Cercetări Agronomice în Moldova
Vol. XLVIII , No. 3 (163) / 2015

SOIL AND WATER SALINIZATION IN GHALEH GHAZI REGION, IRAN

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Received May 9, 2014

ABSTRACT. Approximately 34% of soils in Asia are influenced by salts. With about 25 million ha of saline and alkaline lands, about 15% of the country, Iran has the most saline lands in Asia after China, India, and Pakistan due to its geographical position, climate and human activities. This research was done due to determine the effective factors on soil and water salinization. At the first the boundaries of this region were characterized using GIS, then landuses were determined for field survey and also soil sampling in nine landuses were done according to both factors of planting pattern and water resources in each unit. The soil profile was prepared and soil samples were obtained from surface depths of (0 - 50 cm) and some factors such as soil texture EC, SAR, pH, $CaCO_3$, Cl and potassium were measured. For study of water resources some samples were obtained from 30 wells and also from upland runoff, then soil and water sample were analyzed and some parameters such as EC, SAR, Cl^- and pH were measured. Finally, according to data base, geological map, topography map, landuse map, soil and water measured data and also field studies, soil and water salinization schedule and region status were investigated. The results showed that important factors influencing water salinization in Ghaleh Ghazi region (Iran) are geological formations located in aquifer recharge and climate condition. Important factors of soil salinization in region are irrigation with saline water, improper irrigation method, unsuitable planting method, climate condition and landform.

Key words: Salinization; Electrical conductivity; Sodium absorption ratio; Ghaleh Ghazi; Bandar Abbas.

INTRODUCTION

All natural waters contain soluble salts. The concentration of the salts determines whether the water is of high quality (drinkable or usable for irrigation without need for special precautions) or of low quality

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(brackish or saline). Water in the soil also contains soluble salts (sometimes called free or nonattached salts) (Bruce *et al.,* 1995). The amount of salts in the root zone (or the salt concentration in the soil solution) determines whether the soil is "normal" or "salt-affected" (saline, sodic, or salinesodic).

Salinization on the soil surface and irrigation water occurs where the following conditions occur together (Iranian National Committee on Irrigation and Drainage, 2003; Zehtabian *et al.,* 2010):

- The presence of soluble salts, such as sulfates of sodium,calcium, and magnesium in the soil; !
- Naturally present as products of geo-chemical weathering of rocks and parent materials derived directly from sea water by flooding, spray, or intrusion into groundwater resources caused by irrigation mismanagement, particularly when internal soil drainage is impeded.
- A high water table;
- A high rate of evaporation;
- Low annual rainfall.

In semiarid areas, salinization often occurs on the rims of depressions and edges of drainage ways, at the base of hillslopes, and in flat, low-lying areas surrounding sloughs and shallow bodies of water. These areas receive additional water from below the surface, which evaporates, and the salts are left behind on the soil surface (Kashkuli and Hosseinizare, 2004).

Summer fallow management practices may cause increased salinization by increasing the soil moisture content to the point that water moves to seeps on hillslopes. Salts accumulate as the water evaporates from these seeps.

Around 34% of Asia soils are influenced by salts. Due to geographical position and arid and semi-arid climate, Iran has the most saline lands in Asia after China, India and Pakistan. Iran has around 25 million ha saline and alkaline lands. These areas cover 15% of total areas of Iran (Amiraslani and Zehtabian, 2006; Zehtabian *et al.,* 2010). With the expansion of agriculture into areas without drainage systems, extension of saline and alkaline lands has increased in Iran. Salinity changes are an indicator of increased salinity in most water resources of Iran. This continuous trend has caused an intensive decrease of soil and water quality that in most area has caused decrease or changes of cultivation patterns.

Studies have been conducted to assess and evaluate the status of soil and water resources of desertification sites (Khosravi *et al.,* 2009). The result has highlighted several factors that contribute to the salinization of water resources. For example, one of the important problems in Ghaleh Ghazi region, Bandar Abbas, Hormozgan province is existence of saline soil and this phenomenon had made especial effect on the loss of soil fertility. So, the aim of this research was determination of effective factors on soil and water salinization in Ghaleh Ghazi region.

