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Assessment of Water Quality of El-Salam Canal West of Suez Canal, Egypt

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ABSTRACT

During the summer and winter seasons of 2014 and 2015, a total of 14 samples (7 samples in winter and 7 in summer) was collected from 7 sampling points as follow: Damietta branch, El-Serw drain, El-Salam canal after mixing with El-Serw drain, Bahr Hadous drian, El-Salam canal after mixing with Bahr Hadous drain, El-Salam canal at El Assafra Bridge and El-Salam canal before El-Sahara. The aim of this research is to study the extent of water contamination in Elsalam canal west of Suez Canal as a result of mixing drainage water with Nile water. The results showed that the chemical analysis (salinity and alkalinity) of the studied locations of El-Salam canal differs due to the ratio of mixed the drainage water with Nile water and also differs in different seasons (summer and winter). Higher values of heavy metal ions (Fe^{2+}, Zn^{2+}, Mn^{2+}, Cu^{2+}, Cd^{2+} and Pb^{2+}) were noted after the second mixed stage compared with the first stage at Damietta branch, especially in summer season. It is necessary to note that periodically monitor the water of El-Salam Canal is recommended to avoid the risks results on the surrounding agricultural environment.

Keywords: irrigation water quality; heavy metals, water salinity and alkalinity, El-Salam canal, Egypt.

INTRODUCTION

The most important problem of water resources management in Egypt is the imbalance between increasing water demand and limited water supply. The new land projects require substantial amounts of water that can only be found through better water irrigation efficiency on already irrigated old lands as well as the reuse of drainage water and treated waste water (Moubarak, 2009).

El-Salam canal starts from Damietta river Nile branch and runs south east towards lake of El-Manzala then south to mix with El-Serw drainage water at of the ratio 1:1 then moves east and then again south to mix with Hadous drainage water then moves east under Seuz canal to Sinai peninsula Refae *et al*., (2006). Electrical conductivity for El-Salam canal water was in the range 1.37- 1.60 dSm^{-1}., Mohamed, (2013) also Azza Hafez, (2005) found that the salinity of El-Salam canal water is not only due to the ratio of mixing the drainage water with the Nile water 1:1 but it may be due to the evaporation factor and high wind speed. The other probability the filtration factor which result from the hydraulic pressure of high salinity water sources .The lowest value of EC was recorded in winter season compared with summer season; this may be the most prominent due to the low temperature in winter, thus reducing evaporation from the roofs of irrigation water used in the region, and these agree with Abdel Kawy and Ali, (2012) and Mohamed, (2013). Fourteen heavy metals were measured in the investigated El-Salam canal water samples, these are: Al, B, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sr, V and Zn. Generally, the concentrations of these heavy metals are relatively higher than in the River Nile. The highest recorded values are: Al 1.86, B 3.74, Cd 0.08, Cr 0.06, Cu 0.06, Fe 2.56, Mn 0.61, Pb 1.71, Sr 1.31, V 0.15 and Zn 0.66 mgl^{-1}. These anomalous higher values are mainly attributed to the mixing with the agricultural drains which contain higher levels of heavy metals, Azza Hafez, (2005).The concentrations of trace elements (especiallyPb^{+2}) were increased with increasing the leaching periods under fish farm. Also this means that, heavy metals concentrations tend to increase in the drainage water this data were in an agreement with that observed by FAO, (1992) and Abdel-Salam,*et al*., and El-Hussieny, (2002). Faragand Mehana, (2000) reported that the content of the studied trace elements of the tested water sources can be arranged as follows: Bahr El-Bakar drain > El-Salam canal > Bahr Hadoos drain. The magnitudes of heavy metals concentrations in Nile water can be ranged in the following order Fe^{2+}>Zn^{2+}>Cu^{2+}>Mn^{2+}>Pb^{2+} (Moubarak, 2009). The aim of this research is to study the extent of water contamination in Elsalam canal west of Seuz Canal as a result of mixing drainage water with Nile water.

MATERIALS AND METHODS

During the summer and winter seasons of 2014 and 2015, a total of 14 samples (7 samples in winter and 7in summer) was collected from 7 sampling points as follow: Damietta branch, El-Serw drain, El-Salam canal after mixing with El-Serw drain, Bahr Hadous drian, El-Salam canal after mixing with Bahr Hadous drain, El-Salam canal at El Assafra Bridge and El-Salam canal before El-Sahara. The water samples were filtrated using filter paperNo.1 and subjected to chemical analysis as follow:EC, pH and soluble ions were determined according to Klute, (1986). Also, SAR wasCalculated as follow:SAR=Na/$\sqrt{ca + Mg/2}$. The soluble heavy metals ions concentrations (Fe^{2+}, Zn^{2+}, Mn^{2+}, Cu^{2+}, Pb^{2+} and Cd^{2+}) were determined using atomic absorption spectrophotometer, according to Champan and Pratt, (1961).

