IMPACT OF SOIL SALINIZATION ON NATURAL VEGETATION AND LAND DETERIORATION

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ABSTRACT

This work was conducted to assess the impact of soil salinization and sodification on natural vegetation and land deterioration in Wadi Al-Shatti, Southern Libya. Fallow soils were very strongly saline with mean EC_e of 111.2 and 68.78 dS m^{-1} in crust and surface layers respectively. The cultivated soils were moderately, strongly and very strongly saline with mean EC_e of 14.52 dS m^{-1}. Sodium was the dominant cations, followed by calcium and magnesium. Chloride was the dominant anion. Very low concentrations of bicarbonate and absence of carbonate was recorded. Sodium chloride was prevalent salt in all samples, followed by calcium sulphate in some and magnesium chloride in the others. Sodium and magnesium sulphate were found in some samples, while the presence of calcium and magnesium chloride was confined in fallow soils and crust of very high salinity. Crust and surface layers of fallow soils have high values of ESP with means of 47.78 and 33.85% respectively, whereas low values were noticed in cultivated soils with mean of 18.10%. Field study results showed the disappearance of ordinary natural vegetation and the occurrence of halophyte plants, like; Athel trees (*Tamarix aphylla*), Spiny rush (*Juncus acutus*), Cogon grass *(Emperica cylinderica*), Camel thorn (*Alhagi maurorum*) and Nitre bush (*Nitraria retusa*). Degradation indices confirmed that the cultivated soils suffered from slight to moderate deterioration, whereas fallow soils suffer from sever to very sever deterioration.

Key words: Glygophytes, Halophytes, Saline soils, sodic soils, soil deterioration.

تأثير تملح الترب في الغطاء النباتي وتدهور الأراضي

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المستخلص:

اجريت هذه الدراسة لتحري تأثير تملح الترب الزراعية وصوديتها في الغطاء النباتي الطبيعي وتدهور الترب في منطقة وادي الشاطيء جنوبي ليبيا. أظهرت النتائج ارتفاع ملوحة الترب البور بشدة، وكان متوسط التوصيل الكهربائي لمستخلص العجينة المشبعة للترب البور والقشرة السطحية؛ 68.78 و111.2 ديسيسمنز م$^{-1}$ على التوالي، بينما كانت الترب المزروعة ذات ملوحة متوسطة وشديدة وشديدة جداً، وبمتوسط قدره 14.52 ديسيسمنز م$^{-1}$، وأكدت النتائج سيادة أيون الصوديوم على بقية الأيونات الموجبة ويليه الكالسيوم ثم المغنسيوم، وساد الكلوريد على بقية الأيونات السالبة، ولوحظ انخفاض تركيز البيكربونات وغياب الكربونات في جميع العينات، وأكدت النتائج سيادة ملح كلوريد الصوديوم في جميع العينات يليه كبريتات الكالسيوم في بعض العينات وكلوريد المغنسيوم في بعضها الآخر، ولوحظ وجود كبريتات الصوديوم وكبريتات المغنسيوم في بعض العينات، بينما اقتصر وجود كلوريد المغنسيوم والكالسيوم في القشرة السطحية والطبقة السطحية للترب البور شديدة الملوحة، وبلغت قيم النسبة المئوية للصوديوم المتبادل 18.10 و33.85 و47.78% في الطبقة السطحية للترب المزروعة والطبقة السطحية للترب البور والقشرة السطحية للترب البور على التوالي، وبينت الدراسة الميدانية اختفاء الغطاء النباتي الطبيعي وظهور نباتات البيئة الملحية، مثل: الأثل (*Tamarix aphylla*) والسمار (*Juncus acutus*) والحلفا (*Emperica cylinderica*) والغرقد (*Nitraria retusa*)، وأكدت مؤشرات التدهور أن الترب المزروعة تعاني من تدهور بسيط إلى متوسط بينما تعاني الترب البور من تدهور شديد إلى شديد جداً.

