STATISTICAL STUDY OF IRRIGATION AND DRAINAGE NETWORKS EFFECTS ON SOIL PHYSICO-CHEMICAL PROPERTIES

ETUDE STATISTIQUE DES EFFETS DES RESEAUX D'IRRIGATION ET DE DRAINAGE SUR LES PROPRIETES PHYSICO-CHIMIQUES DU SOL

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ABSTRACT

Soil resources management is necessary for increasing productivity and efficiency of irrigation and drainage networks. Therefore, soil physico-chemical changes against climate, cultivation, operation and maintenance of canals and drains should be monitored carefully.

Soil property changes of the 1238.5 km^2 Doroudzan project region, located 50 km northeast of Shiraz in Fars province have been studied and assessed.

Based on the studies in 1344[4], 1353 and the synchronized studies of 1389, there are 16 soil series with heavy and very heavy soil texture and have the limitation of lime, salinity, alkalinity and etc. it was classified based on (U.S.D.A Soil Taxonomy 1999(Revised 2010)) in four categories such as Alfisols, Aridisols, Entisols and Inceptisols. Various phenomena over the last 35 years have affected the physic-chemical characteristics of these soils.

Studying soil information statistically using SPSS (Statistical Package for the Soil Sciences) software specified that 74% of saline and alkaline lands with severe drainage problems (soil class VA and VW) and those with soil class IIIW, IIIAW and IIIA have improved to II or III soil classes. Considering the poor quality and improper use of water for agriculture, salinity has caused gradual reduction in soil quality of these regions.

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Key words: *Soil physic-chemical property. Satistical assessment, Landsat images, Saline-sodic soil, Doroudzan, Iran.*

RESUME

La gestion des ressources en sol est nécessaire pour accroître la productivité et l'efficience des réseaux d'irrigation et de drainage. Donc, il est nécessaire d'accorder une attention aux modifications physico-chimiques du sol contre le changement climatique, la cultivation, l'exploitation et la maintenance des canaux et des drains.

Ce rapport étudie les changements des propriétés du sol du projet de Doroudzan, étendu sur une superficie de 1238,5 km2, situé à 50 km nord-est de Shiraz dans la province de Fars.

Compte tenu des études de 1344, 1353 et des études synchronisées de 1389, il existe 16 séries de sols à texture lourde et très lourde et à limitation de la chaux, de la salinité, de l'alcalinité etc. Selon la classification de « U.S.D.A Soil Taxonomy 1999 (révisée en 2010) », ces séries comportent quatre catégories telles que « Alfisols, Aridisols, Entisols et Inceptisols ». Au cours des 35 dernières années, divers phénomènes ont affecté les caractéristiques physico-chimiques de ces sols.

L'étude statistique des informations sur le sol, en utilisant le logiciel SPSS (Statistical Package for the Soil Sciences), a indiqué que 74% des terres salines et alcalines ayant des problèmes de drainage (classement du sol VA et VW ainsi que IIIW, IIIAW et IIIA) ont amélioré au classement du sol II ou III. Compte tenu de la basse qualité de l'eau et de l'utilisation inappropriée de l'eau en agriculture, la salinité a donné lieu à la réduction progressive de la qualité des sols de ces régions.

Mots clés: *Propriété physico-chimique du sol, évaluation statistique, les images Landsat, sol salin-sodique, Doroudzan, Iran.*

1. GENERAL DESCRIPTION OF THE AREA

1.1. Location and Surface Area

The study area is located in Fars province near the Sivand river and coveres an area of about 123846 hactare. This area is situated between 52° 4' and 53° 27' E longitude and 29° 18' and 30° 25' N latitude. Figure 1 shows the location of study area.

