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Assessment of soil quality indicators and phosphorus status of the land resources on both sides of Sohag-Safaga highway, Eastern Desert, Egypt

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Abstract

Reclamation of desert lands in Egypt has become an urgent necessity to increase both the cultivated area and the agricultural production. Wherefore, the objective of this study was to evaluate the physical and chemical properties as well as the available phosphorus content of the soils around the Sohag-Safaga highway in the Eastern Desert. The results of this study show that the study area is characterized by a coarse texture of sand, loamy sand, and sandy loam. The organic matter content of the investigated soil samples is low and is less than 0.5%. Most of the soil samples have moderately alkaline pH values. In addition, about 16% of these samples are non-saline (ECe <2dSm^{-1}), 19% are very slightly saline (ECe = 2-4 dS m^{-1}), 14% are slightly saline (4-8 dSm^{-1}), 20 % are moderately saline (8-16 dSm^{-1}) and 30% are strongly saline (>16 dSm^{-1}). The calcium carbonate content of the studied soils ranges from 0.4% to 38.8% with an average of 12.2%. Mover over the available phosphorus content of the under-study soils varies from 2.8 to 16.3 mg kg^{-1} with an average of 6.15 mg kg^{-1}. About 38.4% of the soil samples show low available phosphorus (P) levels that are less than 5 mg kg-^{1}. However, most of the soil samples (about 54.7%) had contain available phosphorus values of 5 - 10 mg kg^{-1}, but only 7% of these samples have >10 mg kg^{-1} available P. So, it is recommended to apply organic manure and phosphate fertilizer to improve the productivity of the soils under study.

Keywords: Eastern desert lands, soil properties, available phosphorus.

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1. Introduction

Land reclamation has been one of the priorities of the successive Egyptian governments since the middle of the last century. It provides solutions to many problems such as desertification, poverty, and unemployment reduction. Over the last decades, Egypt has undertaken many national projects dealing with increasing the agricultural area through the reclamation of some desert lands that is known as the horizontal expansion for agriculture and population in the deserts (Adriansen, 2009; Elbeih *et al*., 2011). Based on this objective, many desert roads have been built. The Sohag-Safaga highway in the eastern desert in Egypt is one of these roads, which connects Assiut, Sohag and Quena governorates with the Red Sea one (Elbeih *et al*., 2011). Geologically the Eastern desert consists of many rocks such as sedimentary (limestone and Nubian sandstone and crystalline rocks) as well as coastal deposits (Quaternary deposits) along the red seacoast (Figure 1). Furthermore, Nubian sandstone contains alternating layers of sandstone, shale, and clay. The sand particles varied from fine to course (Abdel Moneim, 2005). The Eastern Desert is classified as an arid to hyper-arid region, where the annual rainfall ranges between 3 and 50 mm during the rainy season (Aggour and Sadek, 2001; Milewski *et al*., 2009). The annual temperature in this region varies from 41 to 21°C and increases from north to south (Abdel Moneim, 2005). Phosphorus (P) is a major essential macronutrient for plant growth and soil productivity, the deficiency of available P in soils can affect crop yields (Toor, 2009). Several studies found that the available phosphorus content of soils is affected by many factors including parent material, weathering and climatic conditions (Fuentes *et al*., 2008) as well as soil pH, organic matter content, texture (Verma, 2013), and calcium carbonate content (Hopkins and Ellsworth, 2005). Generally, studies of the soils on both sides of Sohag–Safaga highway in the Eastern desert, Egypt are rare, so this study aims to evaluate the soil quality and phosphorus status of the land resources on both sides of Sohag–Safage highway, the Eastern desert.

2. Materials and methods

2.1 The study area

The Eastern Desert is located in the area between the Red Sea coast and Suez Gulf in the east and the Nile Valley in the west. Its area is about 223,000 km^2 and represent 21% of the total area of Egypt (El-Amier and AbdulKader, 2015). The study area is located between longitudes of 32° 42 14.22" to 33° 11 36" E and latitudes of 26° 39 42.42" to 26° 40 7.80" N. It is located in the eastern desert of Egypt in the north of the proposed Golden Triangle and about 135 km from Sohag city and about 83 km from Safaga city (Figure 2).

