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Influence of Land Use in Some Quseir Shale Derived Soils in Dakhla and Kharga Oasis, Egypt

I.S. Rahim and G.W. Ageeb
Soils and Water Use Deptartment, N.R.C., Dokki, Cairo. Egypt.

FOUR SOIL profiles have been selected from virgin Quseir shale, in Balat village at Dakhla oasis and Bedkhlo village at Kharga oasis. Another four cultivated profiles with field crops and/or vegetables, through about 25 years, from the same areas have been sampled.

Texture analysis, total and type of salts. O.M.. $CaCO_3$, gypsum and trace elements status (Fe, Mn, Zn and Cu) have been determined. Field observations and analytical analyses proved that distinct changes have occurred on this shale derived soils. The Halic Haplotorrerts have been developed to Typic Haplotorrerts in certain locations. Total soluble salts are higher in the virgin shales compared with the cultivated sites. The DTPA extractable trace elements from the cultivated shales were higher than those of the virgin shales, with the exception of Zn in virgin shale (profile no. 3). Zn and Cu represent the co-precipitate with Fe and Mn oxides, which are higher in cultivated shale particularly in the surface layers. Surface horizons included more DTPA-extractable trace elements due to the enrichment with organic residues and chemical fertilizers additions in cultivated shales. The amorphous MnO (Mn-DCB extracts) are high in virgin shales, while there is no difference between Fe_2O_3 (Fe-DCB extracts) contents in both types of shales.

keywords : Virgin and cultivatad Quseir Shale. Egypt. Extractable trace elements,Amorphous oxides.

The objective of this study is to show the influence of land use for about 25 years on the development of Quseir shales in The New Valley and their content of available trace elements.

Ageeb (1999) studied the distribution and characteristics of different shale deposits in Egypt and concluded that there are nine types of shales distributed over approximately 41484 km^2 of Egypt mostly at the western desert and some parts of eastern desert. Quseir Formation cover about 3137 km^2, from the previous area, which mostly located in Dakhla, Kharga oasis and Idfu at Aswan.

Said (1990) reported that these Quseir shales were formed after deposition of Campanion deposits, which covers most of the upland along Dakhla and Kharga oasis. Quseir shale is believed to have deposited during the Campanion epoch, approximately 84-74 million yr. Soils formed in the Quseir sediment, therefore are older than 74 million yr.

The distribution of Fe, Mn, Zn and Cu in alluvial profiles in Haryana (India)were studied by Kudeep *et al.* (1990). They found that available Fe, Mn and Zn were high in the surface horizons and decreased with depth, while Cu showed no regular distribution pattern. Labib and Rahim (1998) compared the content of Fe, Mn, Zn and Cu in virgin and cultivated salt affected soils and they concluded that total Fe and B are higher in the saline soils. While total Zn and Cu showed reverse trend as they have higher concentration in the reclaimed soils, total Mn had a limited increase in the cultivated soils compared to the virgin saline soils.

Material and Methods

Four soil profiles (from no.1 to 4) representing virgin shale deposits from the following locations: Balat village, Bedkhulo village at Dakhla oasis, Kharga district and El-Sherka Waheed at Kharga oasis, respectively. Another four profiles (from no. 5 to 8) have been sampled from the same areas under cultivation for about 25 years with: maize, tomato, rice and date palm, respectively (Fig. 1). Also four water wells samples representing the study areas were collected.

The representative profiles were described in the field according to FAO guidelines (1990). The collected samples were subjected to the following determinations according to USDA (1991).