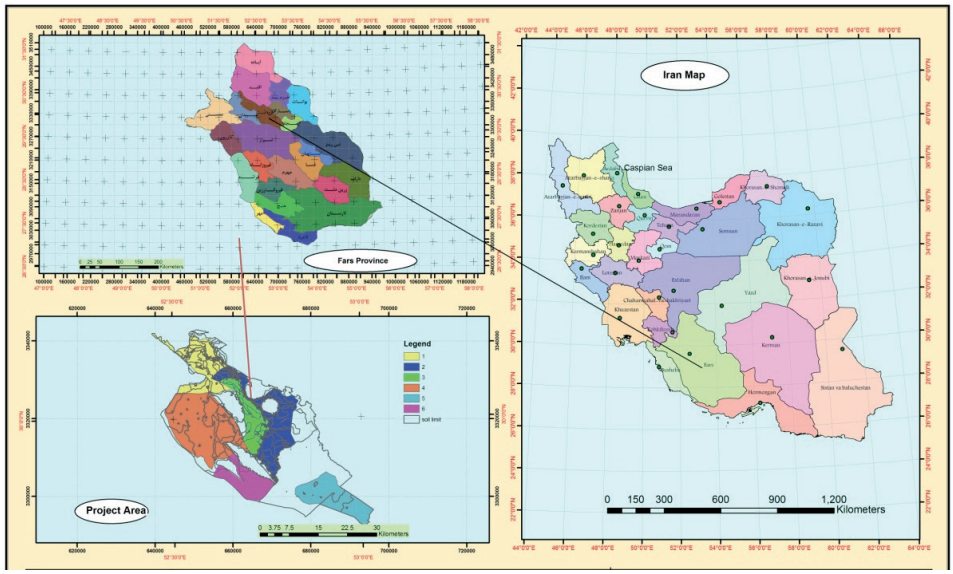

Fig 1: Location of study area

1.2. Climate

Table1 shows some climatic parameters of the study area. According to this table the average monthly temperature in this station is between 5^{0}C and 27.1^{0}C. Also, the mean annual temperature and precipitation is 16^{0}C and 435mm, respectively.

table 1 : Summery of Climate Parameters in the Study Plains of Dorodzan

Parameter		Monthly												
		OCT.	NOV	DEC.	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	annual
Precipitation(mm) in dam	Mean	2.6	25.5	78.7	91.3	83.6	74.0	57.1	17.8	1.8	1.4	1.1	0.2	435
Precipitation(mm)	Mean	3.5	34.4	106.2	123.2	112.8	99.9	77.0	24.1	2.5	1.9	1.4	0.2	587
	(%)	0.6	5.9	18.1	21.0	19.2	17.0	13.1	4.1	0.4	0.3	0.2	0.0	100
Temperature (° c)	Absolute Max	32.8	28.5	20.8	21.0	22.5	26.0	30.6	36.2	40.0	43.8	41.6	38.4	43.8
	Average of Max	28.0	21.2	14.9	10.8	11.1	15.1	19.9	25.7	32.2	35.7	35.7	33.2	23.6
	Mean	19.2	13.2	8.1	5.0	5.3	8.8	13.1	18.0	23.4	26.9	27.1	24.2	16.0
	Average of Min	10.4	5.3	1.3	-0.8	-0.4	2.5	6.2	10.4	14.7	18.2	18.5	15.2	8.4
	Absolute Min	-0.1	-5.6	-7.6	-13.6	-8.4	-6.6	-0.8	2.6	7.6	12.0	10.8	5.4	-13.6
Mean Number of Freezing Days		0	5	14	20	17	10	2	0	0	0	0	0	68
Wind Speed 2m(m/s)		1.9	1.5	1.4	1.6	1.8	2.1	2.2	2.4	2.3	2.2	2.1	2.0	2.0
Average of Sunshine Hours		286	230	196	190	195	226	253	305	344	343	335	316	3219
Relative Humidity	Average of Max	53	65	74	77	76	72	68	59	48	44	44	46	60
	Mean	38	49	60	65	62	57	52	43	35	32	33	33	47
	Average of Min	23	33	46	53	49	42	37	28	22	21	21	20	33
Open Water Evaporation (mm/ month)	mm	162.8	113.2	71.6	57.3	63.9	92.2	132.5	173.7	214.4	233.7	231.5	203.0	1749.8
	%	9	6	4	3	4	5	8	10	12	13	13	12	100

Figure 2 shows the relation between temperature and precipitation. Based on this diagram, in seven months of the year, that temperature is suitable for plant growth. The soil thermal regime is Thermic and the soil moisture regime is Dry Xeric.