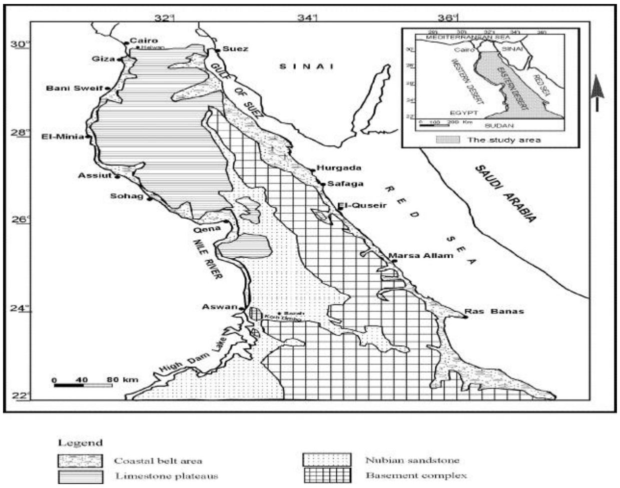

Figure (1): The geological map of the Eastern desert, Egypt (Abdel Moneim, 2005).

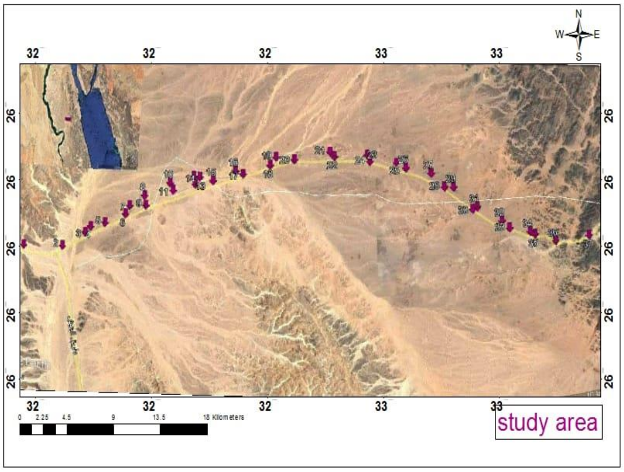

Figure (2): The location map of soil profiles of the study area.

2.2 Soil sampling

Thirty-seven soil profiles were selected to cover the study area. They were dug and morphologically described. The locations of these soil profiles were recorded in the field using the global positioning system (GPS). The distance between each two successive soil profile was about 2 km. The study area extended from the intersection of Sohag –Qena-Safaga highway to 54 km on both sides toward Safaga city. One to four soil samples were collected from each profile according to the vertical morphological variations using the guidelines of Soil Survey Staff (1998). They were collected in October 2017. They were air-dried, crushed, passed through a 2 mm sieve, and kept for analysis.

2.2 Soil analysis

The particle size distribution of the soil samples was a determination by the international pipette method, as described by Richards, (1954) and Jackson, (1969). The soil organic matter (OM) content of the surface soil samples was determined using the Wakley and Black method (Jackson, 1973). The total soil calcium carbonate content is estimated by a volumetric calcium carbonate calcimeter (Nelson, 1982). Soil pH was measured in 1:2.5 (soil: distilled water) suspension using a glass electrode. The electrical conductivity (EC) of the soil samples was determined in 1:1 of soil to water extracts using an EC meter (Jackson ,1973). The ECe of each soil sample was calculated using soil water saturation percentage as follow: ECe = ($EC_{1:1}$ ×100) / saturation percentage. The available phosphorus in the soil samples was extracted using 0.5 M $NaHCO_3$ at pH 8.5 according to Olsen et al., (1954) and then it was determined spectrophotometer using the NH_4. molybdate and stannous chloride method according to Jackson (1973).