كلمات مفتاحية: كلايكوفايت، هالوفايت، ترب ملحية، ترب صودية، تدهور الترب.

INTRODUCTION

Agriculture contributes an essential role in the economics of many countries and in the development and social advancement, particularly in the developing countries. So, many of these countries seek to develop agriculture to increase food production and create jobs. Libya is one of these countries which have since more than three decades a comprehensive agrarian development project in many areas, including Wadi Al-Shatti in the south, to achieve the aforementioned objectives, in addition to installation of the settlement. A number of environmental problems have been emerged in Wadi Al-Shatti regions due to these achieved comprehensive agrarian projects, including land degradation due to soil salinization, resulting in reduction of range land areas, decline of vegetation cover, vegetables, cereals, and forage; and meat productivity. Degradation due to soil salinization and sodification also shows in the deterioration of the physical, chemical and biological properties of soils, prejudice in the ecological balance and biodiversity, the loss of ordinary natural vegetation and emergence of halophytes, spreading of wind and water erosion, desertification and sand dune encroachment. So, land degradation will cause a decrease in standard of living of populations, risk of unemployment, increase of poverty and displacement and migration to cities. Lands salinization is closely related to climate. It is widely spread in arid and semi-arid regions. According to aridity, Libya can be divided to; very arid, arid, semi-arid and semi-humid regions which occupies 90.8%, 7.7 %, 1.5% and 0.3% respectively of the total area of Libya which is estimated to be 1,600000 km^2 (1). Salinization is related also to geomorphological and hydrological conditions. Therefore its existence associated with low land and high ground water (12). Agricultural practices such as poor management of irrigation and drainage, and bad management of soil and crops can contribute effectively to soil salinization process, especially in arid and semiarid regions. Many mineral salts accumulate in soils from the link of chloride, sulphate bicarbonate or carbonate and to lesser extent nitrate or borate with calcium, magnesium, sodium, and potassium. The high accumulations of salts in the soil suppress growth of agronomic plants and lowered its productivity. This happen because salts reduce quantity of available water, regardless of the total amount of water in the rhizospher (18). High accumulation of soluble salts in soil leads to osmotic stress (2) and can cause water withdraw from plant cell as a result of water movement from high to low potential, due to reduction in osmotic potential of soil solution, which stunted plant growth and may cause death (12). Another negative impact of soluble salts accumulation in soil is the imbalance in the absorption of essential nutrients by plant, due to nutritional imbalance in soil environment (20). This will lead to disruption of the ion balance in the plant, especially in mature leaves, and sometimes the toxic effect of specific ions (15) and decrease in the specific activity of the leaves (8). Also, photosynthesis severely affected in all its phases by salt stress (7) as well as plant gas exchange (14). Moreover, salt accumulation could decrease plant growth and production indirectly through its impact on soil physical and chemical properties, such as soil structure, permeability, porosity, pH and nutrient availability. Also, salt accumulation has negative impact on biotic and biochemical properties of soil and soil microorganisms (17) and impeding the growth of rhizobia through osmotic stress or toxic effect of high concentration of ions (11), or reducing nodules formation, or reducing efficiency of formed nodules (10). High accumulation of salts can cause solid soil crust formation on the surface of the soil, which hinder seedling emergence. No studies have been undertaken on Wadi Al-Shatti region, Southern Libya to assess salinization and sodification of agricultural soils, after comprehensive agrarian development which started since more than three decades, and its impact on natural vegetation and soils degradation. So, this work was carried out to achieve this aim.

MATERIALS AND METHODS

Location of the study area

The study area includes the agricultural soils at Wadi Al-Shatti region, Southern Libya. It is located between longitudes 13 and 15 to the east, and between latitudes 20°27¯ to 27°39¯ (9), and covers an area of almost 97160 km^2, and representing 5.5% of the area of Libya (3). Figures 1 and 2 showed the location of the studied area and samples sites respectively.

