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SPATIAL AND TEMPORAL EVALUATION OF EL-SALAM CANAL WATER RESOURCES FOR IRRIGATION PURPOSES

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ABSTRACT

Samples of Nile water, agricultural drainage water and mixed water were taken monthly to study the spatial and temporal evaluation of El-Salam canal water for irrigation in locations extended from El-Adlia village at Damietta branch, upstream of Faraskor dam, up to 89 km at EL-Sahara (siphon), west of Suez Canal. Samples monthly collected from twenty six locations during October 2009 to September 2010. Electrical conductivity (EC), pH, soluble cations (Ca^{2+}, Mg^{2+}, Na^{+}, and K^{+}), and anions (CO_3^{2-}, HCO_3^{-}, Cl^{-}, and SO_4^{2-}) and boron were determined. pH values were slightly alkaline and ranged between 7.71 and 8.0. The EC varied from 0.46 to 2.65 dSm^{-1}, the highest occurred in the drainage water with values up to 2.62 dSm^{-1}. Average EC values were 1.51, 1.91, 1.25, and 2.62 dSm^{-1} for water of Faraskor drain, Alatwi drain, Elserw drain and Hadous drain, respectively. El-Salam water and the associated drains had adjusted SAR values of>10 (10-20). Water is classified as A_2 according to Gupta ABC classification which indicates low-sodium water. Ca^{2+} ranged between 1.94 to 4.16 $mmol_cL^{-1}$, Mg^{2+} ranged between 2.18 to 8.88 $mmol_cL^{-1}$, K^{+} was between 0.21 and 0.74 $mmol_cL^{-1}$and the Cl^{-} ranged between 1.72 and 20.42 $mmol_cL^{-1}$. Water have moderate soluble salts and slight sodicity (alkalinity) and can be used with care for some crops, particularly, the semi tolerant with proper management. Seasonal variation of water and inconsistency of the mixing ratio of Nile water with the drain water may be the main reason for salinity fluctuation throughout the year.

Keywords: El-Salam canal, water quality, drainage water, water classification systems.

INTRODUCTION

There is a great need for additional water resources to meet the agricultural demands of the newly reclaimed soils such as the west of delta and Sinai particularly the rainfall is less than 100 mm a year (Ashoub *et al.,* 2010). Drainage water could be a source of water for irrigation. An intensive expansion program for the reuse of agricultural drainage water requires adequate, proper measures and precaution due to salinity and alkalinity problems to avoid accumulation of salts with long term use of such water.

Concerning water quality criteria, water that has an electrical conductivity exceeding 3dSm^{-1}, is considered unsatisfactory (Ayers and Westcot, 1976 and Gupta, 1979), although El-Nahal *et al.* (1983) observed many cases in Saudi Arabia in which water of excessive salinity were used for irrigation of vegetable crops and of alfaalfa without serious injury.

According to the guidelines presented by Ayers and Westcot (1976), water having boron of <0.75, 0.75-2.0, > 2 mgL^{-1} are classified as "no problems", "increasing problems" and "severe problems", respectively. Gupta (1990) suggested that, irrigation water may be classified under five classes, based and sodic hazard, boron and the salinity hazard. This classification has been called ABC classification.

One of the promising projects in Egypt based on the use of drainage water mixed with Nile water is El-Salam canal to irrigate Northern Sinai area. The Canal collects the drainage water of Eastern Delta mixed with Nile water at a ratio of 1:1. It crosses the Suez Canal through a tunnel 1300-m long. It runs 89 km west of the canal and 175 km east.

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Drainage water constitute about 30% of the total irrigation water used for agriculture and most of which is lost in sea or lakes (Abdel-Hamid *et al.,* 2000). About 9 billion m^3 of drainage water per year could be reused for irrigation in Egypt (El-Degwi *et al.,* 2003).

According to Ashoub *et al.* (2010), the quantity of water in El-Salam canal is about 4.45 billion m^3/year out of which 2.1 billion m^3 from Nile water and 1.9 billion m^3 from Hadous drain (average EC is 2.62 dSm^{-1}) plus 0.45 billion m^3 from El-Serw drain (average EC is 1.25 dSm^{-1}). El-Salam canal is designed to irrigate 600,000 faddan, out of which 200,000 west of the Suez canal (Damietta, Dakahlia, El-Sharkia, Esmaelia and Port-Said governorates) and 400,000 faddan east of the Suez canal (El-Tena plain, northern cost, Ser and Kawarer area).

The aim of the present investigation is to study spatial and temporal variations of El-Salam canal water for irrigation purposes.

MATERIALS AND METHODS

Sampling of Water

Twenty six water samples (i.e. 26 locations) were taken. They represent Nile water (location 1), four main drains from Faraskor drain (location 3), El-Atwi drain (location 4), El-Serw drain (location 7), Hadous drain (location 16), and El-Salam canal (locations 2, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 17,18, 19, 20, 21, 22, 23, 24, 25 and 26). The first three drains dispose their water into El-Salam canal. Water samples were taken monthly during Oct. 2009 to Sep.2010 from Damietta branch, drains and El-Salam canal. Table 1 and Fig. 1 show the locations of samples of the drains and El-Salam canal. The water samples were filtered and subjected to chemical analysis.