3. Results and Discussion

3.1 Elevation

The elevation of the area under study was determined by the GPS. It ranges from 207 to 410 m above sea level (Table 1). It increases at the interaction of Sohag-Qena-Safaga toward Safaga city where the valley ended by the igneous rocks of the Red Sea Mountain chains.

3.2 Particle size distribution

The study area is characterized by a coarse texture of sand, loamy sand, and sandy loam. However, most of the studied soil samples are sand. About 90.70% of the study area have a sand texture while the loamy sand and sandy loam textures represent 8.14 and 1.16%, respectively, of the studied area (Table 1). In most profiles, the sand content increases with depth. The sand content of these soils varies from 62.8% (site 3) to 98.8% (sites 6 and 13), with an average sand content of 91.6%. The lowest silt content (0.4%) is recorded for the subsurface layer of profile 13 but the highest content (35.6%) is for the subsurface layer of site 3 with an average silt content of 7.4%. The clay content in the soil samples under the study is negligible. The lowest and highest clay content (0.4 and 2.8%, respectively) are for in the surface layer of site 3. Only, seven samples are loamy sand which four of them are in the first three profiles in the lower part of the area at an elevation of 207 m (a.s.l), that it may be attributed due to the effect of the flash floods which is known in the area pushing which wash the fine particles toward the bottom of the area (profiles 1, 2, and 3). The texture in most soils of the Eastern desert was reported to varied from sand, sandy loam, loamy sand, loam, and clay loam (Elbeih *et al.*, 2011).

Table (1): Location, elevation, particle size distribution and saturation percentage of the studied soils around Sohag-Safaga highway, Eastern Desert, Egypt.