Fig. 2. Doroudzan umbrothermic diagram

1.3. Landscape

The study area is including five landscapes of Piedmont alluvial plains, Gravelly Alluvial fans, Low lands, River Alluvial Plain and River terraces.

The land use of the study area in divided to 2 part of cultivated and none cultivated area based on satellite images and field studies. Cultivated area including irrigated and dry farming and none cultivated area is including range, flood ways, mountains, hills and urban areas. Total areas of cultivated and none cultivated land is about 56094 and 22459 hectares respectively. Types of land use in study areas is presented in Table 2.

Table 2 .Types of landuse in Dorodzan area

Ratio(%)	Area(ha)	Landuse	
68.91	54131.8	Irrigated Lands	Agricultural Lands
2.00	1963	Dry Lands	
71.41	56094.8	Total	
1.06	830	Urban	non- Agricultural Lands
1.75	1372	Range Land	
1.45	1139.5	Saline Land	
17.51	13758.25	Channels ,Roads and Drains	
6.82	5359.45	Other Lands	
28.59	22459.2	Total	
100	78554	Total	

2. MATERIALS AND METHODS

Landsat Satellite images 30meter resolution, topographic maps 1:25000, meteorological data, Munsel soil color chart were used to obtain the results of this study.

After overlay of satellite images with slope map and hill shade, images were analyzed again based on land form, topography, microrelief, land use, image tone, natural drainage networks, etc. Then, primary soil maps including initial land units were obtained (Fig. 3).

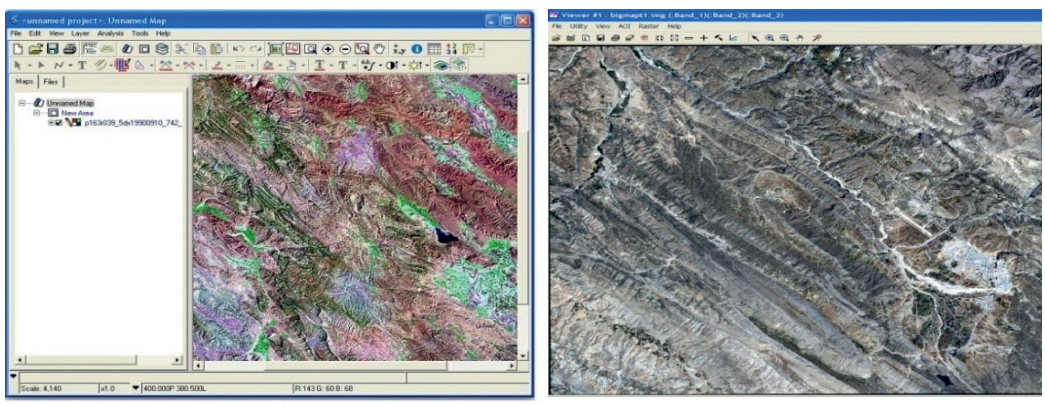

Fig. 3 :Primary soil maps of study area

The soil profiles were described based on surface and subsurface diagnostic horizons, color, depth, texture, structure, concentration of calcium carbonates, calcium sulfate, depth and quality of surface water. After that, soil samples were analyzed in MAHAB GHODSS laboratory. With field observation, physical, chemical and morphological properties of soil profile and laboratories data, the soils were classified based on Keys to Soil Taxonomy 2010. The soils were correlated with the (WRB) World Reference Base for soil resources (Anonymous, 2006). The soil orders were categorized as Entisols, Inceptisols,Vertisols and Alfisols with the texture varied from Silty Clay Loam to Clay. There are sixteen series in these four soil orders (Soil taxonomy, 2010). The results are shown in Table 3.

