity of the output water in under study basin networks (2010 - 2011)



As it was mentioned before drainage water is reused in different parts of the world including central Asia, Egypt, India, Pakistan and the U.S. and for doing this different alternatives based on the situation of each region are applied. The results of studies carried out in India, Pakistan, central Asia, and Egypt show that surface irrigation by direct using of drainage water without decrease in crops is possible provided that the water salinity do not go beyond the upper limit of the plants of interest and the drainage system be in good condition.(7)

9- Suggestions

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

- In order to use drainage water in different fields in the province the quality indices relating to important applications be monitored to control the quality of backwater as much as possible.

- Considering the contamination of the urban and industrial sewages it is necessary that their discharge places become separated from main agriculture drainers because the so contaminant organic and nonorganic and chemical combination of these backwaters that are normally left without purification, besides contaminating the main drainers, create

environmental, wild life and hygiene threats for people and confine reusing of drainage water as one of the greatest resources.

- In order to decrease the air pollution in the province for dust phenomena, to develop green space and also to preserve the soil of the province, considering the rather high amount of the produced drainage water in the province networks, it can be used in plantation of salinity resistant plants in places that have salty drainage water with low quality.

10- Acknowledgement

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.

11- Resources

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