Water Analyses

EC, pH, soluble cations (Ca^{2+}, Mg^{2+}, Na^+, and K^+) and anions (CO_3^{2-}, HCO_3^-, Cl^-) were determined adopting the methods of USDA (1954) with the sulphate being estimated by difference. Boron was determined by the curcumin method according to Jackson (1958).

RESULTS AND DISCUSSION

Table 2 shows the chemical analyses of samples taken from El-Salam canal and the drains during the period from Oct. 2009 to Sep. 2010. Suitability of water for irrigation purposes is based on it's total salt contents and status of sodium to other cations and also the status of chlorides, bicarbonate and boron.

pH

The pH values as shown in Table 2 and Fig. 2 are slightly alkaline in all the studied drain water and El-Salam canal water and ranged between 7.71 to 8.03, indicating possible alkalization upon their use, although these values are in the normal range according to Ayers and Westcot (1976). The high pH values may be due to a slight increasing in HCO_3^- ions. Gupta (1984) recommended using the alkalinity hazard parameter of "Residual Sodium Bicarbonate (RSBC)" as the difference between bicarbonates and calcium ions, i.e. RSBC= HCO_3-Ca, (expressed in $mmol_cL^{-1}$).

Salinity Status

The EC values ranged between 0.46 and 2.62 dSm^{-1}. Table 2 and Fig. 3 show that, water at locations 16, 17, 18 had the greatest salinity with EC of 2.54 to 2.62 dSm^{-1} throughout the year. The greatest value was recorded in the sample of location 16 of Hadous drain. The salinity of drain water is lower in the summer than in the winter. These results are in agreement with Soliman (1983); El-Sherbieny *et al.* (1998); Mohammed *et al.* (1999); Abdel-Hamid *et al.* (2000) and Soliman (2000). One of the contributing causes for high salinity at some locations is the passage of the streams through large areas of recently reclaimed soils like Sahil-Hosaneia.

According to USDA (1954), the studied water of the drains and El-Salam canal are classified as class C_3 (medium salinity) and C_4 (high salinity). However, according to Ayers and Westcot (1976), the water of the drains (EC < 2.5 dSm^{-1}), is of "increasing salinity problems". Water of locations 16, 17 and 18 (EC > 2.5 dSm^{-1}) are of "severe salinity problems".

Table 1. Position and locations of sampling sites on El-Salam canal and contributing drains

Location No.	Location marks	Position, DMS (GPS reading)	Distance from starting point, km
1	Damietta Branch (El-Adlia village)	31°23'42.72"N 31°46'8.22"E	0.00
2	Front of El-Adlia bridge	31°23'38.16"N 31°46'10.50"E	0.15
3	Faraskor drain pump station	31°22'45.96"N 31°46'31.02"E	1.9
4	Atwai drain	31°20'39.96"N 31°48'33.3"E	7.50
5	First bridge after Atawi drain	31°19'10.92"N 31°48'39.90"E	10.40
6	Taftesh EL Serw bridge	31°15'25.68"N 31°48'38.52"E	18.28
7	EL-Serw drain pump station	31°15'26.40"N 31°48'40.86"E	18.35
8	Izbet Ali EL-Sherbiny bridge	31°14'4.08"N 31°51'0.02"E	23.00
9	Small bridge	31°14'3.00"N 31°53'48.48"E	27.43
10	El-Salam bridge	31°14'0.18"N 31°56'51.78"E	32.28
11	Izbet Al-Nasaymah bridge	31°13'35.16"N 32° 0'36.24"E	38.42
12	Izbet Al-Jamamlah bridge	31°10'57.66"N 32° 0'44.34"E	45.00
13	El-Assafra Bridge	31°10'9.48"N 32° 0'22.50"E	46.60
14	Izbet Awlad Banah bridge	31° 8'23.52"N 32° 0'20.16"E	49.87
15	Before Hadous bridge	31° 6'23.64"N 32° 0'25.73"E	53.56
16	Hadous drain bridge	31° 6'21.00"N 32° 0'24.24"E	53.67
17	Hadous drain	31° 6'17.76"N 32° 0'13.62"E	54.00
18	El-Salam Pumping station No. 3	31° 5'51.48"N 32° 0'25.98"E	54.95
19	Next to EL-Rwad Village	31° 3'30.78"N 32° 0'39.48"E	59.33
20	Khaled Ibn El-Waleed	31° 2'21.96"N 32° 2'57.00"E	63.54
21	Next to EL-Azhr village bridge	31° 0'49.44"N 32° 5'42.54"E	69.00
22	Next to Izbet Ashalatiyat	31° 0'54.18"N 32° 9'2.58"E	74.35
23	EL-Shader Bridge	31° 0'59.88"N 32°12'14.28"E	79.44
24	1.24 km East of EL-Shader	31° 1'0.36"N 32°13'1.44"E	80.68
25	4.45 km west of EL-Sahara	31° 1'4.20"N 32°15'30.96"E	84.14
26	El-Sahara, west of Suez Canal	31° 1'7.62"N 32°18'18.60"E	89.12

