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Research Article

SOIL SALINITY ESTIMATION WITH SCF AND OTHER TRADITIONAL PARAMETERS

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ABSTRACT
Agriculture is responsible for 69% of the world's water consumption (FAO, 2000). It is predicted that the area under irrigation will increase by 25–30% until the year 2025 and competition for fresh water among industry, services, agriculture and environment, will continually increase. In the future an increase in agricultural production, or even the maintenance of present day production levels, will only be possible through the reuse of irrigation water. The main objective of this study was survey of factors influencing the accumulation of salts in the soil, leaching and a new method suggestion for soil salinity potential estimation. Therefore, 10 land transects with different quality of water irrigation was sampled at intervals of 6 meters. Also Water salinity of wells was measured. Electrical conductivity was measured. After that Salt Concentration Factor (SCF) was evaluated. The results showed that SCF was variable according to water quality, distance from water sources and cultivation-irrigation methods.

Keywords: *Salt Concentration Factor, Water Quality, Salinity Potential Estimation*

INTRODUCTION

The combined effects of poor irrigation water quality, dryness and insufficient natural drainage, cause the risk of Stalinization the majority of semi-arid irrigation areas problems. Stalinization affects about 20–30 million ha in a total of 260 million ha of irrigated lands in the world (FAO, 2000). Soil salinity is a global environmental hazard, and also a severe Iranian environmental problem. It adversely affects crop yields and agricultural production in salt affected farm lands. As a result, agricultural production from farming industries such as grazing and cropping is diminished. Obviously, monitoring and managing salinity is one of the greatest natural resource management challenges in national, state and regional levels.

Saline water sources with salinity greater than 1000 ppm include ground water, reclaimed municipal effluent, and agricultural drain flow. One of the concerns of using saline water for irrigation is soil Stalinization as noted in a number of publications (Westcot and Ayers, 1984; Adelpour *et al.*, 2010).

Soil salinity caused when rising ground water tables bring natural salts in the soil and groundwater to the surface. The salt remains in the soil and becomes progressively concentrated as the water evaporates (NAP, 2001). Therefore, determining the water movement which controls the mobility and transfer of the salt store is important in salinity studies. In the context of salinity management and risk assessment, accurately mapping water content and flow pathways is as important or more important as mapping salt itself (Spies and Woodgate, 2004). As water movement is controlled by surface elevation, in order to determine where salt accumulates, accurately representing landscape is always required (Kamalimaskouni *et al.*, 2011). Previous researchers have found that much information can be derived from elevation data to improve salinity mapping accuracy (Furby, 1998). Attempts have been made in the past to minimize the adverse effects of saline-sodic irrigation water through different irrigation, soil, and crop management practices (Rhoades, 1987; Oster, 1994; Shalhevet, 1994). The use of such marginal-quality water would not only permit the horizontal expansion of irrigated agriculture, but would also reduce drainage disposal and associated environment problems (Rhoades, 1989; Oster and Grattan, 2002). Salt Concentration Factor (SCF) is a simple method for salinity potential estimation (Miyamoto and Chacon, 2006). The objective of this study was to examine if observed soil salinity levels can be explained better with an empirical equation involving readily measurable soil properties.

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MATERIALS AND METHODS

Theory

We used a new advised parameter, the salt concentration factor (SCF), by normalizing soil salinity (ECe) with salinity of irrigation water (ECw) (Miyamoto and Chacon, 2005):

$$SCF = \frac{EC_E}{EC_w} = (\frac{FM}{SWC})(\frac{n + 1/LF}{1 + n})$$

Where ECe is the electrical conductivity of the soil saturation extract, FM the field soil moisture content, SWC the saturation water content, ECw the salinity of irrigation water, , and *n* a matching factor to estimate the mean soil salinity, leaching fraction (LF). The SCF is dependent on the leaching fraction when ET is assumed to be a function of weather conditions as well as physical properties of the soils, chiefly permeability, but is independent of salinity of irrigation water.

