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IMPACT OF LAND USE PERIODS AND IRRIGATION WATER QUALITY ON SOME SOIL CHARACTERISTICS OF EGYPTIAN LACUSTRINE SOILS

Ragab, I. Fayed

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ABSTRACT

The current study was carried out to compare and analyze changes in lacustrine soil characteristics under different land use periods and irrigation water quality. The land use periods were 1, 2, 3, 4, 5, 10 and 20 years and irrigation waters were Nile and mixed. The salinity for irrigation waters (ECw) were 0.52 and 1.03 dS/m and alkalinity (SAR) were 1.43 and 4.58 for Nile and mixed waters, respectively. Eleven soil profiles were chosen to represent lacustrine soils located at El-Bosaily region South of Idko Lake. The results indicated that the soils were developed in the lacustrine deposits of Lake Idko characterized by clay texture, EC_e values ranged from 0.53 to 24.22 dS/m, SAR values widely varied (2.21 – 45.17), CEC values were moderated and vary from 29.0 to 37.8 cmol kg^-, organic matter content was low and varied between 0.43 and 1.35 % in the surface horizons of the studied profiles. Hydraulic conductivity and available water values ranged from 0.04 to 0.24 cm/hr and from 14.06 to 31.2%, respectively. Contents of available nitrogen, phosphorus and potassium in the surface horizons were in the range of 22.5–69.0, 1.17–2.65 and 1209–2365 ppm, respectively. Most of the cultivated soils tended to have relatively higher values of organic matter content, cation exchange capacity, silt%, hydraulic conductivity, available water and available N, P than virgin soils. The latter soils had higher values of EC_e, sodium adsorption ratio (SAR), total carbonate, bulk density (Db) and clay content in the surface horizons. Increasing the cultivation period caused a slight increase in the hydraulic conductivity, organic matter content, CEC and available N, K in the surface horizons, while Db values tended to decrease. EC_e clearly decreased in the first five years of cultivation, but SAR had opposite trend. Soils irrigated with mixed water (Nile + drainage water) have higher values of EC_e, SAR and available N, K in the surface horizon than those irrigated with Nile water. Organic matter content, pH, CEC, hydraulic conductivity and available water values had opposite trend. Results revealed that there is no effect of irrigation water quality on total carbonate content, available phosphorus, bulk density, grain size distribution and soil texture in the studied soils.

Key wards: Lacustrine soils, Land use period, water quality, soil characteristics.

INTRODUCTION

Agricultural security in Egypt depends largely on the horizontal expansion of sandy and saline soils at northern lakes. Agriculture sustainability in these soils is required to meet the urgent demand of food for the increasing population. Agriculture expansion in Egypt depends mainly on irrigation. Land management is useful for improving soil characteristics, and achieving the agriculture sustainability. Therefore, better soil management and conservation are essential to improve soil production and reduce soil degradation.

When putting a new land under cultivation, a lot of changes take place in its physical, chemical and biological properties. The productivity of any soil is directly related to the properties changed by cultivation for a specific period of time.

According to Fathi et al. (1971), the properties of the newly cultivated land are mainly affected by: 1- Physical and chemical properties of the original soil. 2- Depth of ground water and the efficiency of the drainage system. 3- Quality and availability of irrigation water. 4- Prevailing climate conditions. 5- Period of land use.

Many studies have been carried out to characterize lacustrine soils, among them, Labib and Sys (1970), El-Zahaby (1976), El-Husseiny et. al. (1985) and El-Husseiny et. al. (1988). They pointed out that lacustrine soils are salt- affected, stratified, poorly drained to water logged, heavy to light textured, poor in organic matter and $CaCO_3$, recent and underlain by shelly lagoonal or lake deposits.

El-Zahaby (1976) showed that the soluble salts content varied largely in the different deposits at Rosetta area. The highest salts content was found in the lacustrine deposits followed by marine deposits. Moreover, Na^+ and Cl^- are the major ions in all samples, while Ca^{++} followed by Mg^{++} are the minor cations in the flood plain and sand dunes. In contrast, Mg^{++} exceeds Ca^{++} in lacustrine and marine deposits.

Several studies have demonstrated the importance of soil management and its effect on soil characteristics. Noaman and Sheta (1988) found in their study on the irrigated dried parts of El-Manzala Lake that the surface soil salinity decreased after two years of cultivation and no clear changes in either texture or the contents of amorphous Si and Al occurred. Rabie et al. (1988) reported that addition of clay materials, organic matter and mineral fertilization through manipulation bears much to small changes in physical, chemical and mineralogical properties of the soils. According to Abou-Hussien (1999), the contents of both total and available N, P, K, Fe, Mn, Zn and Cu were increased with increasing cultivation period in some Kalioubiya soils. Beshay and Sallam (2001) found that the different land management practices affect root zone depth, soil texture, salinity and alkalinity, organic matter content and nutrient availability in the area lying between Ismailia canal and Cairo-Suez desert road.

Hamdi et al. (1968) reported that increasing SAR values of irrigation water remarkably increased the relative soluble Na^+ and decreased the soluble Ca^{++} and Mg^{++} in soil solution.

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The use of saline waters for irrigation leads to a marked accumulation of total soluble salts in soils (El-Sawaby and Abu-EL-Anine, 1977 and Abd-Allah, 1988).

The current study is carried out to shed the light on the changes in the soil characteristics that are expected to take place when virgin lacustrine deposits are cultivated for different periods using different irrigation water quality, at El-Bosaily region south of Idko Lake, Egypt.

MATERIALS AND METHODES

The studied area is located at the north-western part of the Nile Delta, which represent soils developed from lacustrine deposits at El-Bosaily village south of Idko Lake. It is bounded to the north and west by Idko Lake, to the south by El-Bosaily drain and to the east by Debono village (Map 1).