Table 3. Soil classification of project area

Landscape	Soil Series		U.S.D.A Soil Taxonomy 1999(Revised 2010)		Word Refrence Base for soil resources,WRB(2006)
	NO.	Name	Family	Order	
Gravelly Collovial Fans	1	Garmabad	coarse-loamy,mixed,calcareous,semiactive,thermic,Typic Xerorthents	Entisols	Haplic Regosols
Piedmont Alluvial Plains	2	Beizad	fine,carbonatic,semiactive,thermic,Typic Calcixerepts	Inceptisols	Haplic Cambisols(Calcaric,Skeletic,Siltic)
	3	Takhtejamshid	fine,mixed,semiactive,thermic,Typic Haploxerepts		Haplic Cambisols(Siltic)
River Alluvial Plains	4	Marvdasht	fine,mixed,semiactive,thermic,Aquic Haploxeralfs	Alfisols	Gleyic Haplic Luvisols(Siltic)
	5	Koshk	fine loamy,carbonatic,active,thermic,Typic Calcixerepts	Inceptisols	Haplic Cambisols(Calcaric)
	6	Kor	fine,carbonatic,semiactive,thermic,Typic Haploxerepts		Haplic Cambisols(Calcaric,Clayic)
	7	Ramjerd	fine-silty,carbonatic,active,thermic,Typic Haploxerepts		Haplic Cambisols(Siltic)
	8	Fathabad	fine-silty,semiactive,thermic,Typic Haploxerepts		Haplic Cambisols(Siltic)
	9	Jahanabad	very fine,carbonatic,semiactive,thermic,Typic Calcixererts	Vertisols	Haplic Vertisols(Calcaric)
	10	Hessamabad	fine-loamy,carbonatic,semiactive,thermic,Fluventic Haploxeralfs	Alfisols	Gleyic Haplic Luvisols(Siltic)
	11	Emadabad	fine,mixed,semiactive,thermic,Typic Haploxerepts	Inceptisols	Haplic Solonchaks(Sodic,Siltic)
	12	Maesomabad	fine-loamy,carbonatic,superactive,thermic,Typic Haploxerepts		Haplic Cambisols(Siltic)
Low Lands	13	Sarouni	fine silty,carbonatic,semiactive,thermic,Typic Haploxeralfs	Alfisols	Haplic Luvisols(Siltic)
	14	Karbal	very fine,carbonatic,subacive,thermic,Typic Haploxererts	Vertisols	Sodic Vertisols
	15	Koroni	fine,carbonatic,semiactive,thermic,Typic Haploxerepts	Inceptisols	Haplic Cambisols(Clayic)
River Terraces	16	Hashemabad	fine,carbonatic,active,thermic,Typic Calcixerepts		Haplic Cambisols(Clayic)

3. RESULTS AND DISCUSSION

According to soil survey and land classification studies in different years of 1974 to 2010 variation trend of soil physiochemical characteristics were compared. Soil salinity map of this area was shown in Figures 4 and 5.

Based on soil survey and land classification studies, the salinity (S) and sodicity (A) of this area was classified from S0A0 to S4A2. Salinity and sodicity in old classification were more than new classification. Also, soil salinity and sodicity in new classification has decreasing trend in comparison to old classification.