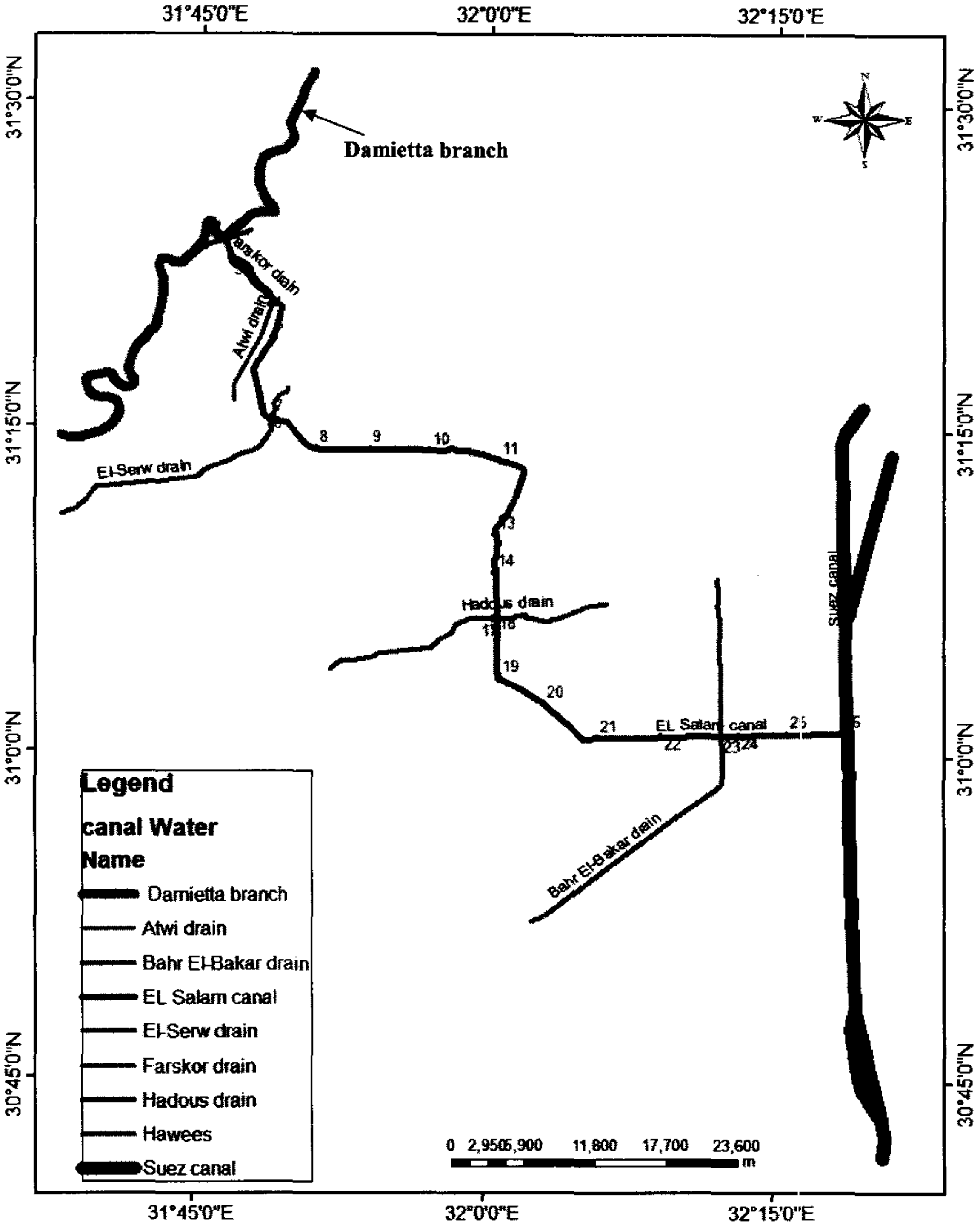

Fig. 1. Locations of water samples of El-Salam canal and it's associated drains (26 locations)

Table 2. Mean Values of pH, EC, and ion contents for water samples collected from different locations along El-Salm canal

Location No.	PH	EC (dSm^{-1})	Cations, $mmol_cL^{-1}$				Anions, $mmol_cL^{-1}$			Boron, $mg\ L^{-1}$
			Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	HCO_3^-	SO_4^{2-}	
1	7.86	0.46	1.76	0.21	1.94	2.26	1.72	3.08	1.37	0.010
2	7.91	0.48	2.11	0.25	2.11	2.18	1.85	3.21	1.58	0.014
3	7.83	1.51	7.48	0.41	3.48	4.38	11.26	4.3	0.57	0.016
4	7.94	1.87	10.28	0.55	3.13	6.76	15.08	4.43	1.20	0.019
5	7.91	0.81	4.17	0.30	2.47	2.49	4.76	3.46	0.90	0.017
6	8.0	0.65	2.93	0.30	2.23	2.48	3.63	3.35	0.81	0.016
7	7.97	1.25	6.28	0.45	2.51	4.21	8.52	4.20	1.12	0.016
8	7.98	0.84	3.74	0.34	2.35	3.11	4.88	3.46	1.22	0.013
9	8.02	0.81	3.48	0.28	2.28	3.1	4.58	3.58	0.98	0.012
10	8.02	0.81	3.59	0.28	2.28	3.06	4.54	3.56	1.10	0.013
11	8.00	0.81	3.67	0.32	2.27	3.06	4.57	3.63	1.12	0.013
12	8.00	0.79	3.73	0.28	2.21	2.94	4.52	3.64	1.01	0.012
13	7.99	0.79	4.05	0.35	2.32	3.12	4.85	3.72	1.28	0.020
14	8.03	0.80	3.82	0.28	2.23	2.98	4.59	3.63	1.07	0.014
15	7.94	0.84	4.00	0.37	2.14	3.33	4.73	3.66	1.45	0.019
16	7.93	2.62	9.82	0.74	3.98	8.88	21.13	5.95	0.78	0.020
17	7.97	2.55	9.47	0.73	4.13	8.54	20.13	5.83	1.02	0.021
18	7.98	2.54	9.31	0.74	4.16	8.63	20.42	5.90	0.96	0.022
19	7.94	1.41	6.29	0.43	2.86	5.44	9.98	4.59	1.11	0.016
20	7.94	1.22	5.63	0.37	2.78	4.36	7.72	4.39	0.95	0.013
21	7.94	1.21	5.51	0.38	2.78	4.35	7.71	4.37	0.86	0.013
22	7.93	1.21	5.23	0.37	2.77	4.41	7.62	4.41	0.78	0.013
23	7.91	1.20	5.33	0.39	2.7	4.35	7.37	4.38	0.93	0.013
24	7.80	1.18	5.28	0.39	2.72	4.44	7.53	4.36	0.85	0.013
25	7.76	1.19	5.18	0.37	2.78	4.50	7.51	4.38	0.85	0.013
26	7.71	1.15	5.13	0.37	2.76	4.6	7.58	4.28	0.91	0.013