Grain-size distribution and texture class, soil reaction (pH) of soil-water suspension (1:2.5), EC (dSm^{-1}) and ion species concentration of soil paste

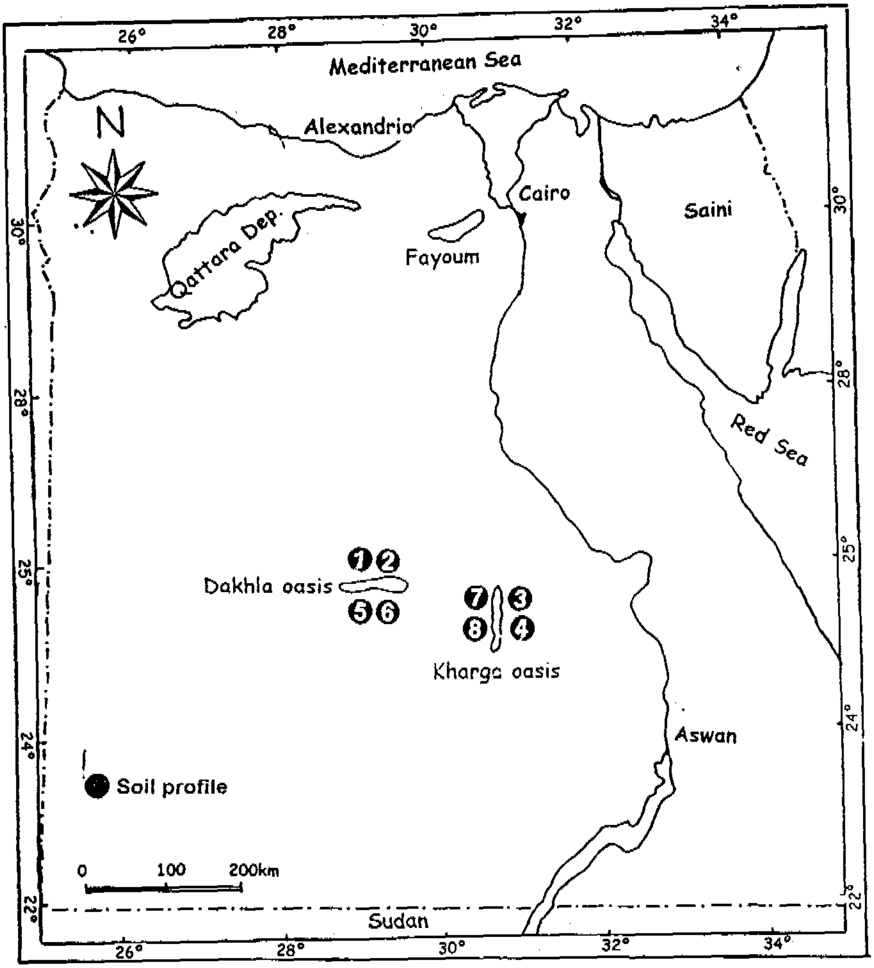

Fig. 1. The location of the studied profiles in the NewValley.

extract. Organic matter, calcium carbonate and gypsum percentages. Free oxides (Fe_2O_3 and MnO) extracted by dithionite-citrate-bicarbonate buffer solution (DCB) and DTPA-TEA extraction as available form (Fe, Mn, Zn and Cu). The studied profiles were classified to the subgreat group level according to USDA soil taxonommy (Soil Survey Staff, 1999).

Results and Discussion

The virgin shale profiles were lacking to any natural vegetation. The morphological criteria of the profiles are recorded in Table 1. The studied sites have a deep profile (>150cm). The differentiation of profile layers is not an easy task and subdivisions are largely based on variations in structure and / or colour. Therefore, A/C horizon sequence is most common in virgin shales. Concerning soil colour, most profiles have 2.5 YR hue, value between 3 and 7, and chroma between 4 and 8. The cultivated profile (no. 6) have a 5 YR hue, value 7 and chroma 3 to 5. Also, the surface layer of two virgin profiles (no. 1 and 4) and the surface layer of the cultivated profile (no.8) have the same hue degree with different value and chroma degrees, under dry conditions. Variegated colour that is predominant in Quseir Formation is present in the subsurface layer of virgin shale (profile no.2). Mottling characteristics producse olive or brownish patches of different sizes due to iron and manganese status, and its content. The structure of these virgin and cultivated shales is generally coarse subangular blocky and/or blocky. Prismatic structure is present only as subsurface layer of the virgin shales (profile no.3) and not present in the cultivated shales. Virgin shales were very hard and hard in dry conditions and some layers were slightly hard. The opposite is present with the cultivated shales where the dominant consistence is slightly hard and some layers was hard. Boundary of the surface layers was clear and diffuse in the virgin shales and gradual in maize profile (no.5) and tomato profile (no.6), clear in rice profile (no.7) and diffuse in date palm profile (no.8) .

