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Use of brackish water and its impacts on soil fertility and wheat crop in Kachho, Sindh, Pakistan

Noor Hussain Chandio*, Gohar Ali Mahar, Naveed Noor

Department of Geography, Shah Abdul Latif University, Khairpur, Sindh, Pakistan

Department of Geography, Federal Urdu University, Karachi, Pakistan

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Abstract

In the Northwest of Sindh, due to the absence of River and irrigation water, the brackish water of Right Bank Out Fall Drain (RBOD) has remain the basic source for irrigation since last ten years. The use of brackish water of RBOD for agriculture purpose, direct impacts on the pH, TDS and EC of the Soil. For the laboratory purpose, soil samples were collected from disturbed parts of research area where a white layer of the salt crust has been exposed out. Average analytical results showed that pH level was 8.2, EC was7.2 $dsm^{-1}$and TDS of 3580ppm. The samples were collected at depth at of depth of 0–15, 15-30 and 30-45cm to find out the depth of salts in soil. The study area is wheat growing region; the study showed that 13.3%, 27.8%, 40.6%and 55.6% productivity has been reduced in 2011, 2012, 2013 and 2014 cropping years respectively.

* **Corresponding Author:** Noor Hussain Chandio ✉ hussain.chandio.@salu.edu.pk

Introduction

Use of brackish water in various flooded irrigated areas particularly in dry and semi-arid area is covered by 41% of the Earth (UNDP, 1997).In these areas, the constant rainfall is not more than 400 mm/year; this amount of precipitation is not adequate to filter out salts from the roots of a plant (Rhoades, J. D. and. Corwin, D. L, 1984). Saltis carried by irrigation system and influence on the physical and chemical properties of the soil of the land.

The research shows that different salts can influence by the scattering on soil particles and also affects water properties (Rhoades JD, 1996). Incoming salt particles fill the gaps between soil particles or decrease space between them that decreases porousness, porosity and soil pressure. Salinization in arid environment is the main factor that is influencing the parched flooded agri-business. Moreover, unreasonable human activities for example, poor irrigation system, and flooded water system increase salinity because of insufficient control of salts collection in soil. In this way, salt increases in broad areas of cultivated land that alternately degrade land salinity is developed (Tedeschi *et al.* 2007).

Brackish water is not useful in inundate agricultural region but it might be the real source of irrigated water in extensive arid areas, particularly in poor countries of Asia and Africa(FAO, 1992),where extraordinary deficiency of fresh water is observed and the quickly expanding public demand for more water is increased. For managing the current croplands, native growers have to exploit the water from RBOD to irrigate their lands.

This process accelerated salt deposition in the soil. Soil salinization brings about vegetation under stress, desertification, infringement and ecological degradation (Anonymous, 1997).

The harmful effects of saline irrigation system can be removed by filtering saline water and saline soil in proper way (Rhoades, J. D. and. Corwin, D. L, 1984). It requires a superior comprehensive study to understand the problem and causes and to rehabilitate the land.

The aim of this research is to evaluate impacts of the water of RBOD by examining the pH, TDS and EC of the soil of study area.

The main occupation of the region is agriculture and wheat is a leading crop of this area. It is observed that wheat productivity has been reduced year by year. Five years data was collected from region, as shown in Table 1.

Materials and methods

Research area

The research area covered three districts of Sindh, Kamber-Shahdadkot, Dadu and Jamshoro, the area is known as Kachho or Kohistan (Western border of Sindh).

Area of the all three districts is 36468.6 sq km. The study area is situated at the Eastern slopes of the Khirthar mountain range. The total number of population of all three districts is 3996293 persons (PBS, 2017).

The area is inundated, where elevations and depressions frequently found. Two highest peaks of the Khirthar Mountains (Kuti-ji-Kaber and Gorakh Hill station)are situated in Dadu and Kamber-Shahdadkot districts. Drigh Lake; Hamal Lake and Mancchar Lake are also main lakes (depressions) of thisregion. The annual precipitation is between the 250 to 380 mm (PMD, 2012) but Rain Water Rills (RWR) from the Khirthar Mountain is source of water which irrigates the region in patches. Apart from rain water and RWR, a drain canal (RBOD) is regularly flowing in the region; the water of the drain canal is normally used for agriculture by local growers (Anwar, M.M and Chandio, N.H, 2012).