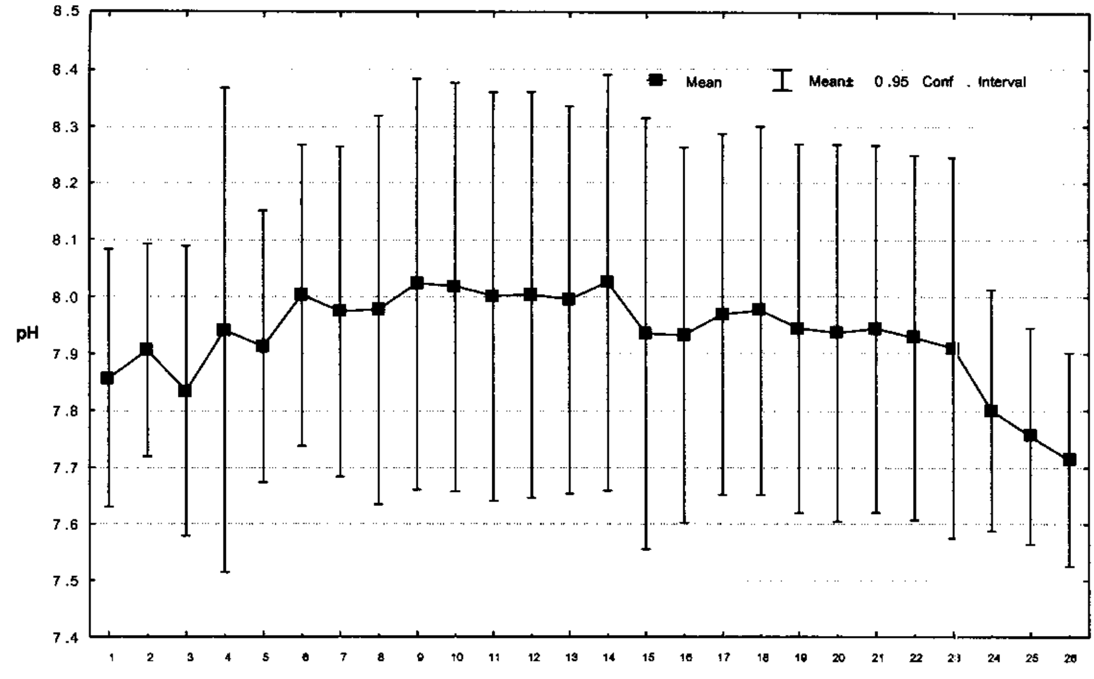

Fig. 2. pH values for water samples collected from different locations along El-Salam canal course