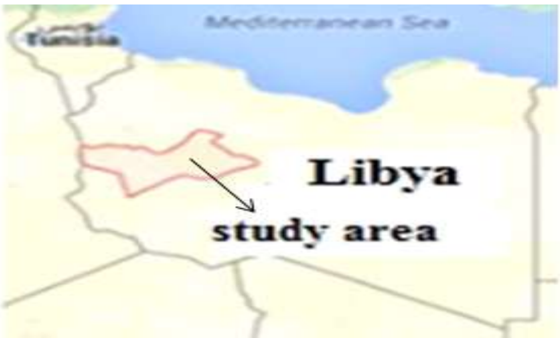

Fig.1. Location of the study area

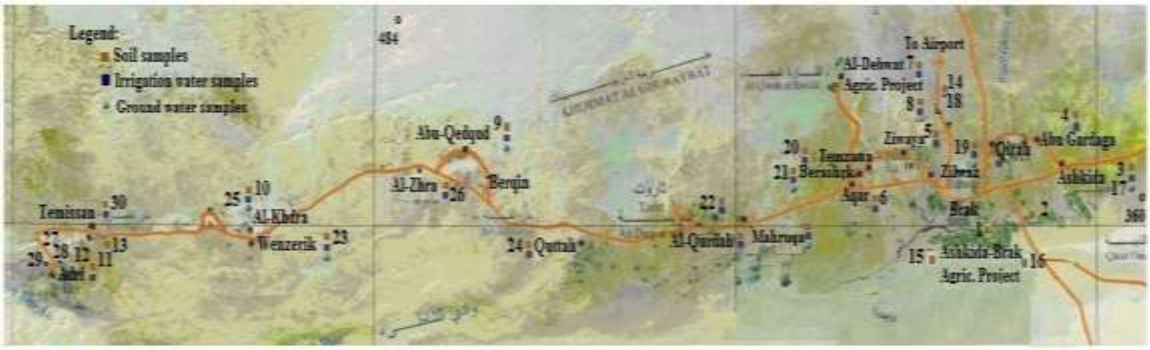

Fig.2: Samples sites

Climate of the study area

Desert conditions prevail across the valley, and its climate is characterized as strongly hot summer, mild winter and drought in most months of the year. Mean monthly temperature is between 11.16-31.20℃. Maximum ranges of temperature are between 5-29℃ in January and between 7-47℃ in July. Mean yearly temperature is 22.36℃, and mean temperature of the hottest three months (June, July and August) is 30 ℃. Low air humidity is noticeable in all months with yearly mean of 32.67%. Continental winds prevail and blow in the north-east and east directions in summer, and the rate of speed is 3.60-6.17 m/sec. In the winter, westerly winds predominate and the average of speed is between 2.06-5.14 m/sec. In the spring, the south-western wind is blowing warm and dry. As for rain, there is no clear season, and rainfall has not exceeded the annual average of 8.61mm. The range of monthly mean solar brightness is between 7.76 hrs at February and 12.04 hrs at July, with yearly mean of 9.65 hrs. Lowest mean value of evaporation is in January (6.99 mm) and the highest value occurs in June (25.47 mm), with yearly mean of 15.68 mm, Table 1.

Table 1. Mean monthly of some climate elements for the period 1946-2006 from the nearest climatic station to study area

Climate element	Months												Mean
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Humidity, %	46.60	39.49	31.85	26.54	24.38	21.86	25.55	28.12	29.33	32.58	40.20	45.50	32.67
Solar brightness, hrs	7.90	7.76	9.01	9.26	10.08	11.86	12.04	11.53	9.95	9.17	8.95	8.27	9.65
Max. Temp.,℃	22.23	25.66	32.43	36.22	38.69	40.97	41.75	40.96	39.14	35.15	28.9	23.92	33.84
Min. Temp., ℃	1.20	1.54	5.32	9.22	11.13	18.99	17.12	16.97	17.12	13.34	6.06	2.18	10.18
Evaporation, mm	6.99	9.94	14.12	18.23	23.93	25.47	22.19	20.86	17.64	14.18	9.76	7.87	15.68
Rainfall, mm	0.20	0.13	0.69	0.29	0.12	0.01	0.00	0.01	0.00	0.12	0.62	1.62	0.32
Wind speed, m sec^{-1}.	4.54	4.77	5.72	5.60	6.29	5.87	5.53	5.47	5.31	4.50	4.47	4.24	5.19
Max. wind speed, m sec^{-1}.	10.60	9.21	9.26	10.29	9.52	10.44	8.33	9.77	9.41	7.72	7.30	7.51	9.11