Selection of sampling area

Two types of samples were collected, soil samples and water samples. The area for both types of samples was

selected carefully. The soil sampling area was found broader where thousands of acres land was found barren that was affected by brackish water of RBOD (Bishop, A. Alvin.1980).Ten samples of soil were collected from each district; total 30 soil samples were collected. For the soil samples, a hole was drilled; the hole was divided in three segments in aspect of the depth, surface depth 0-15cm, mid depth 15-30cm and bottom depth 30-45cm. From the field, soil of surface samples was packed in clean plastic bags.

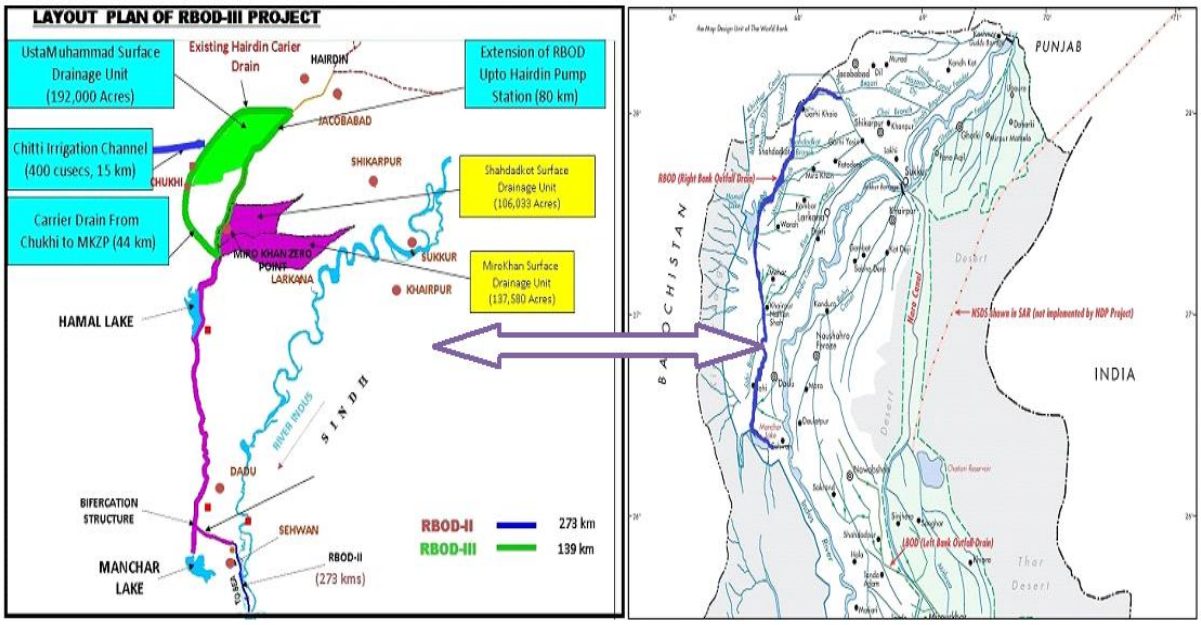

Fig. 1. Location of Right Bank Outfall Drain.
Source: Irrigation Department, Govt. of Sindh,2011.

It was comparatively difficult to collect the water samples because on same sail sample area, water sample could not collected. Five water samples were collected from each district, total 15 samples of water collected into RBOD.

Procedure

Thirty soil samples were collected from the study area to examine three types of parameters of the soil. Those samples were dried in a separate chamber of the laboratory below the 200 volts bulbs, the samples kept away from the window and door sides of the room to mix-up of outer materials in collected soil samples. After dried process, the soil may change in powder form. 78 grams of powder soil were mixed in 300 ML of purified water in a clean funnel shape glasses (Chandio, N.H, *et, al.* 2017).

Afterward, all glasses were kept carefully on the mechanical shaker for half an hour to shake and mixed the water with soil to each other. A net type filter paper was used to filter the soil mixed water to search out the pH, T.D.S and E.C of the soil.

The pH of soil was tested by pH meter. TDS was calculated by TDS meter and E.C was measured by Electric Conductivity meter, all instruments were made by Hanna instruments.