Profile No.	Location		Elevation (m)	Depth (cm)	Particle Size distribution (%)			Texture grade	Saturation percentage (%)
	Longitude	Latitude			Sand	Silt	Clay		
1	32 42 14.22	26 39 42.3	216	0-25	88.8	10.4	0.8	Sand	20.8
				25-40	81.6	17.2	1.2	Loamy Sand	29.2
				40-200	94.0	5.6	0.4	Sand	23.8
2	32 44 28.62	26 39 53.22	207	0-15	84.4	14.8	0.8	Loamy Sand	27.4
				15-90	89.2	10.0	0.8	Sand	29.1
				90-150	75.6	23.6	0.8	Loamy Sand	27.7
3	32 45 40.26	26 40 35.76	207	0-20	92.4	6.4	1.2	Sand	22.2
				20-70	62.8	35.6	1.6	Sandy Loam	27.4
				70-150	77.8	20.8	1.4	Loamy Sand	24.8
4	32 45 55.2	26 40 52.92	209	0-90	94.0	5.2	0.8	Sand	20.9
				90-150	98.0	1.6	0.4	Sand	25.0
5	32 46 40.98	26 41 6.54	214	0-20	86.4	12.4	1.2	Sand	20.4
				20-70	97.6	1.6	0.8	Sand	23.6
				70-150	97.6	2.0	0.4	Sand	22.5
6	32 47 44.58	26 41 34.08	221	0-25	96.8	2.8	0.4	Sand	24.6
				25-80	98.4	1.2	0.4	Sand	26.3
				80-150	98.8	0.8	0.4	Sand	23.7
7	32 47 55.02	26 41 57.54	224	0-60	90.8	8.8	0.4	Sand	24.2
				60-150	84.8	14.4	0.8	Loamy Sand	24.5
8	32 48 40.62	26 42 27.24	229	0-50	95.6	3.6	0.8	Sand	23.5
				50-150	96.8	2.8	0.4	Sand	22.9
9	32 48 48.12	26 42 1.08	227	0-60	87.6	11.2	1.2	Sand	19.0
				60-100	96.8	2.8	0.4	Sand	21.1
				100-120	93.6	6.0	0.4	Sand	32.9
				120-150	96.4	3.2	0.4	Sand	20.6
10	32 49 58.92	26 43 4.92	235	0-60	89.2	9.6	1.2	Sand	21.2
				60-150	97.6	1.6	0.8	Sand	20.4
11	32 50 10.32	26 42 45.72	235	0-40	92.4	7.2	0.4	Sand	22.1
				40-80	96.8	2.4	0.8	Sand	20.5
				80-120	94.0	5.6	0.4	Sand	27.3
12	32 51 12.54	26 43 26.46	242	0-60	96.4	2.4	1.2	Sand	21.0
13	32 51 19.2	26 43 4.8	245	0-40	98.0	1.6	0.4	Sand	28.0
				40-80	98.4	0.4	1.2	Sand	22.0
				80-120	98.8	0.8	0.4	Sand	26.3
14	32 51 31.44	26 43 24.54	241	0-50	91.6	7.6	0.8	Sand	22.0
				50-70	96.0	2.8	1.2	Sand	18.8
				70-150	94.4	4.4	1.2	Sand	25.5
15	32 52 13.38	26 43 15.6	247	0-30	96.0	2.8	1.2	Sand	24.2
				30-100	96.8	2.8	0.4	Sand	31.2
				100-150	96.8	2.0	1.2	Sand	23.2
16	32 53 21.66	26 43 43.62	248	0-30	91.6	7.2	1.2	Sand	16.9
				30-100	88.0	10.8	1.2	Sand	19.0
17	32 53 46.56	26 43 35.22	249	0-40	96.4	2.8	0.8	Sand	18.6
				40-80	94.8	4.8	0.4	Sand	19.5
				80-150	96.8	1.6	1.6	Sand	27.5
18	32 55 10.56	26 44 0.48	259	0-60	92.0	6.0	2.0	Sand	20.3
				60-120	90.0	9.2	0.8	Sand	20.7
				120-200	95.2	4.0	0.8	Sand	27.3
19	32 55 28.5	26 44 22.62	261	0-60	96.0	3.2	0.8	Sand	26.5
				60-150	95.6	3.6	0.8	Sand	20.0
20	32 56 26.1	26 44 15.54	261	0-60	86.0	12.4	1.6	Sand	19.1
				60-150	94.4	4.8	0.8	Sand	19.1
21	32 58 16.56	26 44 36.6	276	0-30	87.6	10.4	2.0	Sand	19.3
				30-150	94.8	4.8	0.4	Sand	21.4

***** m above sea level.

Table (1): Continued.