MATERIALS AND METHODS

Study area

Ghaleh Ghazi is located in 56 15' to 57 03' E and 27 15' to 28 15' N and has an arid climate with annual average precipitation of 202.6 mm. This region is located in Hormozgan province and south of Tehran, with mean annual temperature of 27.4°C (*Fig.1*).

At the first the boundaries of this region were characterized using GIS, then landuses were determined for field survey and also soil sampling in nine landuses were done according to both factors of planting pattern and water resources in each unit.

Using GIS

One of the methods of data entry to computer in natural resources studies is digitizing maps with different scale. In this stage, contour maps and other necessary data were digitized, then using Ilwiss Software, the Digital Elevation Model (DEM) was created using interpolation extension, then hypsometric map was created using slicing algorithm and finally slop and aspect maps were provided (Zehtabian and Sarabian, 2004).

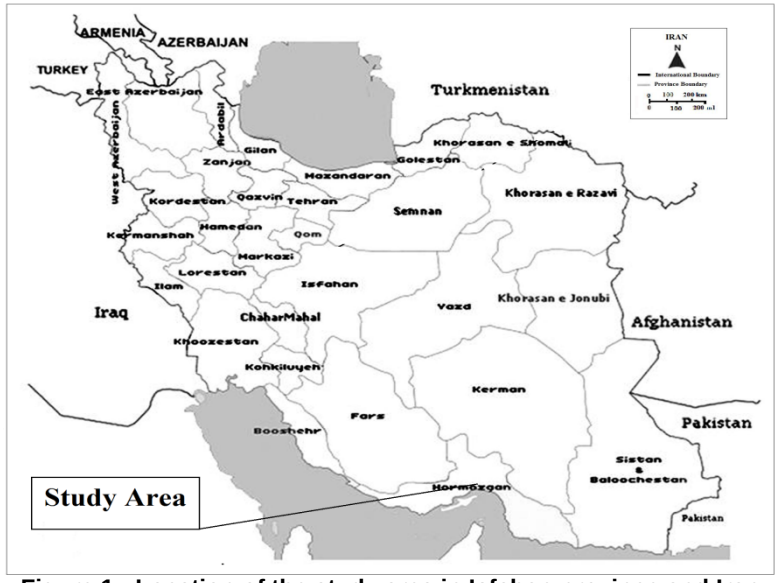

Figure 1 - Location of the study area in Isfahan province and Iran

Soil sampling

Salinity can vary considerably throughout an orchard. You should take at least one composite soil sample for several depths in each landuse in the orchard having a similar soil type. USDA soil surveys are good starting points for targeting sampling areas.

The soil profile was prepared and 27 soil samples were obtained (for every landuse three samples) from different depths of (0-50 cm) and some factors such as soil texture EC, SAR, pH, $CaCO_3$, Cl and potassium were measured (Moradi, 2008; Zehtabian *et al.,* 2004; Zehtabian *et al.,* 2010).

Water sampling

Sampling irrigation water for salinity assessment is much simpler than sampling soils. First, rinse a plastic container in the water that is to be sampled. Collect a small sample. Completely fill the container with water; this eliminates air, which would otherwise promote calcium carbonate precipitation.

For study of water resources some samples were obtained from 30 wells and also from upland runoff, then soil and water sample were analyzed and some parameters such as EC, SAR, Cl and pH were measured (Amiraslani and Zehtabian, 2006).

According to data base, geological map, topography map, landuse map, soil and water measured data and also field studies, soil and water salinization schedule and region status were investigated. Finally, collected and measured data analysis with help of MSTATC software. Vegetation cover in different landuse affected by soil and water salinization has been studied.