Eleven soil profiles were selected to represent soils different in land use periods and irrigation water quality as follow:

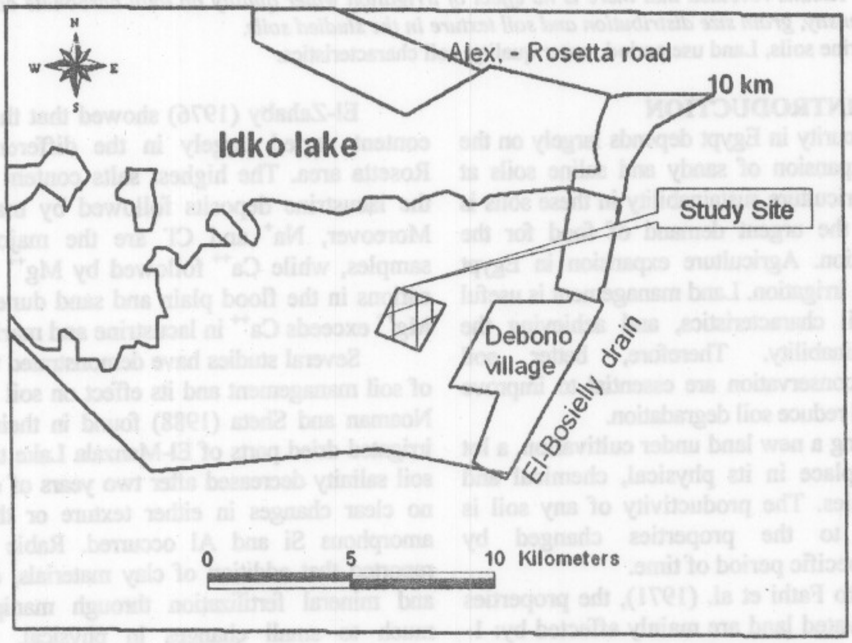
Profile 1 represented virgin land.

Profiles 2, 3, 4, 5, 6, 7 and 8 represented soils cultivated for 1, 2, 3, 4, 5, 10and 20years, respectively and irrigated by mixed water (Nile and drainage water).

Profiles 9, 10 and 11 represented soils cultivated for 5, 10 and 20 years, respectively and irrigated by Nile water

All profiles were morphologically described according to the system of FAO (1990). Soil samples were collected from the subsequent horizons according to morphological variations for laboratory analysis. These samples were air-dried, ground and passed through 2-mm sieve. The main chemical, fertility and physical properties of soils were determined according to the methods outlined by Jackson (1958), FAO (1970) and Page et al (1982).

Two water samples from irrigation canal (Nile water), and mixed water canal were collected every month for chemical characterization.



Map 1: Location of the Study Site

RESULTS AND DISCUSSION

Table (1) contains data pertaining to mean values of some chemical properties of irrigation waters in the study region (averages of 12 water samples).

Table (1): Mean values of chemical properties of irrigation water in the studied area

Irrigation W. source	pH	EC_w dS/m	SAR	Cations meq/L Ca^{++}	Mg^{++}	Na^+	K^+	Anions meq/L HCO_3	Cl^-	SO_4^{--}
Nile	7.06	0.52	1.43	1.6	1.8	1.86	0.22	2.0	2.0	1.2
Mixed	6.94	1.03	4.58	1.8	1.9	6.23	0.34	3.0	4.7	2.6

Nile and mixed water Evaluation

Data in table (1) showed that the mean values of EC_w of Nile water was 0.52 dS/m and its SAR value was 1.43. According to Richard's (1954), Nile water could be classified as C_2S_1, medium salinity low sodicity; for mixed water mean values of EC_w and SAR were 1.03 dS/m and 4.58 respectively, and could be classified as high salinity medium sodicity $C_3 S_2$. Consequently, Nile water was of good quality, whereas mixed water was of poor quality for irrigation.

Effect of land use periods and irrigation water quality on soil properties:

1- Chemical characteristics.

Salinity and soil reaction

Table (2) illustrated the data of total soluble salts, of the soil extract (1: 5). It appears that the EC_e values of the studied soils varied in a wide range from 0.53 to 24.2 dS/m. The virgin soils represented by profile (1) had the highest values of soluble salts (EC_e=17.65, 24.20 and 19.10 dS/m in three layers). This reflected the high soluble salts content of the parent material, as they formed from lake sediments. Regarding the profiles represent cultivated soils (from profile 2 to 11), EC_e values ranged between 0.53 and 14.05 dS/m. Generally, cultivation of lacustrine deposits causes EC_e values to decrease. This may be attributed to the leaching of soluble salts out of soil profile.

For evaluating the effect of land use period on soluble salts content, data indicated that EC_e values decreased with increasing land use period until about 5 years, and then tended to slightly increase (Table 2 and Fig. 1). The virgin soils had a highly EC_e, ranged from 17.65 to 24.2 dS/m. Irrigation with mixed water (EC_w=1.03 dS/m) caused a leaching of soluble salts out of the soil profile. From 1 to 5 years of cultivation, EC_e decreased to 2.01 dS/m (at the surface horizon) as a result of use of mixed water for irrigation. After 5 years, EC_e values were slightly increased in the studied soils. This may be due to continuous use of mixed water for irrigation and low efficiency of the drainage system. Similar results are obtained by Tiwari et al. (1995), and Abou Hussien, (1999).

Concerning, the effect of irrigation water quality on the soluble salts content, it was clear that the soils using mixed water for irrigation had a more pronounced effect in increasing EC_e values than Nile water under the same land use period. Comparison between profiles (6 and 9), (7 and 10) and (8 and 11) which representing soils cultivated for 5, 10 and 20 years, respectively, revealed such trend (Table 2 and Fig. 2). This may be due to the higher content of soluble salts in the mixed water (1.03 dS/m) than Nile water (0.52 dS/m), as shown in table (1). These results are in agreement with those obtained by Zein et al (2002). They reported that using poor water quality for irrigation increased EC and SAR values in soil past extract.

With respect to sodium adsorption ratio (SAR), the results show that SAR values were widely vary in the studied profiles and ranged from 2.21 to 45.17, as shown in table (2). The SAR values of profiles representing virgin and cultivated soils indicated that the cultivation caused a decreasing of SAR values. However, the cultivated soils have high values of SAR (6.40 - 12.03) in the surface horizons (Table 2). This may be due to use of poor water quality for irrigation.