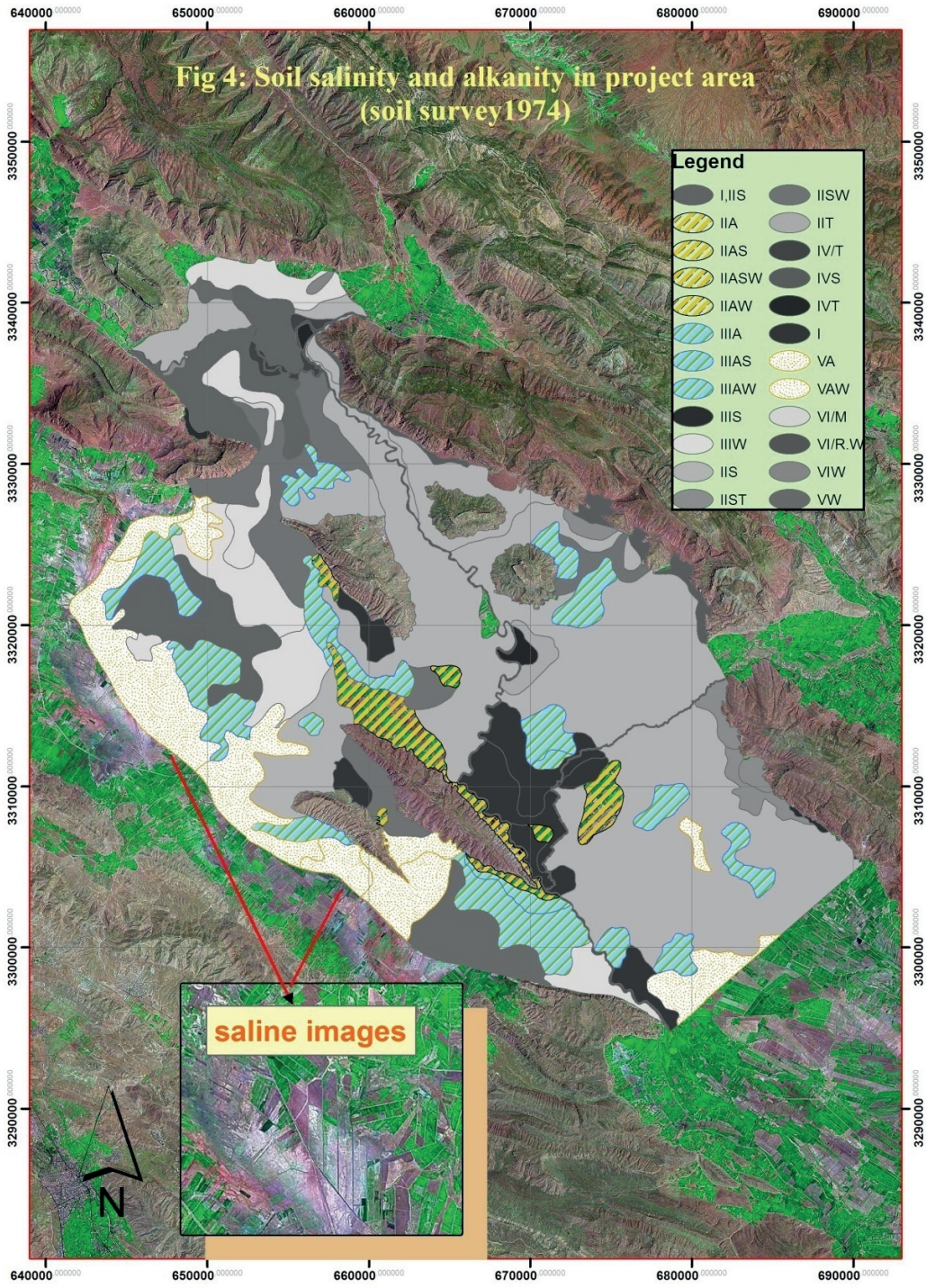

Fig. 4. Soil salinity and alkalinity in project area(1974)