All water samples were taken five foot away from both banks; because near the banks water remains stable and stagnant contaminated by surrounding environment containing water weeds, grasses and other chemicals.

Leaching fraction

This is very essential to remove the salts from salt affected area. The extraction of large volume of water removes salts from root zone (Ayers and Westcott, 1985).This method known as Leaching Requirement

(LR), there search area is preferred for this method but it depends upon the supply of river water. The LR is a fraction of total applied water at research area that must drain out salts below the root zone (Pupisky H, Sheinberg I, 1979). The Warah canal was selected for this experience in Kamber-Shahdadkot district; meanwhile, same method could be applied in other salt affected areas.

Results and discussion

A remote area of the Sindh (Kohistan) was selected for this study. The aim of this study was to solve the problem of usage of brackish water at large scale and to provide for long term benefits in agriculture sector. In the Laboratory, EC, and TDS tests were calculated. Here, each soil example was selected from its particular depth as mentioned in soil sampling.

Table 1. Year wise production of wheat crop.

Year	2010	2011	2012	2013	2014
Production (Kg)	1150	990	830	680	510
Yearly reduced productivity %	--------	13.9	16.1	18.0	25
Over all reduced productivity %	-------	13.9	27.8	40.6	55.6

Source: author 2016.

Changes in soil pH

Change in Ph level at different depth was found. After the successful treatment, the surface soil at depth between 0-15cm, 0.6 (7.3%) pH level has been reduced which showed positive indication that the area can be managed by the LR method. Meanwhile, in sub-surface (15-30cm) soil0.6 (7.5%) pH has been decreased due to treatment. Similarly pH of depth (30-45 cm) 0.3 (3.8%) pH has been reduced. Therefore, very successful results were noted at all depths to drain out the salts.

Table 2. Water analysis of Right Bank Out Fall Drain (RBOD).

S. No	Geographical Location		Date of Collection	pH	E. C (ds/m^{-1})	TDS (ppm)	Location
1.	27°54'21.59"N	67°36'50.91"E	12.08.2016	8.0	5.1	2590	District Kamber-Shahdadkot
2.	27°48'59.45"N	67°36'43.81"E	12.08.2016	7.9	5.2	2759	
3.	27°38'45.89"N	67°45'8.71"E	12.08.2016	7.6	5.3	2980	
4.	27°28'22.51"N	67°39'44.69"E	12.08 2016	8.2	5.7	3550	
5.	27°21'59.62"N	67°39'34.29"E	12-08-2016	8.2	5.4	3500	
6.	27°19'39.94"N	67°39'10.67"E	21.10.2016	7.9	7.2	3580	District Dadu
7.	26°58'2.10"N	67°40'5.87"E	21.10.2016	8.1	7.0	3230	
8.	26°51'44.48"N	67°41'27.30"E	21.10.2016	8.2	6.7	2390	
9.	26°40'54.17"N	67°38'21.79"E	21.10.2016	8.1	6.3	2500	
10.	26°33'33.16"N	67°37'31.25"E	21.10.2016	8.1	6.7	2700	
11.	26°13'15.58"N	67°57'14.97"E	22-10-2016	7.8	5.7	2930	District Jamshoro
12.	26° 9'49.46"N	68° 1'13.77"E	22-10-2016	7.9	6.8	2890	
13.	26° 2'29.80"N	68° 6'51.79"E	22-10-2016	8.0	5.7	2580	
14.	25°58'32.95"N	68°11'14.92"E	22-10-2016	8.1	5.7	2500	
15.	25°48'36.33"N	68°16'57.32"E	22-10-2016	8.1	5.6	2590	

Source: Author 2016.

Electric Conductivity (EC)

In a same way, changes were observed in the surface soil (0-15cm). After the experiment a reduction of 2.2ds/m-^{1}(58.4%) in E.C of soil has been reduced which is very fruitful result, meanwhile, at sub surface depth (15-30cm) a reduction of2.0 ds/m-^{1}(47.6%)in EC was noted which shows great success, Similarly EC of bottom depth (30-45 cm) 2.0ds/m-^{1} (47.6%) has been reduced. Therefore, at all soil depth the experiment found very successful which is positive indication because of the experiment has kept its positive impacts at all depths.