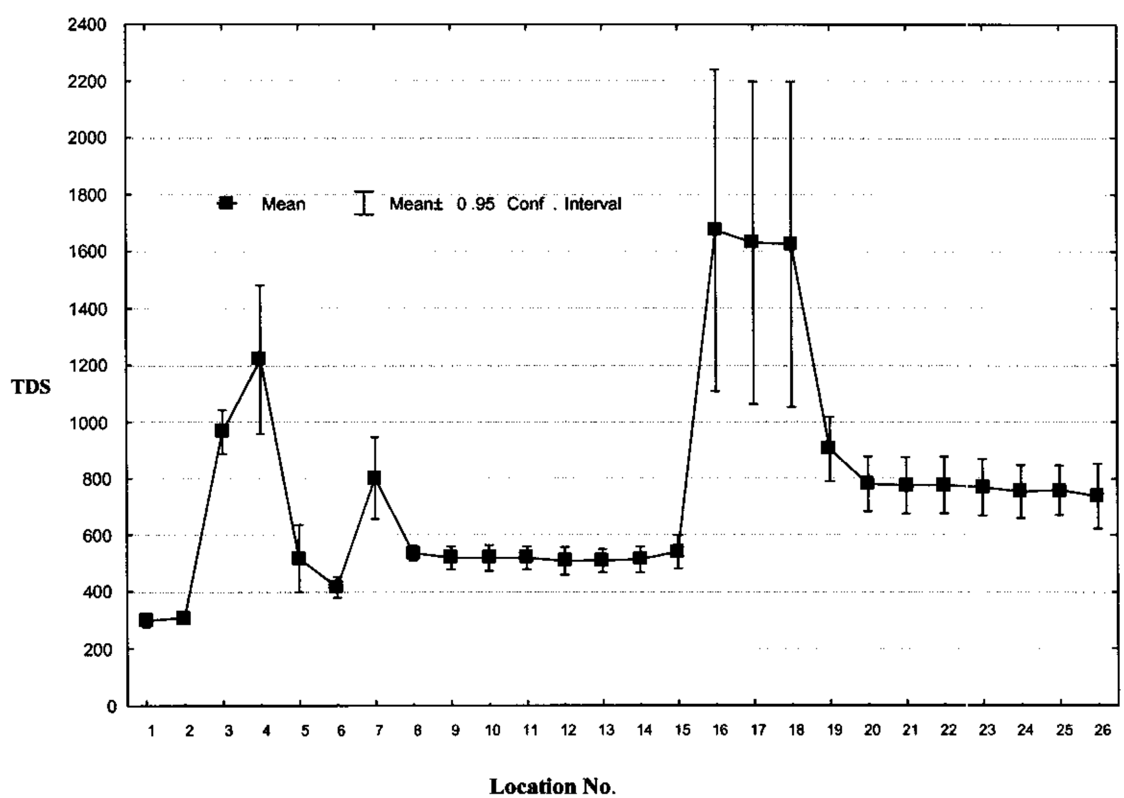

Fig. 3. Total dissolved solids (TDS) for water samples collected from the 26 different locations along El-Salam canal course

Sodicity Status

The data show that, the studied drainage water contains balanced concentrations of calcium, magnesium and sodium. Several methods have been proposed to express sodium hazards, SAR is the widely used one by USDA (1954), which classified irrigation water into four classes (S_1<10, $S_2$10-18, S_3 18-26, S_4>26) taking water salinity (S_1, S_2, S_3,and S_4 being low, medium, high, and very high sodium respectively). The present data indicated that SAR is well below 10 throughout the year in all studied water and classified between S_1 and S_2. On basis of adjusted SAR, Gupta (1979) classified irrigation water into five classes expressed by the letter (A). According to such classification, the water of El-Salam canal is A_1, i.e. good water, whereas the water of location 4 is classified as A_2, which indicates "low sodium water".

Gupta (1979, 1984 and 1990) suggested a classification taking in consideration the ratio between SAR and SCAR (sodium to calcium activity ratio), since the SCAR= "Na/√Ca in $mmol_cL^{-1}$". According to such classification, values of SAR/SCAR of water in the current study are below 5 (ranged between 0.81 to 1.15 throughout the year). Therefore, the water would be classified as "S-0" i.e. non-sodic water; and may be used for irrigation on almost all soils and for all crops even those sensitive to sodium such as stone-fruit trees or wood trees.

The adj ^{R}Na obtained is used in place of the SAR to evaluate the potential of the water to cause an infiltration problem if used for irrigation. Data in Table 3 show adjusted sodium adsorption ratio (adj ^{R}Na) values for El-Salam canal water. The values were around 1.3 for Nile fresh water and ranged between 2.16 and 3.6 for water after blending with the drainage water. High values were noticed for drainage water and ranged between 4.1 and 6.7.

Ionic Composition of the Water

Calcium values ranged between 1.94 to 4.16 $mmol_cL^{-1}$ (Table 2). The losses of soil calcium by leaching depend on the drainage water discharge and the strategy of fertilization and gypsum application, which increase the calcium losses in light textured soils with good quality water (Mostafa *et al.*, 2002, El-Degwi *et al.*, 2003 and Othman *et al.*, 2011).

Magnesium ranged between 2.18 to 8.88 $mmol_cL^{-1}$ (Table 2). The highest was found at location 2. Potassium was between 0.21 and 0.74 $mmol_cL^{-1}$. Potassium may be subject to fixation by clay colloides in clayey soils and the losses by leaching are in most cases considerable only in heavily fertilized sandy soils (Wiklander, 1977).

Chlorides and bicarbonates are the common anions in natural water, including the present studied water. Sulphates anions in the current water are present in relatively low concentrations. The chloride content ranged between 1.72 to 21.13 $mmol_cL^{-1}$ (Table 2). According to the classification of Ayers and Westcot (1976), the chloride content in the current water indicates either "no problem" class or "increasing problem" class. Bicarbonate ranged between 3.08 to 6.3 $mmol_cL^{-1}$ which indicates a "no problem" class or "increasing problem" class. The bicarbonate values of water show their ability to precipitate Ca^{2+} in the soil based on pH_C values. In general, water may be recommended for use for irrigation purposes with proper soil and water management.

The Permeability Index (PI)

The PI index is estimated as follows according to Doneen (1964):

$$PI = \frac{Na^+ + \sqrt{HCO_3^-}}{Na^+ + Ca^{2+} + Mg^{2+}} \times 100$$

Where: concentrations are $mmol_cL^{-1}$.