Sampling of ground water and soils

Thirty samples from the surface layer (0-30 cm) of agricultural soils affected by salts, either fallow (16 samples) or currently under utilization (14 samples), located in Wadi Al-Shatti, Southern Libya have been collected. Figures 1 and 2 indicate location of the study area and samples site respectively. All fallow soils were crusted. Surface crust was collected separately. Samples were air dried and crushed to pass through a 2 mm sieve and stored in plastic container. In some locations, ground water depth was measured, and samples were collected in clean plastic containers and filtered immediately after collection. Electrical conductivity (EC) and pH of ground water samples were determined in situ immediately after filtration.

Physical and chemical analysis

EC, pH, soluble cations and anions, and total dissolved salts (TDS) were measured in soil paste extract as were mentioned in page et al. (16). Cation exchange capacity (CEC) was determined after method of Bower, using sodium acetate for saturation and ammonium acetate for extracting as was described in page et al. (16). Exchangeable sodium (NaX) was calculated after subtraction of soluble sodium from extractable. Exchangeable sodium percentage (ESP) was calculated using this equation:

$$ESP = \frac{NaX}{CEC} \times 100 \quad ....(1)$$

Were NaX and CEC in cmol kg^{-1} soil. Mechanical analysis and bulk density of the studied samples carried out using pipette method and core method respectively (16). Table 2 indicates ranges of soil fractions percentage and textures found in the studied soils. Accumulated soluble salts were calculated in ton ha^{-1}. Salts type percentage were calculated using hypothetical combination as mentioned in Al-Ani (4) which based on the concentration of ions in soil paste extract and degree of its solubility.

Table 2. Range of some physical properties and texture of the studied soils

Sample Type	No. of Samples	Sand (g kg^{-1})	Silt (g kg^{-1})	Clay (g kg^{-1})	Texture
Fallow Soils-crusted	16	709-892	15-181	43-200	L.S, S, S.L *
Cultivated	14	722-879	18-199	30-249	L.S, S, S.L

*** L.S, S, S.L, = Loamy sand, sand and sandy loam respectively**

Soil salinization and sodification evaluation:

Soil salinity and Sodicity levels were assessed according to the criteria of land salinization monitoring proposed by AOAD (6), which is based on the US Salinity Laboratory classification for saline and sodic soils. Levels of soil salinity and Sodicity, depending on electrical conductivity of saturated soil paste extract (EC_e), and ESP respectively are presented in table 3.

Table 3. Degree of salinization and Sodicity according to EC_e and ESP respectively*

EC_e	Degree of salinization	ESP	Degree of sodicity
< 2	Non saline	< 10	Non sodic
>2-4	Slightly saline	>10-20	Slightly sodic
>4-8	Moderately saline	>20-30	Moderately sodic
>8-16	Strongly saline	>30-50	Strongly sodic
>16	Very strongly saline	>50	Very strongly sodic

****Ref: AOAD, 2013***

Assessment of changes in Natural vegetation:

Field study was achieved to assess changes in flora and detect prevailing halophytes by comparing with natural glygophytes (flora present in non-saline soils) nearby salt affected soils.