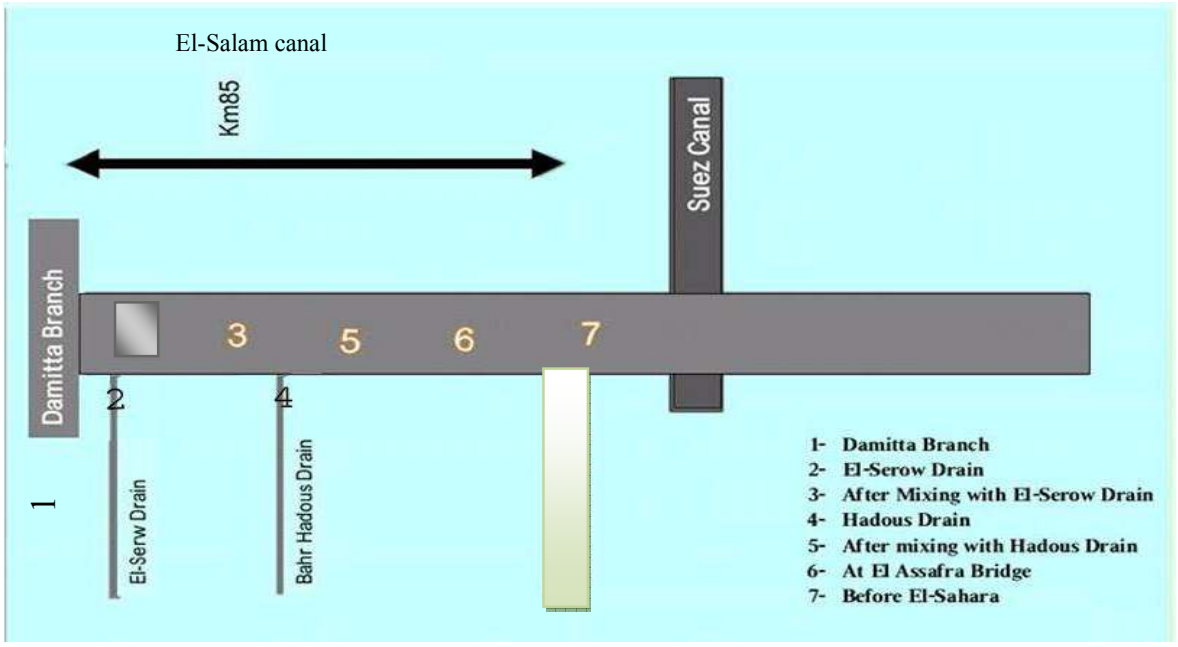

Fig.1. The schematic map of the studied area Water Sample

RESULTS AND DISCUSSION

Values of pH, EC (dSm^{-1}), soluble cation and anions ($mmol_c\ L^{-1}$) and SAR in different water samples during summer and winter seasons.

Data reported in Tables 1 and 2 show that, the average EC values of El-Salam canal water ranged from 0.7 to 2.6 and 0.7 to 1.89 dSm^{-1}, in summer and winter season respectively., the presented results indicate that the lowest value of irrigation water salinity was in Damietta branch 0.7 dSm^{-1} while the highest value was found in Hadous drain (2.6) dSm^{-1}, this notable may be due to that , large amount of this water contains sewage , industrial waste water , salts , heavy metals and residues of agricultural pesticides. In this concern Mohamed, (2013) found that electrical conductivity for El-Salam canal water was in the range 1.37- 1.60 dSm^{-1}., also Azza Hafez, (2005) found that the salinity of El-Salam canal water is not only due to the ratio of mixing the drainage water with the Nile water 1:1 but it may be due to the evaporation factor and high wind speed. The other probability the filtration factor which result from the hydraulic pressure of high salinity water sources.

Also, data reported in Table 1 and 2 reveal that, the low value of EC was recorded in winter season compared with summer season, due to the low temperature in winter, thus reducing evaporation from the roots of irrigation water used in the region and this agree with Abdel Kawy and Ali, (2012) and Mohamed, (2013).

Data show that the mean pH values of the collected water samples ranged from 7.74 to8.11 and 7.27 to 7.65 in summer and winter season, respectively. The results indicate that the lowest value of irrigation water pH was found in Hadous drain 7.83 while the highest value 8.11was found inafter mixing with Hadous drain. This may be the most prominent due to the various sources of water pollution which is acidic and thus reduce the pH of water. In this concern Moubarak, (2009) , found that the average pH of El-Salam canal ranged from 7.66 to 8.04. Table 2 shows that, the dominant cation was Ca, followed by Mg then Na and K. On the other hand the distributions of soluble anions were Cl > HCO_3 and SO_4, while the soluble cation are in the order of: Ca > Mg > Na > K for the summer season in contrast with the mixed water location and drainage water location. Also, it was noticed the same behavior and trend was found in the winter season for all locations. The soluble sodium ions are the dominant ions followed by Mg^{2+} ions in the mixed water or Ca^{2+} ions in the drainage water. Potassium ions are the least in studied summer seasons.