Data in Table 2 indicate that total soluble salts in these profiles range between 2.23 and 18.0 dS/m in the surface layer of profile 4 in Bedkhulo at Dakhla oasis.

According to USDA soil taxonomy (Soil Survey Staff, 1999), profiles No.1,2 and 3 are classified as Typic Haplotorrerts, profile no.4 at Bedkhulo,the salt content is between 8.0 to 18.0 dS/m which satisfy the requirements of Halic Haplotorrerts.

The various management practices have been carried out on some areas of virgin shale derived soils at Balat, Bedkhulo, Kharga district and El-Sherkaa Waheed at Dakhla and Kharga oasis. Those areas have been cultivated for about 25 year with crops such as rice (limited areas were grown with rice for the local consumption), maize and vegetables (tomatoes and potatoes). The morphological features of these profiles show the formation of the plough layer Ap as a result of continuous cultivation. rich with root and plant residues and decomposed organic materials. The boundaries between horizons are gradually/or clear wavy or irregular. Diffuse smooth boundary is also present. The profiles are deep (>150cm) and moderately drained.

TABLE 1. Morphological criteria of the studied Quseir shale.

Profile No.	Horizon	Depth (cm)	Munsell colour (dry)	Texture*	Structure♠	Dry consistence♣	Lower boundary#
				Virgin			
1	A/C1	0-30	5YR 7/6	C	sb	H	cw
	C1 o	30-70	2.5YR 7/6	C	sb	Sh	cw
	C2 o	70-150	2.5YR 6/6	C	b	Vh	
2	A/C1	0-20	2.5YR 7/6	C	sb	H	ci
	C1	20-80	2.5YR 6/6	C	sb	Vh	gw
	C2 o	80-90	variegated	C	b	Vh	as
	C3	90-150	2.5YR 5/6	C	b	Vh	
3	C1	0-40	2.5YR 5/4	C	m	Sh	ds
	C2	40-80	2.5YR 7/6	C	p	H	gw
	C3	80-120	2.5YR 7/7	C	p	H	
4	AC1	0-25	5YR 4/6	C	sb	Sh	ds
	C1	25-70	2.5YR 4/4	C	sb	H	cw
	C2	70-150	2.5YR 3/6	C	sb	H	
				Cultivated			
5°	Ap	0-20	2.5YR 6/4	C	sb	Sh	gw
	C1	20-50	2.5YR 7/4	C	sb	Sh	cw
	C2	50-150	2.5YR 7/5	C	sb	Sh	
	Ap	0-20	5YR 7/3	C	sb	Sh	gi
6°	C1/C2	20-60	5YR 7/4	C	sb	Sh	ci
	C2	60-80	5YR 7/5	C	sb	Sh	
	Ap	0-15	2.5YR 5/6	C	m	Sh	cw
7°	C1	15-50	2.5YR 5/8	C	sb	Sh	cw
	C2	50-150	2.5YR 5/8	C	sb	H	
	Ap	0-30	5YR 7/3	C	m	Sh	ds
8°	C1	30-60	2.5YR 5/6	C	sb	H	gw
	C2	60-130	2.5YR 5/7	C	sb	H	

* Texture abbrev. C = clay

♠ Structure abbrev.: m=massive; sb=subangular blocky; b= blocky; p=prismatic

♣ Dry consistence abbrev.: sh= slightly hard; h= hard; vh= very hard

Lower boundary abbrev.: a=abrupt; c=clear; g=gradual; s=smooth; w=wavy; i=irregular; d=diffuse (FAO, 1990).

° Profiles no. 5, 6, 7 and 8 are cultivated with maize, tomato, rice and date palm, respectively.

TABLE 2. Selected chemical properties of the studied virgin and cultivated profiles .