RESULTS AND DISCUSSION

Soil pH:

Obtained results showed that the pH of saturated paste extracts of the studied soils and the surface crust were neutral, slightly alkaline and alkaline, according to pedological classification of soil pH. Its values ranged between 6.79-8.15, 6.98-7.80, and 7.00-7.78 in surface crust, fallow crusted soils and cultivated soils respectively, Table 4. In general, the crust samples show the wide range of pH value. This may be due to wide range of total salt and sodium ions concentrations in the surface crust samples. Apart from soil from Qurdah (No. 20) and soil and crust samples from Tamzawa (No. 22), which have alkaline pH (7.85 and 8.08 respectively), the pH of the rest samples were neutral to slightly alkaline. The pH of soil and crust samples did not rose to alkaline with increasing soil salinization. This may be due to the absence of carbonate and very low concentration of bicarbonate.

High pH of crust samples in comparison to soil samples is due to sodium accumulation, Table 5.

Soil Salinity: Salinity expressed as EC_e and TDS are shown in Table 4. The results confirmed that the salinity of the crust samples were much higher than that of soil samples. This result reflect the sever salinization of crusted soils. The EC_e of crust samples were between 62.1 to 195.0 dS m^{-1}, whereas the EC_e of surface soil samples were between 11.2 to 142.0 dS m^{-1} and 5.70-29.40 dS m^{-1} in fallow crusted and cultivated soils respectively. The TDS values were between 1.217 to 4.298 % in crust samples, 0.189 to 2.897 % in fallow crusted soils and between 0.169 to 0.549 % in cultivated soils. Lowest EC_e and TDS values were found in soils under agricultural exploitation, Table 4. Left the soil fallow in arid and semi-arid regions lead to the accumulation of salt at the surface, as a result of salt upward movement with capillary water (4). Study area is characterized by dry climate, high mean annual temperature, large solar brightness (7.9-12.04 hr/day) and high evaporation from March to October, Table 1. These conditions increase evaporation and evapotranspiration rate, which accelerate upward movement of capillary water. Land salinization in Wadi Al-Shatti three decades after the beginning of agrarian development program is due to bad management of irrigation practices. Most farmers at Wadi Al-Shatti regions used excess quantity and/or saline irrigation water. The salinity of water used in the studied fields was between 0.94-4.90 dS m^{-1}. Using excess quantity of irrigation water without the presence of drains, especially with weak natural drainage, leads to raise groundwater level to become close to the surface (25-102 cm in the studied soils). Although studied soils were sandy, loamy sand and sandy loam textured, but low permeability and weak natural drainage were well known for many soils of Wadi-Al-Shatti. This is due to the presence of lithic sub-surface layer. AOAD (5) has been confirmed that common land salinization in Arab countries (Libya is one of these countries) is due to the use of high salinity water, and the use of excessive amounts of water of which flood irrigation manner. Depending on the degree of salinity, which set out in table No. 3, the cultivated soils can be divided into moderately saline (samples 1, 2, 10 and 11), strongly saline (samples 3, 4, 5, and 12) and very strongly saline (samples (6, 7, 8, 9, 13, and 14) while all fallow soils were very strongly saline when taking into account the salinity of crust.

Table 4. Some chemical properties of the studied soils

Sample Type	pH_e		EC_e, dS m^{-1}		TDS, %		ESP	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Surface Crust	6.79-8.15	7.46	62.10-195.0	111.2	1.217-4.298	2.696	27.2-71.5	47.78
Fallow Soils-crusted	6.98-7.80	7.41	11.20-142.0	68.78	0.189-2.897	1.686	10.54-51.47	33.85
Cultivated Soils	7.00-7.80	7.40	5.70-29.40	14.52	0.169-0.549	0.301	9.74-30.79	18.10

ESP

Results in table 4 confirmed that most soils were sodic. High values were found in crust samples followed by fallow soils. Lower values found in cultivated soils. Mean ESP values were 47.78, 33.85% and 18.10% for crust, fallow soils and cultivated soils respectively. Based on the ESP, the studied soils can be divided according to US Salinity Laboratory guidelines into four categories, i.e. slightly sodic (ESP=10-20%) which include samples 1, 2, 3, 5, 21 and 23, moderately sodic (ESP=20-30%) include samples 6, 10, 12, 13, 14, 16, and 19, strongly sodic (ESP=30-50%) consisting samples 7, 8, 9, 11, 15, 17, 18, 20, 22, 24 and 25, and very strongly sodic (ESP >50%) which contains sample 4 only. These four soils categories consist 26.67%, 23.33%, 36.67% and 13.33% of the studied soils respectively. The high ESP in the studied samples related to high sodium concentration in soil solution which replaced calcium and magnesium from exchange sites. The low sodicity in samples No. 2 and 21 is attributed to the relatively low sodium chloride and high calcium sulphate especially in sample No. 2 (Table 4).