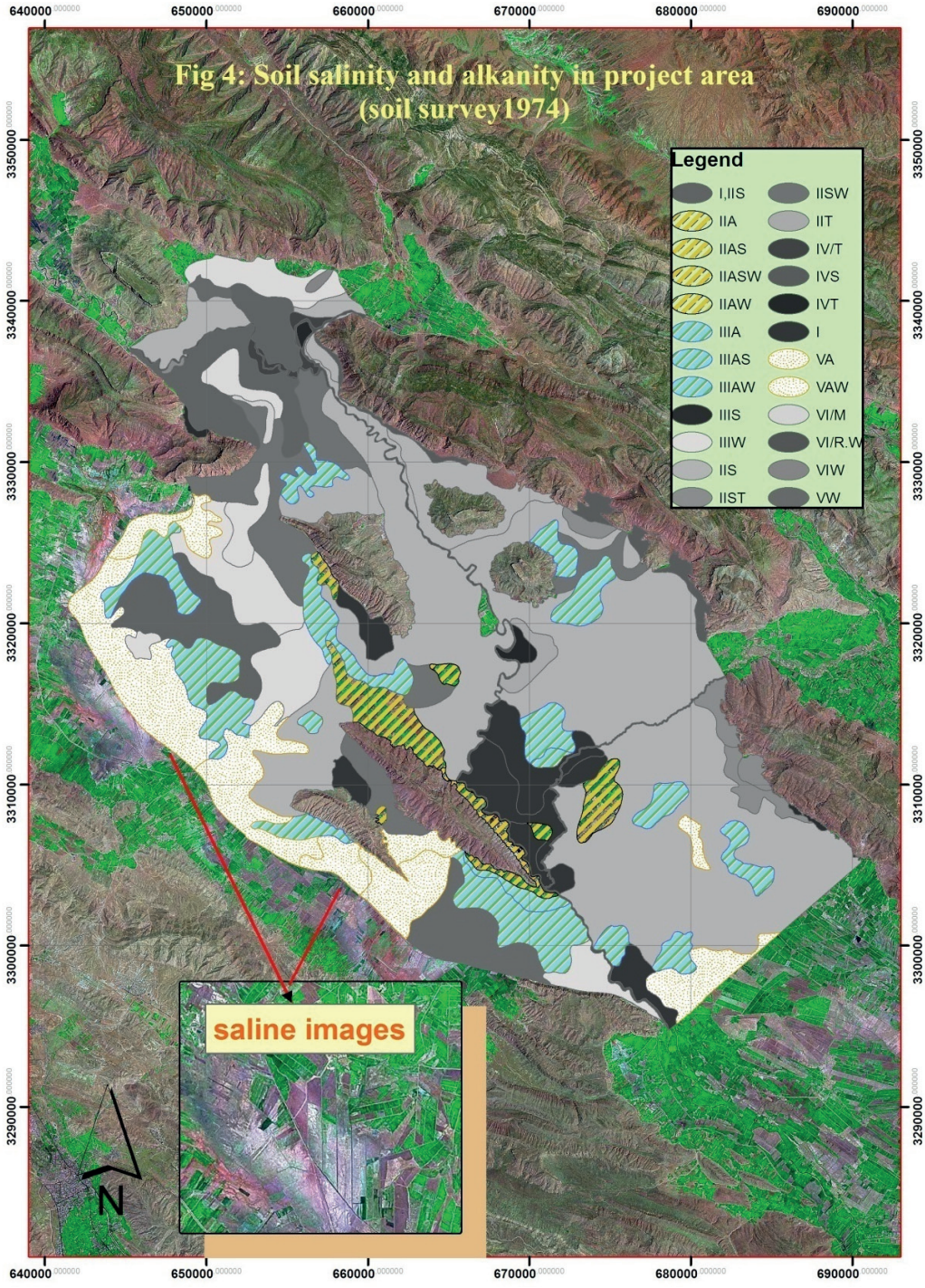

Fig. 5. Soil salinity and alkalinity in project area (2010)