The results indicate that there is no clear trend was observed between land use periods and SAR values in the studied soils particularly in the surface horizons (Table 2 and fig 3). This may be attributed to no application of gypsum to the investigated soils and consequently these soils may be conversion to sodic soils under these conditions.

Data illustrated in table (2) and fig. (4) indicate that the soils, which use Nile water for irrigation characterized by lower SAR values than mixed water. SAR values were 3.75, 2.21 and 2.74 in the surface horizon of profiles 9, 10 and 11, respectively which represent soils irrigated by Nile water. While they are 6.40, 11.86 and 8.96 in profiles 6, 7 and 8 respectively, which represent soils irrigated by mixed water and have the same land use period. This may be due to the higher SAR value in the mixed water compared with Nile water (Table 1).

PH values of the studied profiles vary in a wide range. The data in table (2) indicate that pH values of the studied profiles ranged between 7.56 and 9.03. However, it can be stated that there are no consistent trend in pH values changes due to different land use periods.

The soils, which use mixed water for irrigation tends to have relative lower pH value than Nile water at the same land use period, as shown in table (2). This trend is more pronounced in soil profiles which representing 20 year of cultivation. Similar results were obtained by Abd-Allah (1988) and Mostafa et al (1992). They found that a slight decreasing in soil pH as a result of increasing salinity of irrigation water.

Table (2): Effects of land use periods and irrigation water quality on some chemical properties of lacustrine soils

Profile No.	Depth cm	Land use Period(year)	pH (1:2.5)	EC (1:5) dS/m	SAR	Cations meq/L (1:5)				Anions meq/L (1:5)		
						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{-}
Virgin Soil												
P1	0-30	Virgin	7.90	17.65	25.58	18.0	26	120	1.1	1.6	142.3	24.4
	30-60		8.00	24.20	45.17	10.4	29	200.5	1.4	3.0	210.0	29.0
	60-75		8.78	19.1	33.56	17.4	22.3	149.5	1.2	2.2	165.0	23.8
Soils irrigated by Mixed water (drainage + Nile water)												
P2	0-25	1	8.20	7.65	12.03	8.0	20.0	45.0	1.1	1.6	50.5	24.4
	25-50		8.00	10.71	35.81	5.5	7.7	92.0	1.0	4.0	86.5	16.6
	50-95		7.97	14.05	25.04	15.0	25.0	112.0	1.0	2.6	32.5	105.4
P3	0-25	2	7.87	13.19	8.6	11.2	41.5	0.9	3.2	38.0	21.8
	25-50		7.56	7.76	21.28	5.4	5.2	49.0	1.0	2.4	57.5	17.7
	50-90		8.49	12.3	28.3	11.8	12.4	98.3	0.9	3.2	88.7	32.3
P4	0-25	3	8.62	3.01	8.80	2.2	2.1	12	0.4	3	14.5	12.6
	25-55		8.49	6.30	19.22	5.8	7.2	49.0	0.9	3.2	38.0	21.8
	55-85		8.39	4.22	20.51	1.6	2.4	29.0	0.8	2.4	28.0	11.8
	85-115		8.49	8.11	27.2	5.4	6.2	65.5	0.5	2.4	49	24.7
P5	0-25	4	8.96	2.39	8.7	2.3	3.6	15	0.3	2.4	12.6	8.9
	25-55		8.78	3.72	14.36	3.8	3.8	28.0	0.3	3.8	9.8	3.6
	55-85		8.66	4.16	18.3	3.3	3.5	33.7	0.4	5.4	16.5	17.2
	85-102		8.52	4.97	14.73	3.8	4.5	30.0	0.3	2.4	12.2	5.1
P6	0-25	5	8.1	2.01	6.40	3.4	3.8	12.2	0.2	3.8	4.2	4.1
	25-50		8.17	2.41	11.38	2.5	2.0	18.0	0.3	4.2	4.4	15.5
	50-85		8.34	3.10	11.44	3.8	3.6	22.0	0.2	4.6	3.2	23.2
	85-105		8.15	3.00	17.8	1.8	2.8	27.0	0.2	4.8	3.5	21.7
P7	0-25	10	8.26	2.45	11.86	2.0	3.0	18.8	0.4	4.2	12.9	7.4
	25-50		8.22	3.10	15.81	1.8	3.2	25.0	0.4	4.0	17.3	9.7
	50-90		7.90	4.27	18.17	3.2	3.6	33.5	0.5	5.4	26.2	11.1
P8	25-50	20	7.94	3.45	8.96	2.6	6.0	18.6	0.7	3.0	18.5	13.0
	50-75		7.64	5.17	10.70	7.2	6.0	27.5	1.0	2.4	22.5	26.8
	75-105		7.75	5.95	25.31	1.4	2.0	33.0	0.5	3.0	38.0	18.5
Soils irrigated by Nile water												
P9	0-25	5	8.25	1.35	3.75	2.2	4.0	6.6	0.3	5.8	4.0	3.7
	25-50		8.32	1.58	5.48	2.6	2.8	9.0	0.3	6.2	5.2	4.4
	50-100		8.21	2.25	7.43	2.9	4.2	14.0	0.4	6.4	10.0	6.1
P10	0-25	10	8.35	0.63	2.21	1.6	1.6	2.8	0.2	2.6	3.3	0.4
	25-50		8.37	0.55	2.28	0.8	1.8	2.6	0.2	2.4	2.5	0.6
	50-105		8.79	0.72	3.44	0.9	1.8	4.0	0.2	2.3	3.5	1.3
P11	0-25	20	8.22	0.53	2.74	1.0	1.4	3.0	0.1	3.0	1.9	0.4
	25-50		8.89	0.67	3.53	1.1	1.6	4.1	0.2	3.6	2.0	1.1
	50-105		8.88	1.20	4.54	2.1	2.8	7.1	0.1	5.2	4.3	2.5