RESULTS

The results of soil samples can be presented in three stages. At the first, obtained results from test of data have shown that all of data have a normal distribution. Then, variance analysis was done. In this part, it distinguished that there is significant difference among treatments in each factor (*Table 1*).

The analysis of water samples factors for year 2007 has been shown in *Table 2*. The water factors belong to the Sarmaghsam station located on Jamash River.

Effect of soil and water salinization on vegetation cover has been shown in *Tabs. 3* and *4*.

Table 1 - Soil factor means in different landuse (Moradi, 2008)

Landuse	Factor								
	EC	SAR	pH	P	CaCO3	Cl	Sand	Silt	Clay
Forest planting	1.565c	4.93c	7.9abcd	29.666c	7.8b	24.63c	86a	9.3c	4.66d
Grassland	9.26c	131.22b	7.75cd	440ab	46ab	438b	42.3b	39ab	18abcd
Rangeland	11.7c	36.54c	7.79bcd	164.5bc	88.65ab	352.6bc	45.5b	45.5a	9bcd
Salt marsh	24.75c	194.4a	7.9abcd	713.33a	81.33ab	1093.5a	35.6b	44a	20abc
Agriculture	37/04bc	53.2c	7.68d	64.75c	38.75ab	238.3bc	29.2b	46a	24.75a
Dunes	38.44bc	24.36c	8.04abc	75.33c	13.4b	88.33bc	77.3a	16bc	6.66bd
Shore	64.55b	142.56b	8.2a	700a	130.5a	1216.5a	27b	59a	14abcd
Mangrove forest	100.81a	98.9b	8.095ab	35.5c	35.5ab	349.5bc	25b	56a	19abcd
Scarce forest	110.55a	39.48c	7.81bcd	13c	11.5b	65.23bc	37.3b	40ab	22ab

Table 2 - The mean of surface water parameters (Moradi, 2008)

Month	TDS	EC	pH	Cl	SO_4	Ca	Na	SAR
January	1949	3045	7.6	16.5	11.9	8.9	18.1	7.32
May	8459	13218	8.2	109	21.5	19	98.7	24.2
September	5171	8080	7.8	66.5	12.3	11	61.6	20

Table 3 - Vegetation covers condition in different landuse

Landuse	Spices
Rangeland	*Suaeda* sp., *Salsola* sp., *Halognemum strobilaceum, Convolvulus* sp., *Gymnocarpus decander, Euphorbia larica, Gymnugain* sp., *Teucrium polium,Tephrosia persica*
Mangrove forest	*Avicennia marina*
Dunes	*Aeloropus littoralis, Cressa cretica, Salsola* sp., *Leptadenia pyrotechnica, Indigofera intricate, Calligonum comosum, Pennisetum divisum, Cassia italic, Panicum turgidum, Licium shawii, Heliotropium bacciferum, Cornulaca monocantha*
Agriculture	*Date, Tomato, Potato*
Forest planting	*Prosopis juliflora*
Salt marsh	*Suaeda* sp., *Halognemum strobilaceum*
Shore	*Suaeda* sp.
Grassland	*Tamarix* sp.
Scarce forest	*Suaeda* sp., *Halognemum strobilaceum, Prosopis juliflora*

Table 4 - Vegetation covers percentage in different landuse

Spices	Landuse								
	Grassland	Mangrove forest	Scarce forest	Forest planting	Agriculture	Shore	Salt marsh	Dunes	Rangeland
Suaeda sp.	0	0	6.8983	0	0	0	1.768	1.35	1.575
Salsola sp.	0	0	0	0	0	0	0	0.866	0.273
Halognemum strobilaceum	0	0	1.8	0	0	0	15.796	0.803	0.866
Convolvulus sp.	0	0	0	0	0	0	0	0.020	0.6067
Gymnocarpus decander	0	0	0	0	0	0	0	0	0.230
Euphorbia larica	0	0	0	0	0	0	0	0	1.873
Gymnugain sp.	0	0	0	0	0	0	0	0	0.030
Teucrium polium	0	0	0	0	0	0	0	0	0.0666
Tephrosia persica	0	0	0	0	0	0	0	0	0
Acl	0	0	0	0	0	0	0	0.0166	0.05