The PI index is an important parameter which influences the quality of irrigation water, in relation to soil for development in agriculture. Based on this index, Doneen (1964) classified water for irrigation into 3 classes as $class_1$ $class_2$ and $class_3$, and established a relation between it and the total salinity. In the present study, the PI values ranged from 40 to 80 with general average of 62. Most of water samples fall within Class I and Class II and can be categorized as good irrigation water for soils of medium permeability.

Table 3. Mean values of soluble sodium percent(SSP), sodium adsorption ratio (SAR), residual sodium carbonate (RSC), residual sodium bicarbonate (RSBC), exchangeable sodium percent(ESP) expected in soil irrigated with the water, pH_c, Adj SAR, Ca_x, SAR/SCAR, Adj.^{R}Na, ICAR for water samples collected from different locations along El-Salam canal course*

Location No.	SSP	SAR	RSC	RSBC	ESP	pH_c	Adj. SAR	Ca_x	Adj. ^{R}Na	USDA	SAR/ SCAR	ICAR	PI
1	30.22	1.29	1.1	1.1	0.7	7.40	2.49	1.41	1.38	C_2S_1	0.98	C_1S_0	58.98
2	33.08	1.50	1.1	1.1	1.0	7.40	2.96	1.46	1.60	C_2S_1	1.00	C_1S_0	61.01
3	48.44	3.93	3.6	0.8	4.6	7.20	8.70	1.77	4.45	C_3S_2	0.94	C_1S_0	62.25
4	51.22	6.23	6.0	2.4	7.5	10.00	13.8	2.16	6.77	C_3S_2	1.15	C_2S_0	61.43
5	42.66	2.81	1.5	1.0	2.9	7.40	5.57	1.63	3.08	C_3S_1	1.01	C_1S_0	66.04
6	38.09	1.98	1.4	1.1	1.7	7.40	3.90	1.46	2.16	C_2S_1	0.99	C_1S_0	62.27
7	48.05	3.71	2.5	1.7	4.3	7.20	8.00	1.52	4.10	C_3S_1	0.90	C_1S_0	65.21
8	40.34	2.38	2.0	1.1	2.3	7.40	4.80	1.58	2.58	C_3S_1	0.95	C_1S_0	60.88
9	38.99	2.23	1.8	1.3	2.0	7.30	4.51	1.49	2.43	C_3S1	0.94	C_1S_0	60.63
10	40.06	2.31	1.8	1.3	2.2	7.40	4.63	1.50	2.51	C3S1	0.95	C_1S_0	61.38
11	40.34	2.36	1.7	1.4	2.2	7.40	4.74	1.50	2.57	C_3S_1	0.95	C_1S_0	61.95
12	41.87	2.46	1.5	1.4	2.4	7.40	4.94	1.50	2.67	C_3S_1	0.95	C_1S_0	63.51
13	41.98	2.61	1.7	1.4	2.6	7.30	5.33	1.50	2.87	C_3S_1	0.95	C_1S_0	63.64
14	42.26	2.50	1.6	1.4	2.4	7.40	5.10	1.44	2.72	C_3S_1	0.95	C_1S_0	63.47
15	41.61	2.53	1.8	1.5	2.5	7.30	5.10	1.40	2.71	C_3S_1	0.89	C_1S_0	62.40
16	49.57	4.33	6.9	2.0	5.2	6.88	10.70	1.72	4.78	C4S1	0.81	C_2S_0	61.60
17	49.07	4.16	6.8	1.7	4.9	6.88	10.30	1.79	4.63	C_4S_1	0.83	C_2S_0	60.95
18	48.54	4.06	6.9	1.7	4.8	6.88	10.10	1.78	4.55	C_4S_1	0.84	C_2S_0	60.98
19	45.90	3.37	3.7	1.7	3.7	6.90	8.31	1.51	3.65	C_3S_1	0.83	C_1S_0	59.63
20	44.49	3.24	2.8	1.6	3.6	7.10	7.20	1.55	3.55	C_3S_1	0.89	C_1S_0	60.66
21	43.66	3.18	2.8	1.6	3.5	7.20	6.96	1.55	3.50	C_3S_1	0.89	C_1S_0	60.26
22	42.59	3.02	2.8	1.6	3.2	7.20	6.53	1.55	3.31	C_3S_1	0.88	C_1S_0	59.48
23	43.02	3.06	2.7	1.7	3.3	7.20	6.69	1.54	3.34	C_3S_1	0.88	C_1S_0	59.93
24	42.76	2.99	2.8	1.6	3.2	7.20	6.54	1.54	3.26	C_3S_1	0.88	C_1S_0	59.22
25	41.93	2.90	2.9	1.6	3.0	7.20	6.37	1.54	3.16	C_3S_1	0.88	C_1S_0	58.37
26	41.07	2.87	3.1	1.5	3.0	7.20	6.35	1.56	3.13	C_3S_1	0.87	C_1S_0	57.62
14	42.26	2.5	1.6	1.4	2.4	7.40	5.10	1.44	2.72	C_3S_1	0.95	C_1S_0	63.47
15	41.61	2.53	1.8	1.5	2.5	7.30	5.10	1.40	2.71	C_3S_1	0.89	C_1S_0	62.40
16	49.57	4.33	6.9	2.0	5.2	6.88	10.70	1.72	4.78	C4S1	0.81	C_2S_0	61.60
17	49.07	4.16	6.8	1.7	4.9	6.88	10.30	1.79	4.63	C_4S_1	0.83	C_2S_0	60.95
18	48.54	4.06	6.9	1.7	4.8	6.88	10.10	1.78	4.55	C_4S_1	0.84	C_2S_0	60.98
19	45.90	3.37	3.7	1.7	3.7	6.90	8.31	1.51	3.65	C_3S_1	0.83	C_1S_0	59.63
20	44.49	3.24	2.8	1.6	3.6	7.10	7.20	1.55	3.55	C_3S_1	0.89	C_1S_0	60.66
21	43.66	3.18	2.8	1.6	3.5	7.20	6.96	1.55	3.50	C_3S_1	0.89	C_1S_0	60.26
22	42.59	3.02	2.8	1.6	3.2	7.20	6.53	1.55	3.31	C_3S_1	0.88	C_1S_0	59.48
23	43.02	3.06	2.7	1.7	3.3	7.20	6.69	1.54	3.34	C_3S_1	0.88	C_1S_0	59.93
24	42.76	2.99	2.8	1.6	3.2	7.20	6.54	1.54	3.26	C_3S_1	0.88	C_1S_0	59.22
25	41.93	2.90	2.9	1.6	3.0	7.20	6.37	1.54	3.16	C_3S_1	0.88	C_1S_0	58.37
26	41.07	2.87	3.1	1.5	3.0	7.20	6.35	1.56	3.13	C_3S_1	0.87	C_1S_0	57.62

