TRACE ELEMENTS STATUS IN THE SALINE SOILS LEACHED BY USING LOW QUALITY WATER

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ABSTRACT

This study was carried out on saline soils of Sahl El-Houssinia, El-Sharkia Governorate to evaluate three different water sources as a leaching and irrigation water in these soils and their use effect on some trace elements accumulation in the different soil layers. The using water sources were Bahr El-Bakar drain, Bahr Hadoos drain and El-Salam canal. These sources were used in the leaching three different locations of saline soils under fish-pond farms (contentious leaching) for 0, 3, 5 years followed by cultivation of rice and wheat.

The used water sources were analyzed for total soil salts, soluble ions, pH and the content of some macronutrients (N, P and K) and trace elements (Fe, Mn, Zn, B and Pb) and evaluated as a source of irrigation water according to the international system of water quality classification which appeared the suitable use of these sources in leaching and irrigation the saline soils especially in the short-time.

Soil samples at the depth of 0 - 30, 30 - 60 and 60 - 90 cm were taken from each studied area before leaching, after leaching for 3 and 5 years and after of rice or wheat plants harvesting. The soil samples were prepared for determination their content of available trace elements (Fe, Mn, Zn, B and Pb).

The soil content of the determined trace elements was increased with leaching period increase, where it's decreased with the increase of soil depth. These results were found with all used water sources. The relative increase of trace elements concentration was clear related with water source, initial concentrations of trace elements in water and soil, the type of trace element, leaching period, soil depth and cultivated plant.

Keywords: Water quality, Saline soil, Leaching, Irrigation, Trace elements.

INTRODUCTION

Farag and Mehana (2000) reported that, the concentration of Fe, Mn, Zn, B and Pb in El-Salam canal water was much lower than these of maximum permissible limits for irrigation water. **Mostafa (2001)** noted that, the concentrations of Fe, Zn, Mn and Cu in Nile water, drainage water and sewage water were 422; 618 and 723; 57.1; 724 and

142; 16.5, 29.3 and 25.6 and 33.1, 67.4 and 85.0 ug/l respectively. Also, **Zein et al. (2002)** showed that, the concentrations of Pb, Mn, Zn, Ni and Cu in the Nile water were 0.05, 0.011, 0.10, 0.004, 0.021 and 0.022 mg/l respectively. However, the content of these metals in the drainage water were 0.50, 0.17, 0.19, 0.02, 4.94 and 0.08 mg/l for the first treatment and 0.73, 0.27, 0.18, 0.03, 3.47 and 0.06 mg/l in second one , respectively. Recently, **Ibrahim (2004)** found that, the natural fresh waters showed a very wide range in their concentrations of heavy metals depending on variations in climate, geology and anthropogenic activities. In other study of **El-Wakeel et al. (1986a)** found that the content of B in water sources of Nile Delta ranged between 0.105 – 0.231 mg/l and increased with increasing salinity of water.

Hafiz (2001) reported that, the concentrations of Fe, Mn, and Zn was high in the soils irrigated by sewage water, secondary treated sewage water, canal polluted water and wastewater as compared with those of normal fresh water. **El-Shikh (2003) and Tantawy (2004)** observed that, irrigation with different water qualities led to an insignificant variation on the available content of most trace elements (Co, Ni, Pb and Cd). They also observed that, the content of these trace elements was decreased with the increase of soil depth. **Tantawy (2004)** added that, the soil content of Pb depended on irrigation water quality, soil properties and soil depth.

The main aims of this study were: 1- Evaluation of some irrigation water sources in Sahl El-Houssinia El-Sharkia Governorate. 2- Study of the effect of water quality, leaching period and cultivated plants on: a) Some chemical properties of the studied soils and b) The content of some trace elements and its distribution in these soil profiles, and 3- Evaluation of low quality water sources affinity in salt affected soil leaching.

MATERIALS AND METHODS

This study was carried out on the soils of three locations of Sahl El-Houssinia, El-Sharkia Governorate which classified as salt affected soils. These locations have different three water sources which used in leaching and irrigation the soils in three locations, where the water sources were Bahr El-Bakar drain (mixed of agriculture drainage water and sewage effluent); El-Salam canal (mixed of agricultural drainage water and Nile water by mixed ratio of 1:1) and Bahr Hadoos drain (agriculture drainage water). Nine fed of each location were selected where their divided into 9 experimental units (the area of each unit was one fed = 4200 m^2). The units of each location were divided into three groups. The first group of the three locations was left without leaching where the second and third groups were leached using the presented water source under fish-pond farm cultivation for 3 and 5 years. After that, these units were cultivated by rice (Giza 178) (continuous leaching for 5 months) and wheat (Sakha 8) using the available water sources, respectively. The primary farming treatments which were conducted in each experiment unit were: a) leveling the soil surface by using layer technique; b) deep sub-soiling plough; c) stablemen of filed drains at a distance of 10 m between each of tow drains and deep of 90 cm of the drain beginning, their drainage water flow towards the main collectors of 2 m in depth and d) establishment of an irrigation canal in the middle part of the experimental units.