Total Dissolve Salts (TDS)

A great change has been observed in TDS levels at all three soil depths. Surface soila decrease 810 ppm (50.9%) in TDS was not, similarly 700 ppm (51.8%) 800ppm (57.1%) decrease in TDS has been observed. Therefore, at all levels the experiment was very successful which is positive indication because of the experiment has kept its positive impacts at all depths. Reduced level of TDS in all depth is very fruitful.

Table 3. Soil analysis for pH, EC and TDS, different depths.

	Depth 0-15cm			Depth 15-30cm			Depth 30-45cm		
Water quality	pH	EC (ds/m-¹)	TDS (ppm)	pH	EC (ds/m-¹)	TDS (ppm)	pH	EC (ds/m-¹)	TDS(ppm)
EC_d	8.2	5.3	1590	8.0	4.2	1350	7.7	4.2	1400
EC_w	7.3	0.7	160	7.3	0.7	160	7.3	0.7	160
L.F	7.6	2.2	780	7.4	2.2	650	7.4	2.2	600
Variation	0.6	3.1	810	0.6	2.0	700	0.3	2.0	800
Reduction %	7.3	58.4	50.9	7.5	47.6	51.8	3.8	47.6	57.1

ECd =quality of original water

ECw = quality of applied water

L.F = Leaching Fraction.

Table 4. Increased production in 2016.

Year	Total Production	Production increased (kg)	Production increased in a years (%)	Production increased over all (%)
2014	510	-------	----------	----------
2016	875	365	71.5	71.5

*In cropping year 2015experiment was done.

Source: author 2016.

As already, mentioned 55.6% productivity has been reduced only in five years due to use of brackish water of RBOD. This type of water kept its harmful effects on soil fertility, but it was observed that soil fertility can be maintained by the Leaching Fraction. During 2016cropping year, the production was bumperas compare to 2014 production. The production of 2016 was calculated 875 kg.

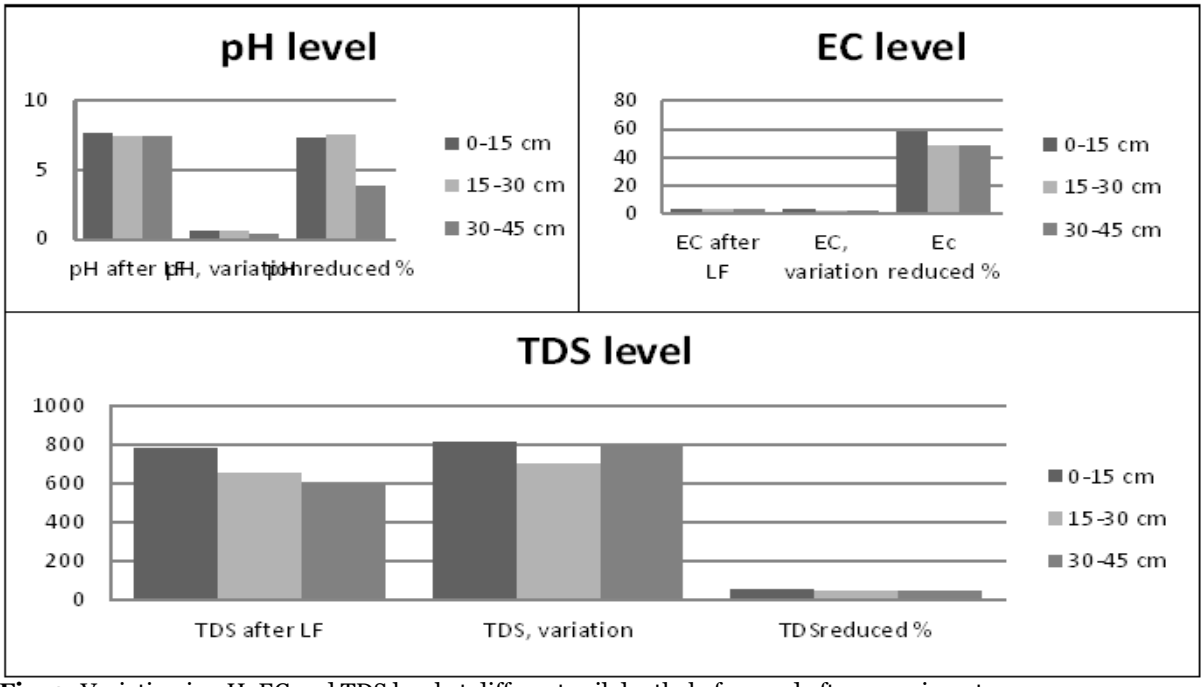

Fig. 2. Variation in pH, EC and TDS level at different soil depth, before and after experiment.