Profile No.	Location		Elevation (m)	Depth (cm)	Particle size distribution (%)			Texture grade	Saturation percentage (%)
	Longitude	Latitude			sand	Silt	Clay		
22	32 58 29.46	26 44 23.88	276	0-60	89.6	8.8	1.6	Sand	18.2
				60-120	89.6	10.0	0.4	Sand	23.2
				120-200	87.2	12.0	0.8	Sand	24.8
23	33 00 11.82	26 44 26.52	295	0-60	77.6	19.6	2.8	Loamy Sand	19.4
				60-150	91.2	7.6	1.2	Sand	24.7
24	33 00 19.8	26 44 8.64	294	0-30	86.8	11.6	1.6	Sand	15.3
				30-150	90.4	8.8	0.8	Sand	20.2
25	33 01 42.18	26 44 5.76	309	0-60	88.4	9.6	2.0	Sand	20.2
				60-150	94.8	4.0	1.2	Sand	25.9
26	33 02 12.12	26 43 48.06	309	0-60	86.0	13.2	0.8	Sand	19.1
				60-200	91.6	7.2	1.2	Sand	23.3
27	33 03 30.72	26 43 30.72	324	0-100	90.4	8.0	1.6	Sand	22.0
				100-200	92.0	7.6	0.4	Sand	23.4
28	33 04 8.1	26 42 51.9	328	0-150	90.4	8.8	0.8	Sand	18.6
29	33 04 36	26 42 50.82	330	0-70	81.6	17.6	0.8	Loamy Sand	19.5
				70-140	89.6	10.0	0.4	Sand	22.4
				140-200	93.6	6.0	0.4	Sand	23.0
30	33 05 30.06	26 41 48.06	341	0-200	93.6	5.2	1.2	Sand	21.7
31	33 05 45.06	26 41 53.46	344	0-30	86.0	12.4	1.6	Sand	17.1
				30-90	93.6	5.6	0.8	Sand	21.1
				90-150	92.0	6.8	1.2	Sand	25.2
32	33 06 58.86	26 41 11.52	357	0-60	87.2	10.8	2.0	Sand	22.0
				60-200	91.6	7.6	0.8	Sand	22.0
33	33 07 20.52	26 40 51	358	0-80	89.2	9.2	1.6	Sand	21.0
				80-200	94.0	4.8	1.2	Sand	21.0
34	33 08 24.18	26 40 36.96	372	0-60	88.0	9.6	2.4	Sand	19.5
				60-150	88.4	10.4	1.2	Sand	23.6
35	33 08 38.04	26 40 27.96	376	0-60	94.4	4.8	0.8	Sand	22.7
				60-150	90.8	8.8	0.4	Sand	27.3
36	33 09 42	26 40 4.5	393	0-80	95.2	3.6	1.2	Sand	20.1
				80-200	96.8	0.8	2.4	Sand	23.9
37	33 11 36	26 40 7.8	410	0-150	93.2	5.2	1.6	Sand	22.1
Minimum			207		62.8	0.4	0.4		15.3
Maximum			410		98.8	35.6	2.8		32.9
Average					91.6	7.4	1.0		22.7

***** m above sea level.

3.3 Organic matter

Organic matter (OM) plays an important role in soils and has positive effect on the other soil properties. The organic matter content of the surface layer in the investigated area, in general, is very low which is less than 0.5 % (Table 2) according to Baruah and Barthakur, (1997). The low content of organic matter in all this area is expected due to the poor natural vegetation cover and the prevailing dry climate. Elbeih *et al.* (2011) found that the organic matter content of the soils of the Eastern Desert is very low because of the high temperature and low rainfall throughout the year.

Table (2): Some chemical properties of the soils under study.