Table (3): Effects of land use periods and irrigation water quality on some fertility properties of lacustrine soils

Profile No.	Depth cm	Land use Period(year)	Avalable (ppm) N	Avalable (ppm) P	Avalable (ppm) K	O.M %	CEC cmol/kg	$CaCO_3$ %
Virgin Soil								
P1	0-30		35.0	1.3	1287	0.43	30.2	4.5
	30-60							2.5
	60-75							4.0
Soils irrigated by Mixed water (drainage + Nile water)								
P2	0-25	1	22.5	2.7	1287	0.57	29.0	3.8
	25-50							2.7
	50-95							4.2
P3	0-25	2	35.0	2.4	1209	0.62	29.5	3.6
	25-50							3.0
	50-90							3.5
P4	0-25	3	45.0	1.5	1650	0.58	32.2	2.3
	25-55							3.5
	55-85							3.5
	85-115							3.7
P5	0-25	4	45.0	1.2	1287	0.82	31.5	2.0
	25-55							2.0
	55-85							3.2
	85-102							2.5
P6	0-25	5	64.0	1.0	1975	0.96	32.1	2.5
	25-50							2.0
	50-85							2.2
	85-105							2.0
P7	0-25	10	62.5	1.2	2184	1.20	32.85	2.6
	25-50							3.4
	50-90							1.2
P8	25-50	20	69.0	0.8	2365	1.15	34.0	1.8
	50-75							1.5
	75-105							4.0
Soils irrigated by Nile water								
P9	0-25	5	52.5	2.39	1287	1.12	32.60	3.1
	25-50							2.8
	50-100							3.5
P10	0-25	10	52.5	1.20	1780	1.28	33.55	2.6
	25-50							3.0
	50-105							
P11	0-25	20	62.5	1.50	1624	1.35	37.80	1.9
	25-50							3.3
	50-105							

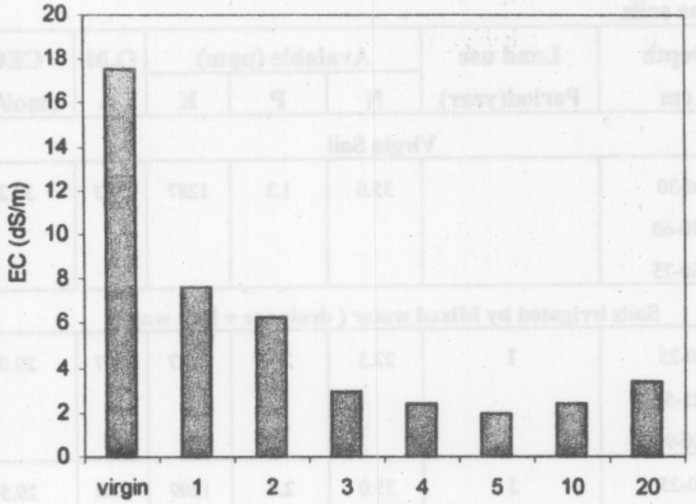


Fig (1): Effect of land use period on EC (dS/m)

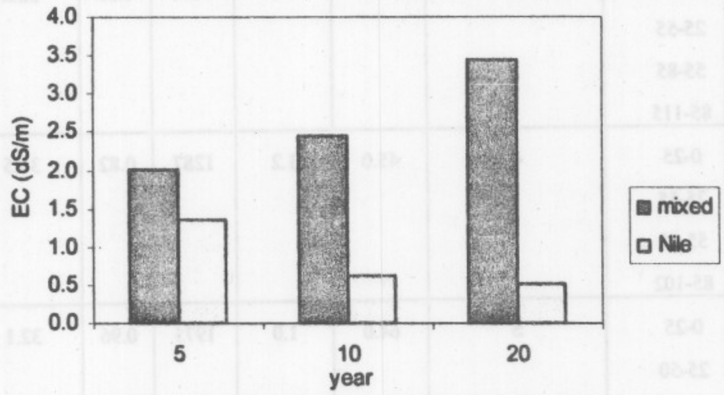


fig (2): effect of irrigation water quality on EC (dS/m)

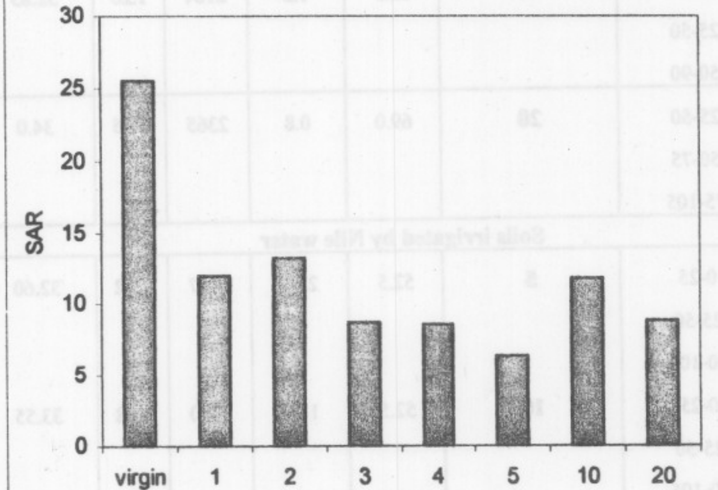


Fig (3): Effect of land use period on SAR

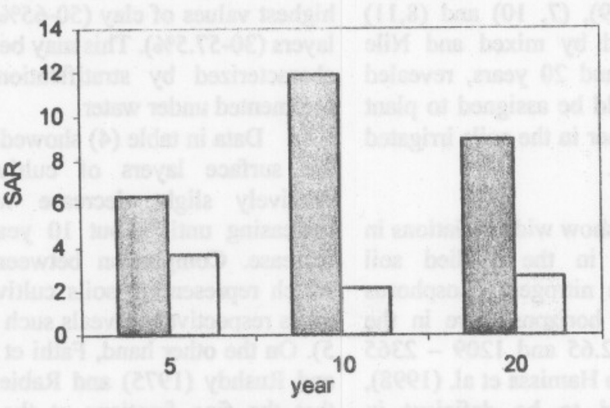


Fig (4): Effect of irrigation water quality on SAR

2- Soil fertility status.