Conclusions

The research area is rain fed region with no irrigation network from main stream of Indus River, but due to lack of precipitation local growers are using the water from RBOD. But in rainy season, a dozen of RWR (Nai) are flowing from the Khirthar Mountain to irrigate this region, because of poor management. The soil of the Kachho is very fertile but it depends on the Barani rain. If stakeholders manage canal irrigation to irrigate the region then it will be better of agriculture sector. Use of brackish water for agriculture purpose has direct negative impact on chemical properties of the soil, which change the physical and chemical properties of any soil. This consequently effects on the crops and indirectly to the growers and economy of the country. Continue use of this type of water could create environmental, social and economic issue in the study area.

Four canals are available in the study area but all canals are not enough for local irrigation. Government should extend the length and width of all canals and increase the volume of water of mentioned canals. This area needs water reserve dam on emergency basis to restore the water table.

Recommendations

An awareness program should be launching to aware the local farmers. Selection of proper and appropriate crops is very important in the region. Salt-resistant crop varieties and salt tolerance crops should be introduced. Leaching Fraction is easiest and approachable methods to leach out the salts from root zone, in these way normal salinity tolerant crops could be cultivated. Water coming from the RBOD could be filter and use to grass land and ranching site for grazing and browsing of herded animals. Water could be used to irrigate the

References

Anonymous. 1997."Basin Tillage Increases Yields," Agricultural Research **29(2),** p 6-7.

Anwar MM, Chandio NH. 2012. Impacts of Drain Water on Soils and Crops and it Causes: A Case Study of Kamber Taluka, Pakistan. Sindh University Research Journal, sci. ser., **44(4),** 623-626.

Ayers RS, Westcot DW, Water quality for agriculture. Rome: FAO. 1985. FAO Irrigation and Drainage Paper **29(1),** p 174.

Bishop A. Alvin. 1980. "Surge Flow," Crops and Soils Magazine **33(2),** p 13-16.

Chandio NH, Mallah QH, Anwar MM. 2017. Evaluation of Soil Salinity and its Impacts on Agriculture: Nexus of RBOD-III, Pakistan, Sindh Univ. Res. Jour. (Sci. Ser.) **49(3),** 525-528.

FAO. 1992. "The use of saline water for crop production, irrigation and drainage paper 48, p 7.

Government of Sindh. 2016¸ land and revenue department, Sindh Secretariat, Karachi Pakistan Metrological Department, (2012).Government of Pakistan, Technical Report No. PMD-25/2012, 29. Pakistan Bureau of Statistics, Government of Pakistan, 2017, 6th population and housing census-2017/
http://www.pbscensus.gov.pk

Pupisky H, Shainberg I. 1979. Salt effects on the hydraulic conductivity of a sandy soil. Soil Sci Soc, am J **43,** 429–433.

Rhoades JD, Corwin DL. 1984. "Monitoring Soil Salinity," Journal of Soil and Water Conservation **39,** p 172-175.

Rhoades JD. 1996. Salinity: electrical conductivity and total dissolved solids. In: Spark DL (ed) Methods of Soil Analysis. Part3. Chemical Methods, SSSA Book Series no. 5. ASA and SSSA, Madison.

Tedeschi A, Menenti M, Tedeschi P Wang T, Xue X, Basile A, Mele G, De Lorenzi F, De Mascellis R, Di Matteo B. 2007. Design and evaluation of saline irrigation schedules to cope with

droughts and scarce fresh water. ICID 22nd European regional conference, Pavia, September 2-6.

UNDP. 1997. Aridity zones and dryland populations. An assessment of population levels in the world's dry lands. UNSO/UNDP, New York.