* $Adj.^R Na = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$ (Suarez, 1981 and Rhoades, 1982)

Water quality class according to USDA (1954); C_1, C_2, C_3, C_4 are low, medium, high and very high salinity; S_1, S_2, S_3, S_4 are low, medium, high and very high sodicity, respectively.

SCAR: sodium/calcium activity ratio Na/√Ca in $mmol_cL^{-1}$ (Gupta 1984).

ICAR water quality class according to Gupta (1979);C-0,C-1,C-2,C_{-3},C_{-4},C_{-5} are non, normal, low, medium, high and very high salinity; S_{-0}, S_{-1}, S_{-2}, S_{-3}, S_{-4}, S_{-5} are non, normal, low, medium, high, and very high sodicity respectively.

Boron

Since values of boron of all studied water reveal a low concentration (from 0.01 to 0.02 mg B L^{-1}) and according to the limits reported by the Branson *et al.* (1975). Water may not have hazard regarding boron since contents do not exceed 1 mg L^{-1}. The current results are similar to those reported by Soliman (1983 and 2000), Mohammed *et al.* (1999) and Abdel-Hamid *et al.* (2000). Gupta (1979) classified irrigation water into five classes on the basis of boron contents and according to such classification all water of the current study would be classified as B_1, i.e. "normal". Therefore water can be used for most crops on most soil.

Conclusion

The monthly water samples collected from 26 locations along EL-Salam canal course and its associated drains for one year period were classified as C_2 (medium salinity) and C_3 class (high salinity), except the Hadous drain water which was classified as C_4 class (very high salinity) according to the USDA (1954). El-Salam samples were classified as C_1 class (good water), whereas water collected from drains may be classified as C_2 class (low salinity water) according to Gupta (1979).

The obtained data showed that the studied water were classified between C_1S_1"low salinity, low sodium" and C_3S_2 "high salinity, low sodium" according to the USDA (1954). These results indicated that water have from low to moderate concentration of soluble salts and slight alkalinity and can be used with care for non salinity-tolerant crops. In addition, these water may be less hazardous when used for light textured soils.

It is recommended that, water of El-Salam canal is either blended with Nile fresh water or mixed with drainage water from neighbouring drains to be used for irrigating most salinity-tolerant and semi-tolerant crops. Good results could be achieved if these water were used for light and/or medium textured soils without problems in the short run, but not recommended for heavy textured soils unless proper management practices are adapted which may be costly.

REFERENCES

Abdel-Hamid, M.W., A.E. Nasr-Alla and K.G. Soliman (2000). Evaluation the quality of irrigation and drainage water contributing to EL-Salam canal, Egypt J. Appl. Sci., 15 (3): 325-345.

Ashoub, T.M., W.H. Abd El-Aziz and S.A. Abd Allah (2010). Studies on the promising areas under reclamation at south port said region reclamation at south port said region 4- assessment of land and water resources of the study area. Egypt J. of Appl. Sci., 25 (12A): 926-940.

Ayers, R.S. and D.W. Westcot (1976). Water quality for agriculture. FAO Irrigation and Drainage Paper No. 29, FAO Rome.

Branson, R.L., P.F. Pratt, J.D. Rhoades and J.D. Oster (1975). Water quality in irrigation water sheds. J. Environ. Quality, 4 : 33- 40.

Doneen, L.D. (1964). Notes on water quality in agriculture. Water Science and Engineering Paper 4001, Dept. of Water Sci. and Engin., University of California.

El-Degwi, A.M.M., F.M. Ewida and S.M. Gawad (2003). Estimating BOD pollution rates along El-Salam canal using monitored water quality data (1998–2001). In: Proceedings of 9th International Drainage Workshop, Paper No 50. The Netherlands, Utrecht, September, 10–13.