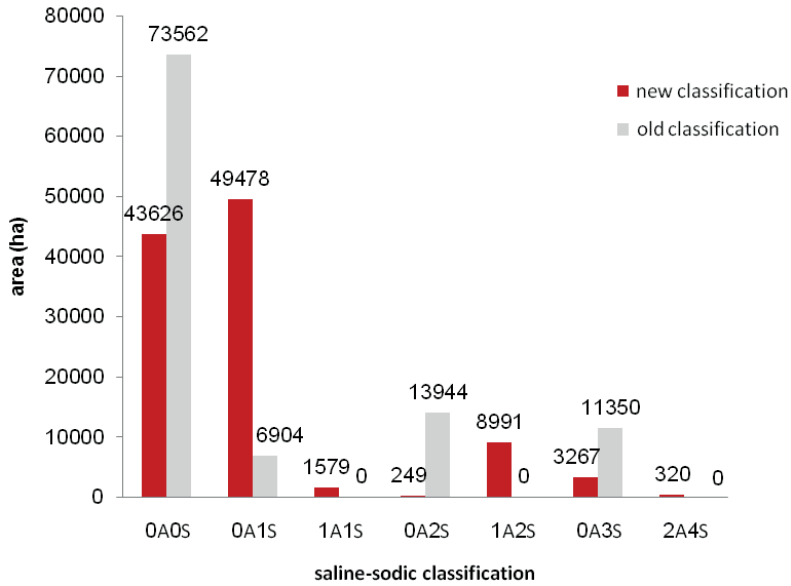

Fig. 6. Area under saline-sodic classification (old 1974 and new 2010)

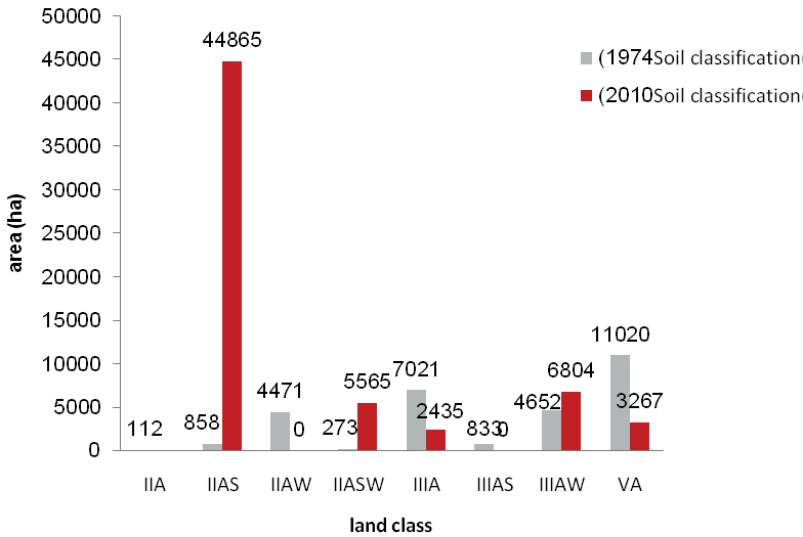

Fig. 7. Area under different land classification (old 1974 and new 2010)

Finally, the results indicated that over 74% of the study area has salinity and sodicity limitations (VA,VW,VIW) and also about 53% of the study area rehabilitated from IIIA , IIIAW, IIIW classes to II and III classes.

In saline soils, plant response to salinity directly influences by salt contents within the root zone as well as by water table depth. Then a reasonable crop production in this soils can only be obtained after desalinization practices.

Plantation and cultivation of salt tolerant plants result in soil salinity reduction. Reclamation operations such as sub drainage and canal networks implementation helps to reduce the groundwater table, hydromorphy and waterlogging threats.

Importance of detailed planning in agriculture and better operation of existing limitations necessitates correct decision making about agriculture lands for executers and producers in agriculture sector.

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