Total carbonate

The data in table (3) showed the distribution of the total carbonate in the studied soil profiles. The results indicate that the total carbonate values in the studied soils vary from 1.5 to 4.5 %. With respect to the influence of cultivation, the total carbonate content in the surface layers of virgin soils was relatively higher than most of the cultivated soils. This could be assigned to the presence of continuous supply of H-ions and organic acids in the cultivated soils, which originated from roots and/or organic manures decomposition and consequently enhance the carbonate transformation into a more soluble form (Soliman, 1982 and Abd El-Aal, 1994). Similar results indicating the decrease of total carbonate due to cultivation were also obtained by Abd El-Aal et al. (1987). Data revealed also that total carbonate content (%) in the surface horizons of the studied profiles slightly decreased with the increase of land use period. These results are in harmony with those obtained by Abou Hussien (1999). There is no observed influence of irrigation water quality on total carbonate content and/ or distribution, as shown in table (3). In this context, Jenny (1980) pointed out that calcium carbonate is static or a slowly renewable property.

Cation exchange capacity (CEC)

The cation exchange capacity (CEC) of soils is generally, considered to be related entirely to clay, fine silt fractions and organic matter content, (Wicklander 1964). Data illustrated in table (3) indicated that CEC values in the studied soils were moderate and varied from 29.0 to 37.8 cmol kg^{-1}. These values reflected the clay texture of the studied soils, although, the low contribution of organic matter under such conditions.

Investigation of CEC values at the surface horizons in the studied soils indicated that the cultivation tended to cause an increase of CEC values. These results are in agreement with those obtained by Fathi et al. (1971), El-Reweiny and Rushdi (1975) and Abou Hussien (1999). Data also show that the CEC values increased with increasing of the cultivation period, except in the first 4 years of cultivation, which does not show regular trend, as shown in table (3).

Also the recorded data in table (3) show that the soils irrigated with Nile water tended to have relatively higher CEC value at the surface horizons than mixed water. This trend was noticed only in the long period of land use (20 years), where CEC values were 34.0 and 37.8 cmol kg^{-1} at the surface horizon of profiles 8 and 11, which represent mixed and Nile irrigation water, respectively. This may be due to increase of organic matter values in the soils irrigated with Nile water comparing with those irrigated with mixed water (Table 3).

Soil organic matter

Data in table (3) indicated that the organic matter content was low and varied between 0.43 and 1.35 % in the surface layers of the studied profiles. These results are expected in arid climatic conditions, which encourage organic matter decomposition. However, it can be stated that organic matter content was relatively higher in cultivated soils (0.57 –1.35 %), than virgin soils (0.43 %). The data also show that the organic matter content generally, increased with the increasing the land use period. This may be due to the continuous addition of manures and accumulation of plant residues. These results are in harmony with those obtained by Fathi et al. (1971), Rabie et al. (1988) and Abou Hussien (1999). They found a significant increasing in the organic matter content in the cultivated soils by various crops for the long periods.

Regarding the effect of irrigation water quality on organic matter content, results indicated that soils using Nile water in irrigation had higher values of O.M at the surface horizons than mixed water. Comparison between pairs of profiles (6, 9), (7, 10) and (8,11) which represent soils irrigated by mixed and Nile water, respectively for 5, 10 and 20 years, revealed such trend (Table 3). This could be assigned to plant residues accumulation was higher in the soils irrigated by Nile water than mixed water.

Available Macronutrients

Data record in table (3), show wide variations in the available macronutrients in the studied soil profiles. Contents of available nitrogen, phosphorus and potassium in the surface horizons were in the range of 22.5 – 69.0, 1.17 – 2.65 and 1209 – 2365 ppm, respectively. According to Hamissa et al. (1998), Egyptian soils are considered to be deficient in macronutrients when the available contents are less than 40, 10 and 200 ppm for N, P and K, respectively. Thus, most of the investigated soils exhibited inadequacy of available phosphorus, while had a high amounts of nitrogen and potassium in the surface horizons, especially in the cultivated soils (Table 3).

The pronounced effect of land use periods on both N and K was higher with period increasing. The available phosphorus had irregular trend. This was clearly in profiles 6, 7 and 8 which represent soils cultivated for 5, 10 and 20 years, respectively as shown in table (3).

The results indicated that the soils using Nile water for irrigation had relative lower values of available N and K than mixed water. The values were 52.5, 1287 – 52.5, 1780 – 62.5, 1624ppm of profiles 9, 10, and 11, which represent soils irrigated by Nile water. The corresponding values with soils irrigated by mixed water were 64.0, 1975 – 62.5, 2184 – 69.0, 2365 ppm of profiles 6, 7, and 8, respectively with the same land use periods, as illustrated in table (3). This may be attributed to the relative increase in nitrogen and potassium compositions as contamination elements in the mixed water. Data exhibited also that there are no relation between available P contents with irrigation water quality (Table 3).

3- Physical properties.

Grain size distribution and soil texture

Data of some physical properties of the studied soil profiles are presented in table (4). These data showed that the investigated soils had clay texture through the entire horizons with high clay and silt contents (31.25 - 65.0% and 15.00 - 48.75%, respectively). Data also indicated that the virgin soils tended to had higher clay content at the surface layer (52.5%) than cultivated soils (42.5 - 49.2%). This may be due to the irrigation water cause slight downward movement of fine and very fine clay particles from surface to subsurface layers especially in the first years of cultivation. Consequently, silt content was relatively higher in the surface layers of cultivated soils (29.8-35.0%), than virgin soils (26.25%), as shown in table(4). Concerning the distribution of clay content with the depth, the second layers (20-50cm) had the highest values of clay (50-65%) comparing with other layers (30-57.5%). This may be due to the studied soils characterized by stratification phenomenon, which sedimented under water.