El-Nahal, M.A.A., A.A. Abdel-Wahid, K.I. Noman and F.M. Hoyyela (1983). Irrigation potential of drainage water in the Estern Nile Delta Region, Egypt. J. Soil Sci., 23(2):181-184.

El-Sherbieny, A.E., S.A. EJ-Saadany and F. Osman (1998). Seasonal variations in quality of some drainage water in Sharkia Governorate. Egypt J. Soil Sci., 38 (1-4): 185-198.

Gupta, I.C. (1979). Use of saline water in agriculture in arid and semi arid zones of India. Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.

Gupta, I.C. (1984). Reassessment of irrigation water quality criteria and standards. Curr. Agric., 8 : 113-126.

Gupta, I.C. (1990). Use of saline water in agriculture in arid and semi-arid zones of India. Revised Edition Oxford & IBH publishing Co. Pvt. Ltd New Delhi.

Jackson, M.L. (1958). Soil chemical analysis, Printice-Hall, Inc., New Jersey, USA.

Mohammed, I.R., A.E. Nasr-Alla and W.M. Mosad (1999). Evaluation of drainage water quality in El-Garbia Governorate. Egypt. J. Appl. Sci., 14 (7): 285-308.

Mostafa, A.M., S.T. Gawad and S.M. Gawad (2002). Development of water quality indicators for Egyptian drains. ICID, Montreal, Canada, Paper No. Q50/R6.01.

Othman, A.A., S.A. Rabeh, M. Fayez, M. Monib and N.A. Hegazi (2012). El-Salam canal is a potential project reusing the Nile Delta drainage water for Sinai desert agriculture: Microbial and chemical. J. Adv. Res., 3 (2): 99-108.

Rhoades, J.D. (1982). Reclamation and management of salt-defected soils after drainage. Soil and Water Management Seminar, Nov. 29-Dec. 2, Lethbridge, Alberta, Canada.

Soliman, K.G. (1983). Evaluation of drainage water as additional resources for irrigation of Sharkia Governorate. M. Sc. Thesis, Faculty of agriculture, Zagazig University, Egypt.

Soliman, K.G. (2000). Assessing pollution and quality of Bahr El-Bakar drain system water for salinity, sodicity and heavy metals and possibility for reuse in irrigation. Egypt. J. Appl. Sci., 15 (2): 301-328.

Suarez, D.L. (1981). Relation between pHc and sodium adsorption ratio (SAR) and an alternative method of estimating SAR of soil or drainage water. Soil Sci. Soc. Am. J., 45: 469-475.

USDA Staff (1954). Diagnosis and improvement of saline and alkali soils: US Dept. Agriculture Handbook 60. US Government Printing Office, Washington, DC.

Wiklander, L. (1977). Leaching of plant nutrients in soils IV. Contents in drainage water arid ground water. Acta Agricultura Scandinavica, 27.

التقييم المكاني والزمني لمصادر مياه ترعة السلام لأغراض الري

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تم اخذ عينات مياه من فرع دمياط (نهر النيل) وترعه السلام (مياه مخلوطة) والمصارف المغذية لها ابتداء من العدلية عند فرع دمياط الى سحارة ترعة السلام بطول ٨٩كم فى الفترة من شهر أكتوبر عام ٢٠٠٩ الى شهر سبتمبر ٢٠١٠ وذلك لدراسة الإختلافات الموسمية فى التركيب الكيميائى بهدف تحديد صلاحية المياه وكذلك بيان مدى الاستفادة منها واستخدامها فى أغراض الرى. وأوضحت النتائج أن متوسط رقم الحموضة تراوح من ٧,٧ - ٨,٠٣ وذلك يدل على ظهور بعض القلوية على المدى الطويل. كما تراوحت تركيز الأملاح بين ٠,٤٦-٢,٦٢ ديسي سيمنز/متر.بلغت أقصاها فى المصارف المغذية لترعة السلام حيث كانت أعلى من ٢,٣٤ ديسى سيمنز/متر وكان متوسط قيم الملوحة ١,٥١ ، ١,٩١ ، ١,٢٥ ، ٢,٦٢ ديسى سيمنز/متر للمغذيات مصرف فارسكور والعطوى والسرو السفلى وحادوس على الترتيب وكانت قيم SAR للمغذيات ما بين ١٠-٢٠ حيث تم تقسيم المياه الى A_2 تبعا لتقسيم جوبتا عام ١٩٧٩ مما يشير إلى انخفاض الصودية فى المياه. كما تراوحت قيم الكالسيوم ما بين ١,٩٤-٤,١٦ والماغنسيوم مابين ٢,١٨-٨,٨٨ والبوتاسيوم ما بين ٠,٢١-٠,٧٤ والكلوريد ١,٧٢-٢٠,٤٢. وقد دلت النتائج على أن هذه المياه تحتوى على تركيزات متوسطة من الملوحة والقلوية وبالتالى يمكن استخدامها مع بعض المحاصيل وخاصة متوسطة التحمل للملوحة مع توافر خدمة مناسبة للتربة والمياه ويرجع سبب ارتفاع الملوحة إلى الاختلافات الموسمية بالإضافة إلى خلط مياه النيل مع مياه المصارف.