The highest values of soluble ions are recorded in Hadous Drain, while the lowest ones are recorded in the Damietta branch;these results could be in enhanced with those obtained by each of Moubarak, (2009) and Mohamed, (2013).The results also indicate that SAR values ranged between 1.57 to 8.7 and 0.76 to 6.8 in summer and winter season, respectively. The highest values of SAR were 6.8 and 8.7 after mixing with Hadous drain water, while the lowest values of SAR were 0.76 and 1.57 in the Damietta Branch. This means that sodium hazard is small for the mixed drainage water. In this concern Moubarak, (2009) who showed that the average SAR in El-Salam canal water ranged between 3.73 to 9.77 in mixed water of El-Salam canal, and the this agree with Othman, *et al*., (2012).

Table 1. Values of pH, EC (dSm^{-1}), soluble cation and anions ($mmol_c\ L^{-1}$) and SAR in different water samples during summer.

No Sample	pH	EC dSm^{-1}	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{2-}	SAR
Damietta branch	7.74	0.7	2.4	1.9	2.3	0.27	1.7	1.4	3.77	1.57
El-Serw drain	7.98	1.6	3.5	3.9	8.9	0.31	2.8	6.2	7.61	4.6
After mixing with El-Serw drain	7.88	1.1	2.7	2.8	6.2	0.27	2.9	1.5	7.57	3.8
Hadous drain	7.83	2.6	3.9	6.5	14.5	0.39	6.5	6.7	12.09	6.5
After mixing with Hadous drain	8.11	2.1	4.1	2.2	14.9	0.22	5.2	6.3	9.92	8.7
At El Assafra bridge	7.52	2.3	5.5	3.1	13.8	0.28	4.6	7.9	10.18	6.9
Before El-Sahara	7.71	2.4	5.1	4.2	14.1	0.29	4.7	7.5	11.49	6.7

Table 2. Values of pH, EC (dSm^{-1}), soluble cation and anions ($mmol_c\ L^{-1}$) and SAR in different water samples during winter.

No Sample	pH	EC dSm^{-1}	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{2-}	SAR
Damietta branch	7.4	0.70	2.0	4.4	1.3	0.23	4.0	1.2	2.73	0.76
El-Serw drain	7.27	1.63	3.2	3.4	9.5	0.28	4.2	4.8	7.38	5.2
after mixing with El-Serw drain	7.46	1.10	2.2	4.2	3.9	0.25	3.8	1.8	4.95	2.2
Hadous drain	7.65	1.30	2.2	5.4	5.6	0.24	4.2	3.2	6.04	2.9
After mixing with Hadous drain	7.31	1.89	5.6	3.6	14.3	0.33	6.6	8.0	9.23	6.8
At El Assafra bridge	7.44	1.83	5.6	3.8	14.7	0.34	6.2	7.2	11.0	6.8
Before El-sahara	7.35	1.63	4.2	1.6	10.4	0.25	5.6	5.0	5.85	6.1

Heavy metals of water samples in summer and winter seasons

Data in Table 3 and 4 show the concentrations of Zn^{2+}, Cu^{2+}, Mn^{2+}, Fe^{2+}, Cd^{2+} and Pb^{2+} in the water samples in the studied locations. It is evident from the data that the ions of Zn^{2+}, Cu^{2+}, Mn^{2+}, Fe^{2+}, Cd^{2+} and Pb^{2+}in the location 2 to 7 were higher than Damietta branch . It is noticed also that the high values of the ions were obtained in location 2 followed by 3,4,5,6 and 7.

In addition, it is noticed that location 2 to 7 have high values of plant nutrients compared by 1. This is probably due to the effect of different sources of pollution bearer of heavy elements (such as agricultural pesticides and exchange of the remains of some factories in the agricultural drains and extravagance in use of agricultural fertilizers and others, and various other sources of pollution in the study area), similar results were obtained by Moubarak, (2009). In this concern Azza Hafez, (2005)stated that fourteen heavy metals were measured El-Salam canal water samples, these are: Al, B, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sr, V and Zn. Generally, the concentrations of these heavy metals are relatively higher than in the River Nile. The highest recorded values are: Al 1.86, B 3.74, Cd 0.08, Cr 0.06, Cu 0.06, Fe 2.56, Mn 0.61, Pb 1.71, Sr 1.31, V 0.15 and Zn 0.66 mgl^{-1}. These anomalous higher values are mainly attributed to the mixing with the agricultural drains which contain higher levels of heavy metals. Also, data reported in Table 3 and 4 show that, the low values of Zn^{2+}, Cu^{2+}, Mn^{2+}, Fe^{2+}, Cd^{2+} and Pb^{2+} were recorded in winter season compared with summer season, This may be the most prominent due to the low temperature in winter, thus reducing evaporation from the roofs of irrigation water used in the region., rainfall may cause dilution of salts in water of El-Salam Canal, the this agree with Abdel Kawy and Ali, (2012), Mohamed, (2013)and Azza Hafez ,(2005).