Profile No.	Depth (cm)	Organic matter (%)	$CaCO_3$ (%)	pH (1:1) Susp.	EC (1:1) Ext.	ECe (dS m^{-1}) Ext.	Available phosphorus (mg kg^{-1})
1	0-25	0.084	36.0	7.63	3.63	17.45	3.6
	25-40		37.0	7.77	16.73	57.29	3.8
	40-200		36.0	7.45	12.43	52.23	3.3
2	0-15	0.252	27.7	7.96	0.93	3.40	3.8
	15-90		29.2	8.17	0.46	1.58	2.8
	90-150		17.3	8.07	0.81	2.93	4.3
3	0-20	0.285	17.8	7.88	4.54	20.45	4.5
	20-70		20.0	7.58	22.40	81.75	3.4
	70-150		18.9	7.93	1.99	8.02	3.9
4	0-90	0.017	7.8	8.11	2.47	11.82	8.9
	90-150		9.4	8.22	0.59	2.34	3.4
5	0-20	0.285	8.8	8.29	1.13	5.53	5.2
	20-70		1.6	8.26	1.39	5.89	5.2
	70-150		1.0	7.69	2.19	9.73	7.1
6	0-25	0.168	10.1	7.84	2.69	10.93	9.3
	25-80		9.1	7.88	0.98	3.72	5.2
	80-150		36.3	8.14	0.61	2.57	4.8
7	0-60	0.050	6.6	7.89	2.01	8.31	6.3
	60-150		10.4	7.91	8.25	33.67	3.8
8	0-50	0.017	17.2	8.24	0.44	1.88	5.2
	50-150		11.4	8.28	0.40	1.72	11.5
9	0-60	0.252	34.7	7.92	6.08	32.00	6.8
	60-100		8.9	7.63	5.20	24.64	5.6
	100-120		31.4	7.47	5.10	15.50	8.5
	120-150		12.2	8.15	0.30	1.43	5.1
10	0-60	0.034	11.7	8.12	2.51	11.84	5.0
	60-150		16.8	7.94	1.81	8.86	9.2
11	0-40	0.084	38.8	8.16	1.15	5.19	6.9
	40-80		11.4	7.75	0.45	2.18	4.1
	80-120		22.3	7.7	0.63	2.32	6.1
12	0-60	0.017	4.2	8.14	2.22	10.57	8.9
13	0-40	0.084	2.0	8.23	5.88	21.00	4.8
	40-80		2.3	8.04	7.64	34.73	3.2
	80-120		3.8	8.01	7.84	29.81	4.5
14	0-50	0.050	9.6	8	5.51	25.05	7.1
	50-70		5.0	7.99	5.21	27.71	4.5
	70-150		9.7	7.75	8.03	31.49	3.0
15	0-30	0.050	3.6	8.17	1.55	6.39	5.9
	30-100		12.0	8.63	1.13	3.63	6.5
	100-150		29.4	7.96	0.32	1.37	4.9
16	0-30	0.017	11.9	8.02	0.33	1.93	6.0
	30-100		11.9	7.71	0.66	3.49	3.4
17	0-40	0.017	23.4	8.23	1.25	6.69	5.4
	40-80		20.0	8.06	1.44	7.36	7.2
	80-150		11.6	8.01	0.34	1.23	5.5
18	0-60	0.017	8.6	8.2	1.72	8.46	5.3
	60-120		5.8	7.87	3.00	14.49	4.6
	120-200		2.1	7.85	1.63	5.97	3.2
19	0-60	0.118	13.9	8.29	0.39	1.48	15.7
	60-150		6.8	8.08	0.40	2.00	4.9
20	0-60	0.067	21.1	8.49	2.13	11.15	7.3
	60-150		2.0	7.89	2.24	11.73	8.2
21	0-30	0.101	15.2	8.17	2.29	11.87	4.3
	30-150		3.3	7.81	4.57	21.36	8.4

Table (2): Continued.

Profile No.	Depth (cm)	Organic matter (%)	$CaCO_3$ (%)	pH (1:1) Susp.	EC (1:1) Ext.	ECe (dS m^{-1}) Ext.	Available phosphorus (mg kg^{-1})
22	0-60	0.067	4.8	8.23	0.46	2.51	5.9
	60-120		1.4	7.88	2.09	9.01	4.6
	120-200		0.7	8.55	0.53	2.13	8.2
23	0-60	0.034	29.9	8.1	4.53	23.35	5.2
	60-150		1.5	7.62	6.99	28.30	7.4
24	0-30	0.067	15.8	7.99	0.80	5.21	5.5
	30-150		1.3	8.32	0.24	1.17	5.0
25	0-60	0.017	4.2	8.02	1.98	9.78	9.9
	60-150		2.1	7.57	4.86	18.76	13.5
26	0-60	0.050	5.4	8.04	2.23	11.68	7.9
	60-200		1.3	7.56	2.93	12.58	8.5
27	0-100	0.017	2.6	8.18	0.26	1.18	5.0
	100-200		1.8	8.66	0.36	1.54	7.2
28	0-150	0.050	6.8	7.73	4.08	21.94	7.7
29	0-70	0.017	27.9	7.76	5.20	26.67	5.9
	70-140		2.0	7.62	4.20	18.75	5.3
	140-200		0.7	7.89	0.79	3.43	10.1
30	0-200	0.084	3.8	7.81	9.43	43.46	7.1
31	0-30	0.050	16.8	8.51	0.41	2.37	16.3
	30-90		13.4	8.49	0.65	3.09	7.2
	90-150		12.5	7.82	1.74	6.89	4.4
32	0-60	0.118	15.8	8.14	1.74	7.89	3.9
	60-200		2.0	7.7	5.94	27.00	4.2
33	0-80	0.084	11.6	7.9	3.34	15.90	7.7
	80-200		5.1	7.71	3.79	18.05	3.9
34	0-60	0.017	17.5	8.33	0.69	3.53	6.6
	60-150		2.6	7.53	16.03	67.92	5.0
35	0-60	0.067	16.3	8.04	1.80	7.92	4.1
	60-150		6.2	7.46	10.38	38.02	13.5
36	0-80	0.017	1.8	8.1	0.33	1.62	4.4
	80-200		0.9	8.26	0.27	1.11	3.7
37	0-150	0.050	0.4	7.83	0.38	1.72	4.4
Minimum		0.017	0.4	7.45	0.236	1.11	2.8
Maximum		0.3	38.8	8.66	22.4	81.8	16.3
Average		0.08	12.02	7.99	3.2	13.87	6.15