Data in table (4) showed that the clay content at the surface layers of cultivated soils tended to relatively slight decrease with land use period increasing until about 10 years, and then tends to increase. Comparison between profiles 2, 7 and 8 which representing soils cultivated for 1, 10 and 20 years respectively reveals such trend (Table 4 and Fig. 5). On the other hand, Fathi et al. (1971), El-Reweiny and Rushdy (1975) and Rabie et al. (1988) reported that the fine fractions at the surface layers in the cultivated sandy soils increase with increasing land use period. This may be due to decrease the open textured nature of the soils and consequently reduces the movement of fine particles to the lower horizons. However, data show also that there is no effect of land use periods on soil texture.

Moreover, data indicated that there is no effect of irrigation water quality on grain size distribution and soil texture in the studied soils (Table 4).

Bulk density (Db)

Bulk density is influenced by soil texture, organic matter content and cultivation practices (Biswas and Mukherjee, 1987). Results in table (4) indicated generally that the bulk density values at the surface horizons decrease gradually with increasing land use period. This was clearly in profiles 1, 7 and 8 (Db =1.38, 1.24 and 1.18 Mg/m^3, respectively), which represent soils cultivated for zero, 10 and 20 years. Data revealed also that there is no effect of irrigation water quality on bulk density values (Table 4).

Hydraulic conductivity (Ks)

Data in table (4) exhibited that the hydraulic conductivity values of the studied soils ranged between 0.11 and 0.24 cm/hr at the surface layers and from 0.04 to 0.12 cm/hr in subsurface layers. Data also indicated that the virgin soils had lower value of hydraulic conductivity than cultivated soils. The first soils Ks value was 0.11 cm/hr in the surface horizons. The corresponding values of the second one ranged from 0.16 to 0.24 cm/hr. This may be due to the soil ploughing practices in the second soils. Results in table (4) showed that the hydraulic conductivity values at the surface horizons slightly increased with increasing land use period.

Data showed also that the soils irrigated with mixed water tended to have relative lower hydraulic conductivity value than those irrigated with Nile water at the same land use period, (Table 4). This may be due to the first soils had relatively higher content of organic matter (Table 3) and then increasing pore space, as a result for accumulation of fine particles.

Available water

Data presented in table (4) indicated that the available water in the surface horizons of cultivated soils higher than virgin soils. This may be due to the relatively high content of organic matter in the first soils. Data showed also that there is no consistent trend of land use period on available water values (Table 4).

Data in table (4) show that the soils using Nile water for irrigation attain higher available water values (26.4–31.2%) at the surface layer than those using mixed water (23–25.57%).

Table (4): Effects of land use periods and irrigation water quality on some physical properties of lacustrine soils

Profile No.	Depth cm	Land use Period(year)	Db gm\cm³	Ks cm\hr	A.Water %	Sand %	Silt %	Clay %	Soil* texture
				Virgin Soil					
P1	0-30		1.38	0.11	22.45	21.25	26.25	52.50	clay
	30-60		1.40	0.04	23.95	12.50	31.25	56.25	clay
	60-75		1.32		22.00	25.80	28.90	45.30	clay
			Soils irrigated by mixed water (drainage and Nile water)						
P2	0-25	1	1.27	0.16	21.29	21.00	29.80	49.20	clay
	25-50		1.24	0.05	28.69	15.00	27.50	57.50	clay
			1.38		26.20	17.50	35.00	47.50	clay
P3	0-25	2	1.22	0.17	24.60	21.25	30.00	48.75	clay
	25-50		1.24	0.05	27.20	20.00	25.00	55.00	clay
			1.33		19.80	32.50	22.50	45.00	clay
P4	0-25	3	1.18	0.16	22.30	26.25	31.25	42.50	clay
	25-55		1.24	0.07	28.38	15.00	26.25	58.75	clay
	55-85		1.28		23.95	11.25	27.50	61.25	clay
	85-115					20.00	35.00	45.00	clay
P5	0-25	4	1.20	0.16	22.30	25.00	32.50	42.50	clay
	25-55		1.10	0.06	26.77	27.50	20.00	52.50	clay
	55-85		1.15		27.99	20.00	26.25	53.75	clay
	85-102					53.75	15.00	31.25	s.cl.l
P6	0-25	5	1.18	0.17	25.57	21.00	35.00	44.00	clay
	25-50		1.18	0.07	28.50	22.50	17.50	60.00	clay
	50-85		1.38		14.06	25.00	27.50	47.50	clay
	85-105					21.25	48.75	30.00	cl. l
P7	0-25	10	1.24	0.19	23.00	25.00	32.50	42.50	clay
	25-50		1.20	0.09	25.77	16.25	18.75	65.00	clay
	50-75		1.18		27.20	30.00	20.00	50.00	clay
	75-95					41.50	23.50	35.00	cl. l.
P8	0-25	20	1.18	0.21	25.66	22.50	30.00	47.50	clay
	25-50		1.10	0.10	27.40	9.50	26.75	63.75	clay
	50-75		1.15		30.10	12.50	21.75	65.75	clay
	75-105					15.00	35.00	50.00	clay
				Soils irrigated by Nile water					
P9	0-25	5	1.21	0.18	26.40	25.50	28.75	45.75	clay
	25-50		1.12	0.06	26.07	30.00	20.00	50.00	clay
	50-100		1.26		22.80	32.50	22.50	45.00	clay
P10	0-25	10	1.20	0.22	27.05	26.25	31.25	42.50	clay
	25-50		1.23	0.08	22.30	18.25	26.75	55.00	clay
	50-105		1.22		23.10	30.20	28.00	41.80	clay
P11	0-25	20	1.18	0.24	31.20	20.75	31.25	48.00	clay
	25-50		1.23	0.12	27.40	13.75	27.50	58.75	clay
	50--110		1.22		21.60	25.50	32.50	42.00	cl. l.