Profile_No	Location	Depth (cm)	Sand %	Silt %	Clay %	Texture	EC dS/m	pH	$CaCO_3$ %	Gypsum %	O.M.%
					Virgin						
	Balat	0-30	23.4	25.7	50.9	C	2.23	7.6	1.6	0.6	-
		30-70	27.0	16.7	56.3	C	2.75	7.7	4.3	1.3	-
		70-150	29.4	15.6	55.0	C	3.75	7.6	3.5	1.5	-
	Bedkhulo	0-20	12.5	30.4	57.0	C	3.78	8.0	0.8	-	-
		20-60	16.4	27.5	56.1	C	3.65	8.5	-	1.7	-
		60-90	17.7	28.6	53.7	C	2.69	8.5	0.8	3.2	-
		90-150	10.1	29.2	60.7	C	2.80	8.5	0.4	4.5	-
3	Kharga	0-40	17.7	21.5	60.8	C	4.62	7.5	2.0	-	-
		40-80	16.2	21.2	62.6	C	3.76	7.9	2.0	-	-
		80-120	19.8	14.8	65.4	C	2.53	8.0	0.8	-	-
4	El-Sherka	0-25	11.2	10.1	78.7	C	18.0	8.0	7.3	-	1.9
	Waheed	25-70	10.3	21.0	68.7	C	12.0	8.1	10.9	-	0.9
		70-150	11.4	13.0	75.7	C	6.0	8.1	12.0	-	0.8
					Cultivated.						
5	Balat	0-20	18.4	19.3	62.3	C	1.7	7.7	2.7	-	1.6
		20-50	8.9	16.6	74.5	C	1.9	7.8	3.1	-	1.0
		50-150	7.6	16.6	75.4	C	1.6	7.8	3.4	-	0.6
6	Bedkhulo	0-20	13.6	24.4	62.0	C	0.9	7.4	5.9	-	1.3
		20-60	15.0	20.0	65.0	C	1.2	7.4	3.5	-	0.9
		60-80	17.0	12.7	70.3	C	1.3	7.4	7.4	-	0.6
7	Kharga	0-15	26.0	16.7	57.3	C	0.9	8.0	5.5	-	1.8
		15-50	21.3	18.6	60.1	C	0.8	8.0	2.0	-	1.3
		50-150	27.2	18.9	53.9	C	1.0	8.2	2.2	-	1.0
8	El-Sherka	0-30	23.9	28.5	47.6	C	2.6	7.6	5.1	1.9	1.5
	Waheed	30-60	22.6	27.6	49.6	C	4.4	7.5	1.6	3.2	1.3
		60-130	17.6	29.1	53.1	C	4.7	7.5	1.8	4.7	1.1

The chemical properties (Table 2) indicate that pH values of virgin profiles are slightly higher than the corresponding values of the cultivated profiles. The lower values of pH are associated with the presence of gypsum (p.8).

The cultivated profiles have a relatively low content of soluble salts (from 0.8 to 4.7 dS/m). The distribution of salts by depth was heterogeneous, as salts accumulated in Cl and/or C2 due to imperfect drainage(profiles no.5, 6 and 8).

The heavy clay texture and massive structure at the soil surface followed by subangular blocky structure characterize the cultivated profiles at Kharga district and El-Sherka Waheed. The surface horizon Ap is relatively high in organic matter content.

The only source of irrigation water in the New-Valley is the wells. The chemical analysis of this irrigation water of the four tested wells (Table 3) shows that they contain low content of soluble salts (< 1.0 dS/m). The soluble iron range between 88.5-105.2 ppm. Irrigation water have high soluble iron coupled with low pH value (6.72) in Balat followed by Bedkhulo well water as 6.94.

TABLE 3. The chemical composition of the tested well water.