The Study Area

The study area (Figure 1), encompassing an area of 10 km^2, lies between 758300 and 760100 E Longitudes and 3084800 And 3086000 N Latitudes, about 1044m above sea level. The average annual precipitation is 250-300 mm and rainfall is concentrated in autumn and winter. The potential evaporation for the area is about 750.0mm. The average maximum daily temperature in summer is approximately 28 C while the average minimum daily temperature in winter is about 8 C.

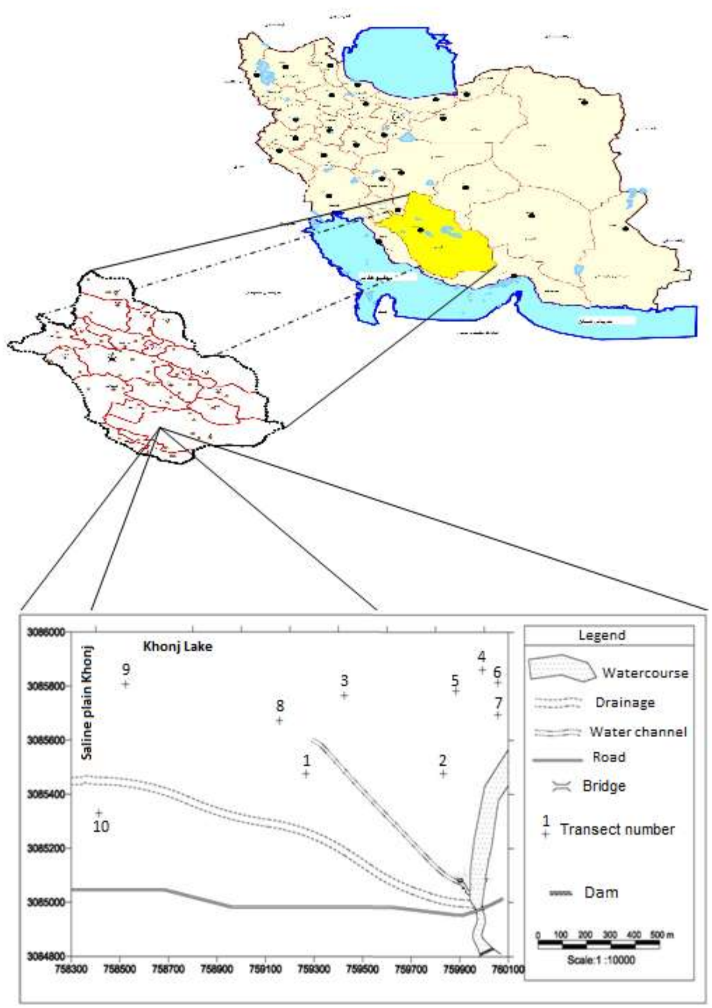

Figure 1: Study area Map and transect positions (Khonj, Fars, Iran)

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Water Sampling

Groundwater samples were collected in June 2011. The samples were collected after pumping for 45 minutes. This was done to remove groundwater stored in the well. For all samples collected electrical conductivity (EC) was measured in the field.

Soil Sampling

Soil samples were collected from seven wheat farms and three Date palm located in Khonj plain, Fars province, Iran. Soil samples were taken to a depth of 20 cm with 6 m spacing from each other along a transect placed at the center line. The top few centimeters of the soil samples, which had high organic matter, was discarded, and the remaining samples were analyzed for salinity of the saturation extract, the saturation water content and EC by the method described in Rhoades and Miyamoto (1990).

Table 1: Irrigation water quality, soil properties each transect

Transect number	**Water sources salinity**	**Saturation Extract**					**SCF***
		Water content		**Salinity**			
	EC dSm^{-1}	**$Kg\ Kg^{-1}$**	**CV (%)**	**dSm^{-1}**	**Max.C**	**CV(%)**	
1	1.75	0.469	10.82	4.61	5.12	6.67	2.63
2	5.08	0.405	2.38	8.48	9.06	2.90	1.67
3	5.21	0.481	3.19	9.03	10.01	6.37	1.73
4	6.68	0.393	4	8.92	10.49	5.55	1.33
5	7.17	0.334	2.85	6.79	8.30	10.49	0.95
6	6.48	0.391	1.09	9.66	10.43	3.94	1.49
7	6.44	0.33	3.17	4.60	5.10	9.81	0.71
8	5.49	0.436	2.02	9.20	9.88	3.55	1.67
9	9.91	0.519	1.81	15.67	17.01	4.39	1.58
10	9.62	0.565	4.74	8.55	9.15	3.93	0.89
Mean		0.38	12	5.9	12.8	5.76	1.47