*S.Cl.L: Sandy Clay Loam Cl. L: Clay Loam

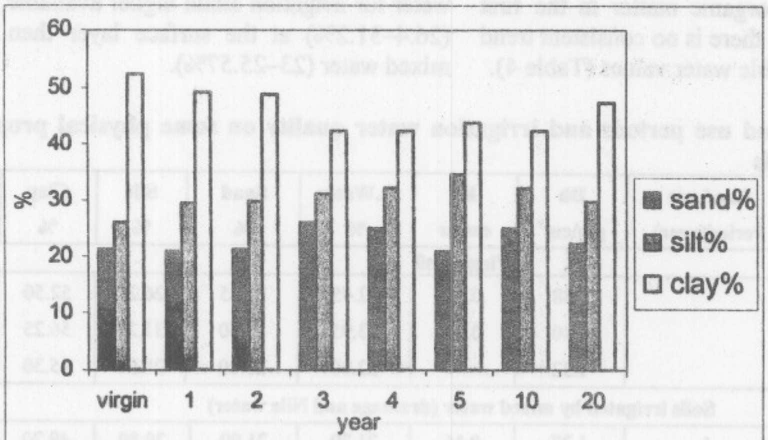


fig (5): Effect of land use period on grain size distribution

CONCLUSIONS

From the previous discussion, it is clear that the soil salinity, soluble cations and anions and sodium adsorption ratio were higher in soils irrigated with mixed water than those irrigated with fresh Nile water at the same land use periods. Moreover, lacustrine soils used mixed water (poor quality) for irrigation caused desalinization process in the first five years of cultivation, but using this kind of water for longer periods caused these soils to be converted to saline or saline sodic soils (secondary salinization process) and consequently soil degradation occurred. The best means of maintaining there soils could be achieved through periodic application of fresh Nile water to avoid the hazardous effect of salinity and to enhance optimum plant growth and soil productivity.

REFRENCES

Abd-Allah, A.E. (1988). Effect of water quality on some physical, chemical and pedological characteristics of soils. Ph.D.Thesis. Fac. Agric., Ain Shams Univ., Egypt.

Abd El-Aal, Sh.I.; Shawky, M.E. and Shahin, R.R. (1987). Effect of land use on aggregation and carbonate mineralogy of some desertic calcareous soils of Egypt. Soil Sci. Soc.of Egypt. 2nd National Congress on: Problems and Technology for invading desert soils. Cairo, 15-17 Dec.

Abd El-Aal, N.I. (1994). Influence of soil organic matter on the behaviour of some trace elements in soil. Ph.D. Thesis Fac. Agric. Cairo. Univ., Egypt.

Abou Hussien, E.A. (1999). Effect of different cultivation periods of banana plants on : 1- Soil chemical properties and some nutrients status. Minufiya J. of Agric. Res. 24 (2): 685-699.

Beshay, N.F. and Sallam, A.Sh. (2001). Effect of land management practices on soil characteristics and sustainable productivity (East of the Nile Delta). Egypt. J. Soil Sci. 41(3):353-378.

Biswas, T.D. and Mukherjee, S.K. (1987).Textbook of Soil Science. Tata McGraw-Hill Publishing Company Limited, New Delhi.

El-Husseiny , N., Kassem, Y.S and El-Zahaby. E.M. (1985). Micromorphology of some soils developed in the lacustrine deposits of Lake Maryut, Egypt.Comm. Sci. devel. Res., 10 (3), 57.

El-Husseiny,N., Kassem,Y.S and Abd El-Rahman,S.M.H.(1988). Morphology genesis and classification of El-Bosaily soils. Desert instit. Ball., A.R.E.,38 (1): 97-114.

El-Reweiny, F.M. and Rushdi, M.K. (1975). Effects of reclamation and cropping on some physical and chemical properties of soils. Egypt J. Soil Sci., Special Issue, pp. 263-270.

El-Sawaby, M. Sh. And Abu-El-Anine, A.A. (1977). Effect of quality of irrigation water on the chemical properties of the soils. Agric. Res. Rev. 55,11.

El-Zahaby, E.M. (1976). The relation between geomorphological aspects and the pedological and mineralogical characteristics of the soils in Rosetta area, A.R.E. ph.D Thesis, Fac. Of Agric. Alex. Univ.

FAO (1970). Physical and chemical methods of soil and water analysis. Soils Bulletein No. 10, FAO, Rome.

FAO (1990). Guidelines for soil profile description. 3rd ed., FAO, Rome.

Fathi, A.; Naga, M.; Kandil, M.F. and El-Abbaseri, M. (1971). Effect of land use period on soil properties. U.A.R.J.Soil Sci. 11 (2):147-157.

Hamdi, H.; Youssef, S; El-Shabassy, A. and Tewfiek, Y. (1968). Studies on the effect of saline irrigation water on the chemical composition of a clay loamy soil. U.A.R.J. Soil Sci., 8, 7.

Hamissa,M.R., N. El-Mowalhy and S. Y. Salem (1998). Agricultural fertilizers and special recommendations to economize their use. Soil, water and environ. Institute, Agric. Res. Center, Cairo. Egypt. (In Arabic).

Jackson, M.L. 1958. Soil Chemical Analysis, Prentice Hall, Englwood Cliffs, N.J.Jenny. H. (1980). The soil recource. Springer- Verlag, New York.

Labib,F. and Sys, C.C (1970). Soils on l lacustrine and marine deposits in United Arab Republic. Pedologie, 20, 381.

Mostafa, M.A.; Khaled, E.M.; El-Sweedy, A.M. and Abd-El-Nour, A.Sh. (1992). The effect of irrigation water quality on some chemical properties of certain soils of Egypt. Egypt. J. soil Sci. 32 (3):391-406.

Noaman, K.I. and Sheta, A.S. (1988). Chemical and mineralogical studies on some deposits in north eastern Delta region, Egypt. Egypt.J.Soil Sci. 28(2):247-260.

Page, A.L.; Miller, R.H. and Keeny, R. (1982). Methods of Soil Analysis. Part 2. Chemical and microbiological properties. Agron. Monograph No. 9, ASA, Madison, Wisc., USA.