Location	pH	EC dS/m	Soluble cations meq/L				Soluble anions meq/L			Soluble iron & manganese (ppm)	
			Na^+	K^+	Ca^{++}	Mg^{++}	$HCO_3^- + CO_3^{--}$	Cl^-	SO_4^{-}	Fe	Mn
El-sherkaa	7.20	0.81	3.30	0.30	2.50	2.00	0.20	5.50	2.40	88.50	45.30
Khargha	7.07	0.71	3.00	0.30	2.00	1.80	0.20	4.10	2.80	90.20	50.50
Bedkhulo	6.94	0.24	1.00	0.10	0.80	0.50	0.10	1.50	0.80	100.80	53.40
Balat	6.72	0.27	1.10	0.10	1.00	0.50	0.10	1.60	1.00	105.20	70.00

The soluble iron is oxidized after short time and precipitates as ferric oxides, hydroxides and sulphates. The morphology of surface and subsurface horizons of cultivated profiles having rusty mottles. However, the culivated profiles have been strongly affected by iron compounds coming from irrigation water. Therefore, these profiles can be classified as Entic Haplotorrerts. Profile no.7 at Kharga district satisfy the requirements of Typic Haplotorrerts.

Changes in trace elements status (Table 4) show the available form of trace elements in virgin profiles compared to the cultivated sites. The obtained values of available Fe are exceptionally higher in the cultivated profiles, which may be due to the irrigation water as it is rich in that component which is easily precipitated in high amounts at the surface.

Available form of Zn and Cu (as DTPA extract) showed the same trend in the virgin profiles and cultivated profiles. Zn is exceptionally higher in cultivated profiles (P.5 and 6). The addition of agrochemical which contains Zn through cultivation practices, is the main cause of this increase. Concerning the available Mn, a limited increase in the cultivated profiles compared to the virgin profiles is occurred.

TABLE 4. The DTPA-extracted trace elements in virgin and cultivated profile (mg/kg).

Virgin						Cultivated					
Profile No.	Depth (cm)	Fe	Mn	Cu	Zn	profile No.	Depth (cm)	Fe	Mn	Cu	Zn
1	0-30	15.3	13.7	3.4	3.9	5	0-20	22.2	20.3	4.0	12.2
	30-70	16.9	16.5	4.0	4.0		20-50	14.9	15.6	3.9	4.7
	70-150	13.3	11.9	3.3	3.4		50-150	15.2	15.1	3.8	4.5
2	0-20	13.9	13.6	3.3	3.4	6	0-20	18.0	15.4	3.4	6.4
	20-80	13.5	11.5	3.2	3.5		20-60	15.9	14.3	3.5	4.4
	80-90	18.5	11.0	3.3	3.5		60-80	16.0	14.0	3.4	1.4
	90-150	14.1	13.2	3.4	3.5						
3	0-40	14.8	13.9	3.6	4.3	7	0-15	17.8	16.2	3.5	4.5
	40-80	13.8	12.7	3.4	3.7		15-50	15.4	14.2	3.4	3.7
	80-120	13.7	12.9	3.1	4.8		50-150	15.7	14.5	3.4	3.8
4	0-25	17.9	11.4	3.5	4.0	8	0-30	20.3	15.7	3.9	4.6
	25-70	16.5	13.4	2.9	3.7		30-60	18.3	13.6	3.4	4.5
	70-150	15.4	12.8	3.0	3.8		60-130	16.7	13.9	3.4	4.5

Data in Table 5 of the dithionite-citrate-bicarbonate extraction of Fe and Mn (calculated as Fe_2O_3 and MnO) show that the cultivated profiles contained higher level of Fe_2O_3 and MnO than the virgin profiles. The only source of irrigation water in the study area and New Valley as general is artisan water wells that affects chemically the soil properties.

These soils have been cultivated with some field crops and vegetables and irrigated with iron-rich ground water, which adds great amount of iron components to the surface and subsurface layers (Abd El-Hady, 1995).

TABLE 5. The DCB-extracted trace elements in virgin and cultivated profile (mg/kg).