The heavy metals concentrations in water samples can be ranged in the following order Pb^{2+}> Cu^{2+}> Mn^{2+}> Cd^{2+}>Fe^{2+}>Zn^{2+}, for the summer seasons while in winter season the treated was as follows Pb^{2+}> Mn^{2+}> Cu^{2+}> Fe^{2+}> Zn^{2+}> Cd^{2+}.

The magnitudes of heavy metals concentrations in Nile water can be ranged in the following order Fe^{2+}>Zn^{2+}>Cu^{2+}>Mn^{2+}>Pb^{2+}.These results may be due to the high initial values of heavy metals due to sewage effluent.

Table 3. Micronutrient and heavy metals concentration in water samples during summer (mg kg^{-1})

No Sample	Zn^{2+}	Cu^{2+}	Mn^{2+}	Fe^{2+}	Cd^{2+}	Pb^{2+}
Damietta branch	0.312	2.23	0.79	0.97	0.045	4.86
El-Serw drain	0.233	7.29	2.97	2.12	0.221	5.14
After mixing withEl-Serw drain	0.252	6.64	1.70	0.25	0.143	5.59
Hadous drain	0.218	7.10	3.98	1.30	0.375	3.21
After mixing with Hadous drain	0.362	4.47	0.88	1.21	0.496	4.16
At El Assafra bridge	0.291	6.87	2.9	1.13	0.267	4.40
Before El-sahara	0.573	4.98	3.10	1.30	2.17	5.20

Table 4. Micronutrient and heavy metals concentration in water samples during winter (mg kg^{-1})

No Sample	Zn^{2+}	Cu^{2+}	Mn^{2+}	Fe^{2+}	Cd^{2+}	Pb^{2+}
Damietta branch	0.212	1.25	0.39	0.92	0.045	3.86
El-Serw drain	0.203	6.22	1.77	2.37	0.111	4.17
after mixing with El-Serw drain	0.202	5.66	1.53	0.29	0.153	4.59
Hadous drain	0.218	6.18	1.68	1.39	0.225	4.28
After mixing withHadous drain	0.312	3.48	0.88	1.29	0.296	4.18
At El Assafra bridge	0.211	6.29	1.9	1.20	0.266	4.45
Before El-sahara	0.503	2.32	2.65	1.36	0.215	5.20

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تقييم جودة مياه ترعة السلام غرب قناة السويس, مصر

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يهدف هذا البحث الى تقييم بعض الخواص الكيميائية لمياه الري لترعة السلام غرب قناةالسويس ولتحقيق هذا الهدف تم جمع 14عينة مياه من سبع مواقع على مسار ترعة السلام خلال موسمى الشتاء و الصيف 2014-2015 كالتالى: 1- منطقة المأخذ من مياه النيل (فرع دمياط),2- مياه مخلوطة بنسبة 1:1 من مياه النيل ومياه مصرف السرو , 3- مياه مصرف السرو , 4- مياه مصرف حادوس ,5- مياه ترعة السلام المخلوطة مرة واحدة مع مياه مصرف حادوس , 6- المياه المخلوطة من المرحلة الثانية والتي تمر عند كوبري الصفراء , 7- مياه مرحلة الخلط الثانية قبل الصحارة (حادوس والسرو). وتم تحليلها واظهرت النتائج ان الخواص الكيميائية (الملوحه والقلويه) لمياه الرى لترعة السلام للمواقع المدروسه كانت مختلفه بسبب خلط مياه النيل مع مياه الصرف المختلفه وأيضاً كانت مختلفه فى موسمى الدراسه الشتاء عن الصيف وقد لوحظ ارتفاع مستويات العناصر الثقيله تحت الدراسة (الحديد , الزنك , المنجنيز , النحاس , الكادميوم والرصاص) فى مرحلة الخلط الثانية بالمقارنة بالموقع الاول (منطقة المأخذ من مياه النيل (فرع دمياط)خاصة فى فصل الصيف عن الشتاء. ومن النتائج السابقة يمكن القول بضرورة المتابعة الدورية لمياه الرى لترعة السلام المخلوطة ومعالجتها لتجنب مخاطرهاعلى البيئة الزراعية المحيطة.