3.4 Total calcium carbonate ($CaCO_3$)

The calcium carbonate content of the studied soils ranges from 0.4% to 38.8% with an average value of 12.2% (Table 2). The surface layer has a relatively higher calcium carbonate content than the subsurface ones in most soil profiles. According to FAO (2006), about 17.44 % of the investigated soil samples are slightly calcareous ($CaCO_3$ is 0-2%), 33.72% of them are moderately calcareous, ($CaCO_3$ is 2-10 %), 34.88 % of these samples are strongly calcareous ($CaCO_3$ is 10-25%), and 13.95 % of the samples are extremely calcareous ($CaCO_3$ >25%). The distribution of calcium carbonate in the studied soils is present in Figure (3).

3.5 Soil pH

The soil pH of the studied soils is shown in Table (2) and Figure (4). The soil pH values of samples under study vary from 7.45 to 8.66. According to Soil Survey Division Staff, (1993), about 30% of soil samples have slightly alkaline pH (7.4-

7.8), 63% of these samples have moderately alkaline pH (7.9-8.4), and a few samples (7%) have is strongly alkaline pH (8.5-9).

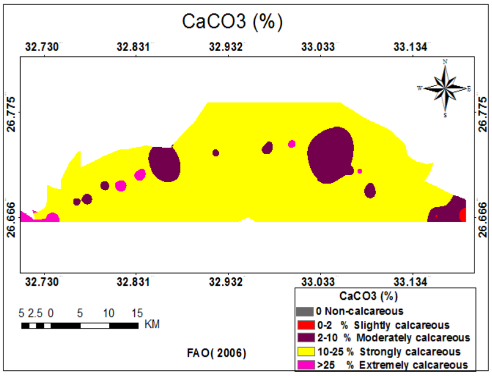

Figure (3): The variation in the soil calcium carbonate ($CaCO_3$) content of the study area according to FAO (2006).

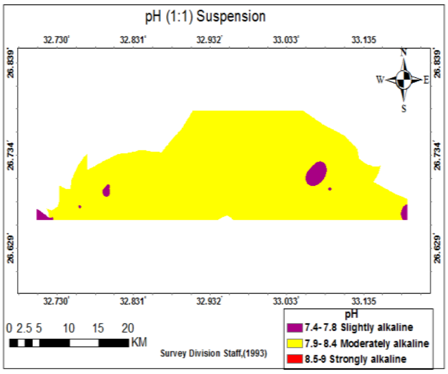

Figure (4): Distribution of soil pH in the study area. according to Soil Survey Division Staff (1993).

Elbeih *et al*. (2011) indicated the soil pH in the Eastern Desert generally ranged from neutral pH of 7.1 to a moderately alkaline pH of 8.2.