Ions species and salts type

Results indicate that sodium was the dominant cation in all surface soils and crust samples, followed by calcium and magnesium but with large differences (Table 5). Lowest value was noticed in cultivated soils. Its concentrations were 259.6-1000.6 meq l^{-1}, 42.3-769.0 meq l^{-1}, and 33.0-190.2 meq l^{-1} with means of 715.9 meq l^{-1}, 368.9 meq l^{-1} and 85.4 meq l^{-1} in crust samples, fallow soils and soils under cultivation respectively. Apart from samples No. 4 and 5 which show the dominancy of sulphate, chloride was the dominant anion in the rest samples. Its concentrations were 540.7-1389.5, 85.7-1040.1and 33.0-201.7 meq l^{-1} with means of 927.1, 489.9 and 84.5 meq l^{-1} in crust samples, fallow soils and soils under cultivation respectively. Sulphate was the second anion with concentrations of 80.0-702.5, 13.3-439.7 and 12.8-142.2 meq l^{-1}, and means of 356.8, 173.9, and 58.4 meq l^{-1} in crust samples, fallow soils and soils under cultivation respectively. The dominancy of sulphate concentration in samples No. 4 and 5 may be due to the type of fertilizers used (ammonium sulfate and potassium sulphate), as the fact these soils belong to Al-Debwaut Agricultural Project and subjected to exploitation due to annual cultivation with grain crops. The dominancy of sodium and chloride is due to their high concentration in irrigation water. Analysis of irrigation water confirmed the dominancy of sodium among other cations and high concentration of chloride, which was nearly equal or sometimes higher than the concentration of sulphate (unpublished data). Also, groundwater contributes effectively to salinization process and accumulation of sodium chloride due to its proximity from soil surface (25-102 cm) and its high concentration of sodium and chloride ions. High potassium concentrations in some samples were observed. This was possibly due to high concentration of potassium in irrigation and ground water. Very low concentrations of bicarbonate and absence of carbonate was noticed in all studied samples.

Table 5. Concentration ranges and means of soluble ions in soil paste extract of the studied samples

Ions meq l^{-1}	Surface Crust		Fallow Soils-crusted		Cultivated Soils	
	Range	Mean	Range	Mean	Range	Mean
Na^+	259.6-1000.6	715.9	42.3-769.0	368.9	33.0-190.2	85.4
K^+	21.8-179.5	73.3	5.2-88.1	34.1	1.4-13.1	7.1
Ca^{2+}	160.4-570.0	334.3	21.0-473.2	188.6	9.6-60.5	34.8
Mg^{2+}	39.2-350.0	162.2	12.2-240.0	97.9	4.7-30.5	16.4
Cl^-	540.7-1390.5	927.1	85.7-1040.1	489.9	33.0-201.7	84.5
$SO_4^=$	80.0-702.5	356.8	13.3-439.7	173.9	12.8-142.2	58.4
HCO_3^-	0.8-6.4	1.8	0.3-2.4	1.1	0.4-1.5	0.9

Results in table 6 showed the percentage of salts types accumulated in soils and crust samples. It confirmed the dominancy of sodium chloride which was between 41.8-74.0 %, 39.6-68.0 % and 31.3-68.5 % in the crust samples, fallow soils and soils under cultivation respectively. Calcium sulphate was the second salt in all soil and crust samples, except for two crust samples and two soil samples from crusted soils where magnesium chloride was the second salt. Apart from surface crust of samples No. 23 and 26 and surface soil samples No. 17 and 23, magnesium chloride was found in all fallow soils. Magnesium sulphate was the third salt component in soils under cultivation, while it was found in low concentration in some crust and surface samples. Sodium sulphate was found in low amount in all cultivated soils and two crust and two samples of crusted soils. Magnesium and calcium chloride were confined in crust and surface soil of very high salinity. The dominancy of sodium chloride and the presence of magnesium and calcium chloride in crusted soils is due to the high increase in salt concentration of the soil solution (14), which reflects that the salinization process in these soils have reached advanced stages.