Rabie, F.; Sheta, A.S. and El-Sharif, O. (1988). Anthropic influences on the properties of some sandy soils in Egypt. Egyptian J. Soil Sci. 28(2):153-165.

Richards, R.L. (ed.) 1954. Diagnosis and improvement of saline and alkali soils. Agriculture Hand Book No. 60, U.S Govt. Printing Office, Washington, USA.

Soliman, H.S.H. (1982). The effect of the functional groups of some nutrients produced during decomposition of organic matter in plant nutrition. Ph. D. Thesis Fac. Agric. Zagazig Univ. Egypt.

Tiwari, R.C.; Verma, U.N. and Mishra, A.K. (1995). Effect of long-term cropping systems on chemical characteristics of soil profiles. J. of Indian Soc. Soil Sci., 43(2):278-279.

Wicklander, L. (1964). Cation and anion phenomena. In Chemistry of the soil. (F.E. Bear, ed.).Chapter 4:163-205. Reinhold Publishing Co.PVT. LTD., New Delhi.

Zein,F.I., Manni,Z., El-Leithi, A.A. and El- Shami M.M (2002). Effect of polluted irrigation water of some crops and their contents of heavy metals. 1- Wheat. Egyptian J. Soil Sci. 42 (1):139-159.

الملخص العربي

تأثير فترات الاستخدام الزراعي و جودة مياه الري على بعض خصائص الأراضي البحيرية المصرية

د/ رجب إسماعيل فايد

معمل بحوث الأراضي الملحية بالإسكندرية – معهد بحوث الأراضي و المياه والبيئة– مركز البحوث الزراعية– مصر

أجريت هذه الدراسة بهدف تتبع ومقارنة التغيرات التي تطرأ على بعض الخصائص الطبيعية والكيميائية للأراضي البحيرية ومدى تأثرها بفترات الاستخدام الزراعي وجودة مياه الري، وذلك بهدف تفهم هذه التغيرات والاستفاده من ذلك في الاستخدام الأمثل لهذه الأراضي والمحافظة عليها من التدهور والعمل على تحسين خواصها.

تم اختيار أحد عشر قطاعا أرضيا في الرواسب البحيرية بمنطقة البوصيلي جنوب بحيرة ادكو لتمثل الاختلافات في فترات الاستزراع (١، ٢، ٣، ٤، ٥، ١٠ ، ٢٠ عاما) وكذلك الاختلاف في جودة مياه الري (مياه النيل و مياه مخلوطة) بالإضافة إلى الأراضي البكر (للمقارنة).حيث مصدر الرى الرئيسى لمعظم الأراضى فى منطقة الدراسة هى مياه مخلوطة (خليط من مياه النيل والصرف الزراعي). وقد تم وصف هذه القطاعات مورفولوجيا وأخذ العينات الممثلة لها لأجراء التحليلات المعملية للخواص الفيزيائية والكيميائية و الخصوبة.

يمكن تلخيص النتائج المتحصل عليها في الآتي:

تتميز الأراضي المدروسة عموما بقوام طيني في معظم الأفاق، محتوى متفاوت من الأملاح الذائبة يتراوح من ٠,٥٣ الى ٢٤,٢٢ ديسي سيمنز/م، قيم متوسطة إلي مرتفعة من نسبة ادمصاص الصوديوم SAR (٢,١٢–٤٥,١٧)، قيم متوسطة من السعه التبادلية الكاتيونية (٢٩–٣٧,٨ سنتي مول/كج)، محتوى منخفض من المادة العضوية (٠,٤٣–١,٣٥%) وقيم متوسطة من المحتوى الصالح من المغذيات الكبرى نتروجين، فوسفور وبوتاسيوم (٢٢,٥–٦٩، ١,١٧–٢,٦٥، ١٢٠٩–٢٣٦٥ جزء في المليون على التوالى).

وفيما يختص بتأثير كل من مدة الاستخدام الزراعي وجودة مياه الري على خصائص التربة المختلفة، فقد أظهرت النتائج الملاحظات الآتية:

١– بصفة عامة تميزت الأراضي المنزرعة عن الأراضي البكر بمحتوى أعلى من المادة العضوية والسعه التبادلية الكاتيونية والمحتوى الصالح من النتروجين والفوسفور والبوتاسيوم، بينما أظهرت قيما أقل من الأملاح الذائبة والكثافة الظاهرية والكربونات الكلية ونسبة الصوديوم المدمص وكذلك المحتوى من الطين في الأفاق السطحية.

٢– أدى زيادة فترات الاستخدام الزراعي إلى حدوث زيادة في محتوى الأرض من المادة العضوية و السعة التبادلية الكاتيونية وكذلك الصالح من النتروجين والبوتاسيوم في الأفاق السطحية، في حين أدى الى انخفاض في قيم الكثافة الظاهرية، اما الانخفاض الكبير في الأملاح الذائبة (EC_e) ظهر في الخمس سنوات الأولى من الزراعة وبعدها حدثت زيادة طفيفة (بسبب استخدام مياه مخلوطة رديئة الجودة في الري)، ولا توجد علاقة واضحه بين نسبة الصوديوم المدمص (SAR) ومدة الزراعة.

٣– استخدام المياه المخلوطة في الري لفترات طويلة أدى الى زيادة نسبية في الأملاح الذائبة ونسب الصوديوم المدمص والمحتوى الصالح من النتروجين والبوتاسيوم في الطبقة السطحية مقارنة بالأراضي التي استخدم فيها ماء النيل كمصدر للرى، بينما كان لاستخدام الأخيرة تأثيرا أعلى في زيادة رقم الحموضة (pH) والمحتوى من المادة العضوية و قيم السعة التبادلية الكاتيونية (CEC) وكذلك قيم التوصيل الهيدروليكي و الماء المتاح.

٤– لا يوجد تأثير لجودة مياه الري على المحتوى من الكربونات الكلية و الصالح من الفوسفور وكذلك قيم الكثافة الظاهرية والتوزيع الحجمي للحبيبات وبالتالي قوام التربة.