Virgin				Cultivated			
Profile No.	Depth (cm)	Fe_2O_3	MnO	Profile No	Depth (cm)	Fe_2O_3	MnO
1	0-30	1304.1	121.5	5	0-20	1696.3	182.9
	30-70	1375.3	159.1		20-50	1659.2	171.0
	70-150	1380.5	176.6		50-150	1662.1	172.2
2	0-20	1440.7	230.2	6	0-20	1725.7	254.0
	20-80	1420.2	228.5		20-60	1651.7	249.8
	80-90	1083.6	202.9		60-80	1650.9	231.6
	90-150	1520.3	253.5				
3	0-40	1330.2	189.7	7	0-15	1743.6	229.4
	40-80	1341.5	199.3		15-50	1678.1	213.1
	80-120	1339.4	197.8		50-150	1692.2	216.1
4	0-25	2151.9	290.0	8	0-30	2421.3	372.4
	25-70	1710.6	315.0		30-60	1919.0	361.6
	70-150	1818.4	326.0		60-1[illegible]	[illegible]	[illegible].4

Amorphous iron (Fe_2O_3) ranges between 1304.1 and 2151.9 mg/kg in virgin shale profiles compared with 1696.3 and 2421.3 mg/kg in cultivated shales of the same location. The increase is due to the processes associated with cultivation practices,*i.e.* ploughing, irrigation at intervals lead to solubility through reduction and oxidation of iron and manganese forms and precipitate as amorphous compounds. This type of shale is rich in total iron as mentioned by Abu Zeid (1974) and associated with the dominating colour (5 YR 7/3, 4, 5 and/or 6)

Conclusion

The results of this study show the changes occurred in Quseir shale due to land use. Cultivated shales have a low soluble salts content comparing with virgin shales in the same area due to the leaching effect of irrigation water. For that there are highly promising areas for agricultural investment in the New Valley. Quseir shales at Kharga and Dakhla oasis have a slightly high amount of amorphous iron oxides and available Fe especially in cultivated shales, so that, it is called purple-red soils (Abdel Aal *et al.*, 1988). This amount is correlated well with the chemical composition of artisan irrigation water (cultivated shales) and the initial content of iron in the shales itself (cultivated and/or virgin shales). There is no variation in the available forms of Zn and Cu in both kinds of shales as a general. Concerning the available Mn, a limited increase in the cultivated profiles compared to the virgin profiles occurred.

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تأثير الاستخدام الزراعي على بعض الأراضي الطفلية بالواحات الداخلة والخارجة في مصر

إبراهيم سعيد رحيم و جميل وهيب عجيب

قسم الإراضى واستغلال المياه - المركز القومى للبحوث - القاهرة-مصر.

تم اختيار أربع قطاعات أرضية من طفلة القصير غير منزرعة فى الواحات الداخلة والخارجة وأربعة قطاعات أخرى منزرعة بمحاصيل الحقل والخضروات لمدة حوالى ٢٥ عام من نفس الأماكن.

أجريت التحليلات الأساسية مثل تقدير القوام وكميه ونوع الأملاح الذائبة والمادة العضوية وكربونات الكالسيوم والجبس وكذلك حالة العناصر الصغرى (الحديد - المنجنيز - الزنك والنحاس) .

وقد بينت الدراسات الحقلية ونتائج التحليلات المعملية حدوث تغيرات فى هذا النوع من الأراضى فقد تطورت أراضى Halic Haplotorierts إلى أراضى Typic Haplotorerrts فى بعض المواقع . الأملاح الكلية الذائبة كانت عالية فى الأراضى البكر بالمقارنة بالأراضى المزروعة . الصورة الميسرة للعناصر الصغرى كانت أعلى فى الأراضى المزروعة عنها فى الأراضى البكر . أكاسيد الزنك والنحاس تشترك مع أكاسيد الحديد والمنجنيز فى أنها مرتفعة فى الأراضى المزروعة خاصة فى الطبقة السطحية . ويرجع ارتفاع الصورة الميسرة للعناصر الصغرى فى الطبقة السطحية إلى غناها ببقايا عضوية وكذلك التسميد الكيماوى . أكاسيد المنجنيز الأمورفية كانت عالية فى الأراضى البكر بينما لا يوجد فرق بين أكاسيد الحديد الأمورفية فى كل من النوعين.