Table 6. Percentage of ranges and means of salts in paste extract of the studied samples

Salt Type	Surface Crust		Fallow Soils-crusted		Cultivated Soils	
	Range	Mean	Range	Mean	Range	Mean
NaCl	41.8-74.0	55.4	39.6-68.0	54.5	31.3-68.5	52.6
$CaSO_4$	10.1-32.3	22.3	12.8-28.6	20.9	13.2-31.1	23.5
$MgCl_2$	0.5-16.4	8.7	0.0-17.6	10.6	-	-
$CaCl_2$	0.0-12.8	3.2	0.0-11.2	4.6	-	-
Na_2SO_4	0.0-4.31	0.3	0.0-0.9	0.1	0.5-29.6	6.82
$MgSO_4$	0.0-13.1	3.4	0.0-12.3	3.0	7.6-17.9	12.48
KCl	1.3-16.0	6.0	1.7-15.5	6.0	2.1-8.2	4.8
$Ca(HCO)_2$	0.1-0.3	0.16	0.1-0.8	0.28	0.2-1.8	0.8

Natural Vegetation: The field study of Wadi Al-Shatti area showed that the flora of non-saline soils were Bermuda grass (*Cynodon dactylon*), wild lettuce (*Lettuce serriola*) in addition to Sodom Ap (*Calotropis procera*), wild barley (*Hordem leprinum*). More than 50% of these plants disappeared in cultivated soils, especially in high and very high saline soils, and completely disappeared in fallow salt affected soils. Halophytes occurred in these salt affected soils are: Athel tree (*Tamarix aphylla*), Spiny rush (*Juncus acutus)*, Cogon grass (*Emperica cylinderica*), camel thorn (*Alhagi maurorum*), Nisela (*Panicum repens*) and Nitre bush (*Nitraria retusa*).

Land deterioration evaluation: The AOAD (6) proposals were used to assess soils deterioration. These proposals used soil salinity, accumulated salts in soils (ton ha^{-1}), salinity of ground water, and biological factors as deterioration indices. In our study we used TDS, accumulated salts, and residual percentage of dominant variety of natural glygophytes, as a biological factor for soil deterioration indices. Soil deterioration intensity has been placed in three categories: slight, moderate, and sever to very sever deterioration (Table 7). Based on that, three samples of cultivated soils do not suffer from deterioration, while the rest suffer from slightly deterioration (samples No. 4, 5, 7, 8, 11, 12, 13, and 14) and moderately deterioration (samples No. 6 and 9). All fallow soils suffer from sever to very sever deterioration.

Table 7. Soil deterioration degree according to AOAD, 2003

Evaluation criteria	Degree of soil deterioration		
	Slightly deterioration	Moderately deterioration	Sever and very deterioration
TDS	0.2-0.4	0.4-0.6	> 0.6
Accumulated salts, ton ha^{-1}	16-30	>30-45	>45-90
% of residual natural glygophytes	>75	25-75	< 25

In conclusion, salinity and sodicity are widespread in soils of Wadi Al-Shatti, Southern Libya. Most of these soils suffer from sever to very sever deterioration. Unsuitable management of soil and irrigation applied by traditional farmers was the main reason for this problem. Among these wrong agricultural practices used are the excess flood irrigation and using saline water. Using drip or sprinkler irrigation, water of good quality and increasing soil permeability highly recommended to avoid soil salinization and sodification in these regions.

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