Spices	Landuse								
	Grassland	Mangrove forest	Scarce forest	Forest planting	Agriculture	Shore	Salt marsh	Dunes	Rangeland
Aeloropus littoralis	0	0	0	0	0	0	0	0.0148	0
Cressacretica	0	0	0	0	0	0	0	0.0133	0
Leptadenia	0	0	0	0	0	0	0	7.766	0
Indigofera intricata	0	0	0	0	0	0	0	0.0733	0
Calligonum comosum	0	0	0	0	0	0	0	1.4	0
Pennisetum divisum	0	0	0	0	0	0	0	0.373	0
Cassia italica	0	0	0	0	0	0	0	0.260	0
Panicum turgidum	0	0	0	0	0	0	0	1.133	0
Licium shawii	0	0	0	0	0	0	0	0.8066	0
Heliotropium bacciferum	0	0	0	0	0	0	0	0.0066	0
Cornulaca monocantha	0	0	0	0	0	0	0	4.760	0
Prosopis juliflora	0	0	12.79	15.253	0	0	0	0	0
Tamarix sp.	80	0	0	0	0	0	0	0.11	0

DISCUSSION

Analysis of soil and water parameters in different landuse shows that in Ghaleh Ghazi region salinity is a major problem in salt marsh landuse after that shore, rangeland and mangrove forest, respectively. In forest planting and scarce forest landuses salinity is not serious problem. In agriculture landuse because of irrigation mismanagement salinity has increased recently. In salt marsh landuse, water table and salinity are high and it seemed that in addition of geologic formations, water table is major factor of salinity.

The vegetation condition and dominate spices are different in various landuse. in shore there is no vegetation and *Suaeda* sp. is limited. There are *Halognemum strobilaceum* and *Suaeda* sp. in salt marsh landuse. The most percent of vegetation is related to *Halognemum.* In general, it can be said that the more salt the less flora variety. The most vegetation verity is in sand dune. The results

show vegetation cove has been affected by soil and water salinization. The most number of spices there are in dunes landuse. In salt marsh landuse, with very high salinity, *Halognemum strobilaceum* and *Suaeda* sp. are dominated. In forest planting, with the least salinity, *Prosopis juliflora* is seen.

According to data base, geological map, topography map, landuse map, soil and water measured data and also field studies, soil and water salinization schedule and region status were investigated. The results showed that important factors influencing water salinization in Ghaleh Ghazi region are geological formations located in aquifer recharge and climate condition. Important factors of soil salinization in region are irrigation with saline water, improper irrigation method, unsuitable planting method, climate condition and landform (Zehtabian *et al.,* 2010).

According to soil salinity map and obtained results, from upstream to downstream the soil salinity changes is irregular and it is different based on lauduse and formation type. In the study area soil texture is different based on landuse. From the perspective of anionic, the salinity type is chlorine and from cationic salts, sodium ion is dominate.

CONCLUSION

This research was done due to determine the effective factors on soil and water salinization. In salt marsh area, salty amount and the underground water level is high. It seems that in addition to geological factors, underground water could cause soil salinity.

The most salinity is related to salt marsh; whereas the lowest amount is belong to forest planting and scarce forest. The remarkable thing is that whereas the lowest salinity is in forest planting landuse, but because of high salinity trees has been dried. Due to redirect drainage water, communication road has caused soil salinity and the loose of vegetation. Based on the result following executive suggestions are recommended: Monitoring and control in operation and limitation in groundwater consumption; Because of the high salinity, especially in landuse with high salinity cultivation of halophytes and native plants is necessary for soil conservation.

In agriculture land use drainage system prevents the accumulation of salts and agricultural product performance increases, so the destruction of agricultural land is avoided.

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