3.6 Electrical conductivity (ECe)

The ECe values of investigated soil samples change from 1.11 to 81.8 dS m^{-1}, with an average value of 13.87 dS m^{-1} (Table 2). The lowest ECe value was found in the deepest layer of profile 36, while the highest one was observed in the subsurface layer of profile 3. According to Soil Survey Division Staff (1993), about 16% of soil samples are non-saline (ECe < 2 dS m^{-1}), 19% of them are very slightly saline (ECe = 2 - 4 dS m^{-1}), 14% of the studied soils are slightly saline (ECe = 4 - 8 dSm^{-1}), 20 % are moderately saline (ECe = 8 - 16 dSm^{-1}) and 30% are considered strongly saline (ECe ≥16 dSm^{-1}) (Figure 5). Therefore 35% of the investigated of the study area soil samples are less than 4 dS m^{-1}. Which are fair to be cultivated. A study carried but by Elbeih *et al*. (2011) showed that the soil salinity in the Eastern Desert differed from non-saline to extremely saline.

3.7 Soil available phosphorus (Olsen-P)

The results of the Olsen-P of the soil samples collected from the study area are shown in Table (2). The available phosphorus (P) content of these samples varies from 2.8 to 16.3 mg kg^{-1} with an average level of 6.15 mg kg^{-1}. The lowest available phosphorus level is found in the subsurface layer of profile 2, whereas the highest one is in the surface layer of profile 31. Olsen and Sommers (1982) suggested that the soils which contain the Olsen-P of < 5 mg kg^{-1} respond, 5–10 mg kg^{-1} probably respond, >10 mg kg^{-1} unlikely respond to added P fertilizers.

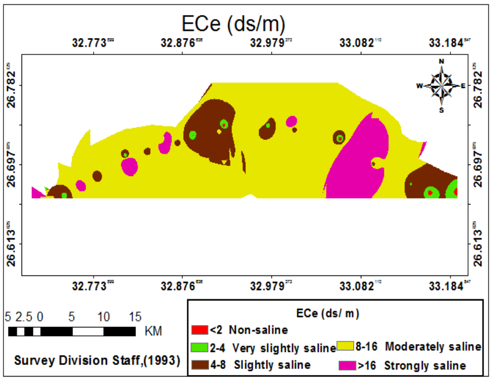

Figure (5): Distribution of electrical conductivity values of the soils under study according to Soil Survey Division Staff (1993).

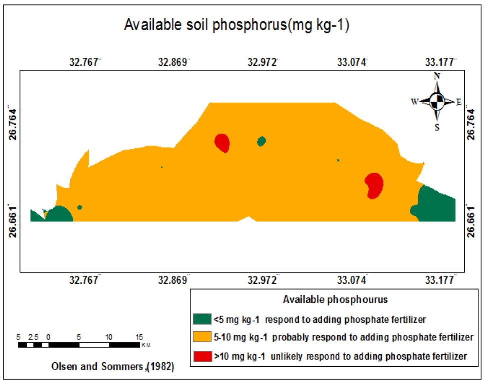

Figure (6): Available phosphorus distribution of the soils of the study area according to Olsen and Sommers (1982).

Accordingly, about 38.4% of the soil samples show low available P levels that are less than 5 mg kg^{-1}. However, most of these soil samples (about 54.7%) have available P values of 5 - 10 mg kg^{-1}, while only 7% of them contain >10 mg kg^{-1} of available P (Figure 6).

4. Conclusion

In study area around the Sohag-Safaga highway in the Eastern Desert was chosen to be evaluated due to the scarcity of studies on this part. Low organic matter contents in all soil samples of the study are expected due to its poor natural vegetation cover and the prevailing dry climate. Most of the studied soil samples had moderately alkaline pH values. The soil salinity in the studied soils varied from non-saline to strongly saline. From this a recent study, about 54.7% of the soil samples probably respond to adding phosphate fertilizers as the available P values vary from 5 - 10 mg kg^{-1}. So, it is recommended that the organic manure and phosphate fertilizer should be applied to the soils under study to improve their fertility.

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