** SCF (salt concentration factor) = soil salinity/irrigation water salinity.*

RESULTS AND DISCUSSION

Results

The saturation water content and salinity of the saturation extract averaged over each transect are summarized in Table 1. Included in the table is the coefficient of variability (CV), and the mean salt concentration factor (SCF). The CV for saturation water contents averaged 3%, and that of soil salinity was ~6%. When soil salinity readings averaged for each sampling transect were plotted against salinity of irrigation water used, there was no correlation between them (Figure 2). The *r* square value was only 0.393 and had a positive slope. The figure also includes a hypothetical dotted line (ECe =ECw or SCF = 1) just as a reference. Soil salinity data from sites number 5, 7 and 10 were under the line.

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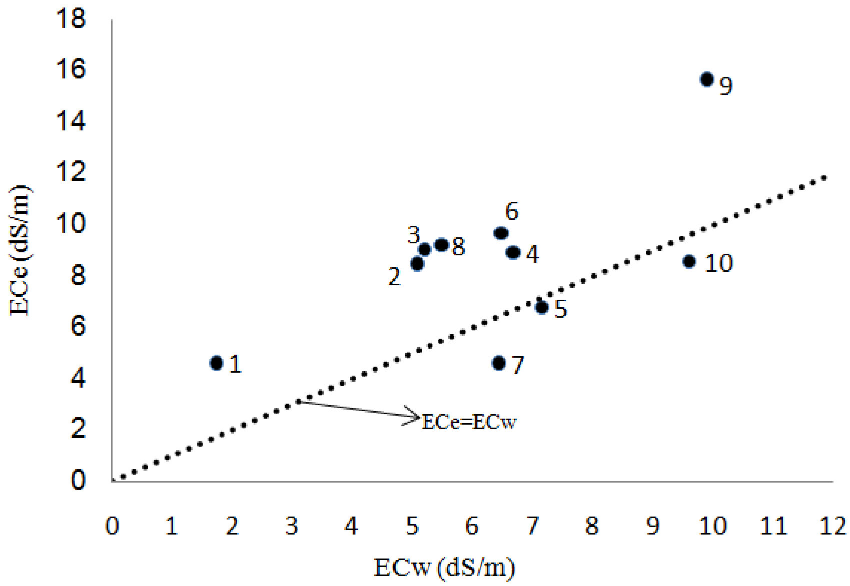

Figure 2: Mean soil salinity as related to salinity of irrigation water at ten sites

The salt concentration factor for transect number 1 was the highest, because EC_w for this transect was 1.75 dSm^{-1} that its resource was water of dam. On the other hand, the salt concentration factor for transects number 5, 7 and 10 were under EC_e/EC_w=1, because of their flooding irrigation, that it shows leaching fraction was more than other transects. Finally, the range of other transects were between 1.33 and 1.73 in this study.

We had found that the first transect had the lowest EC that its resource was water of saved in reservoir of dam and also the transect number 9 had the most EC that it was the nearest transect to the plain Khonj. However, the results of this study indicate the ground water quality is decreasing from dam to saline lake (Khojnj). Also, it shows that well number 9 and 10 were recharging by saline lake water, but other wells were recharging by dam.

One of the objectives of this study was to evaluate the workability of the traditional and SCF equations. The results shown in Figure 2 indicate that soil salinity does not necessarily increase with increasing salinity of irrigation water. This finding is rather surprising, because ECe should increase, in proportion to salinity of irrigation water if LF (leaching fraction) is the same. We must assume that soil salinity was affected by other factors besides salinity of irrigation water.

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