The waters of the studied sources were analyzed before beginning the leaching process directly and every six months for total soluble salt (EC dSm^{-1}), soluble ions (meq/l), pH, NH4-N, NO3-N, P and K (mg/l) and trace elements (mg/l) using the described methods by **Jackson (1973) and Page (1982)**. Soil samples were taken from each experimental unit before and after leaching periods and after harvesting of rice and wheat plants at the depth of 0 – 30, 30 – 60 and 60 – 90 cm. The soil samples were air-dried, ground, sieved through a 2 mm sieve and analyzed for some chemical properties and their content of some trace elements. There analyses were carried out according to **Jakson (1973), Cottenie et al. (1982) and Page (1982)**. The chemical properties of the studied soil samples were listed in Table (1).

Table (1) Some chemical properties of the studied soils as affected by the available water resources after a fish-pond farm, rice and wheat filed

Water source *	Period (year)	Depth (cm)	After a fish pond farm			after a rice field			after a wheat field		
			pH (1-2.5)	EC (dS/m)	ESP %	pH (1-2.5)	EC (dS/m)	ESP %	pH (1-2.5)	EC (dS/m)	ESP %
Bahr El-Bakar drain	0	0 – 30	8.15	59.5	34.3	8.12	20.2	20.3	8.18	10.8	22.0
		30 – 60	8.40	62.4	45.4	8.30	21.4	20.8	8.25	11.9	21.7
		60 – 90	8.70	50.7	38.2	8.51	23.3	20.4	8.32	13.2	20.5
		Mean	8.42	57.5	39.3	8.31	21.6	20.5	8.25	11.97	21.4
	3	0 – 30	8.12	18.9	19.3	8.16	11.1	15.4	7.95	10.5	21.1
		30 – 60	8.16	27.3	23.8	8.23	12.9	16.3	7.96	11.5	21.8
		60 – 90	8.55	19.1	12.5	8.40	15.1	16.8	7.99	12.0	20.2
		Mean	8.27	21.7	18.5	8.26	13.03	16.2	7.97	11.33	21.0
	5	0 – 30	8.10	15.9	15.1	8.01	9.4	15.7	7.90	10.0	20.5
		30 – 60	8.17	16.1	11.1	8.12	10.2	15.9	8.15	10.3	16.9
		60 – 90	8.35	15.6	14.3	8.15	11.5	14.9	8.20	11.7	20.1
		Mean	8.21	15.8	13.5	8.09	10.37	15.5	8.08	10.6	19.2
El-Salam canal	0	0 – 30	8.27	54.2	44.3	8.35	15.7	22.2	8.32	11.7	22.5
		30 – 60	8.30	50.8	33.4	8.40	17.3	22.8	8.37	12.1	24.8
		60 – 90	8.41	48.7	38.3	8.48	22.4	28.2	8.12	12.6	26.6
		Mean	8.32	51.23	38.7	8.41	18.47	24.2	8.27	12.1	24.6
	3	0 – 30	8.32	26.1	24.1	8.45	13.5	21.2	8.21	11.1	22.4
		30 – 60	8.20	28.7	25.0	8.47	15.2	21.7	8.43	11.2	23.8
		60 – 90	8.28	31.7	28.0	8.52	17.5	24.1	8.35	11.3	26.7
		Mean	8.27	28.83	25.7	8.48	15.4	22.3	8.33	11.2	24.3
	5	0 – 30	8.56	19.6	19.4	8.34	12.0	20.8	8.43	9.7	20.9
		30 – 60	8.30	22.6	26.7	8.37	12.8	20.3	8.47	11.2	21.8
		60 – 90	8.36	27.7	25.0	8.42	16.6	24.4	8.36	11.3	20.7
		Mean	8.41	23.3	23.7	8.38	13.8	21.8	8.42	10.73	21.1
Bahr Hadoos drain	0	0 – 30	8.91	39.4	34.1	8.45	22.05	24.7	8.45	14.6	21.4
		30 – 60	8.67	34.5	30.5	8.36	18.7	24.2	8.50	14.5	22.6
		60 – 90	8.42	27.6	31.7	8.27	20.1	22.9	8.41	12.65	23.3
		Mean	8.66	33.8	35.1	8.38	20.3	23.9	8.45	13.91	22.4
	3	0 – 30	8.56	21.8	31.3	8.02	11.9	23.9	8.52	12.3	23.4
		30 – 60	8.20	23.4	28.6	8.13	13.7	23.3	8.54	11.6	20.9
		60 – 90	8.61	24.8	25.4	8.15	15.0	22.9	8.32	11.7	21.4
		Mean	8.46	23.33	28.4	8.10	13.53	23.4	8.40	11.87	21.9
	5	0 – 30	8.31	11.85	17.4	7.98	10.7	23.2	8.7	10.5	21.1
		30 – 60	8.50	12.41	18.7	8.01	11.3	22.4	8.61	11.4	22.8
		60 – 90	8.55	13.3	17.7	8.06	13.5	16.0	8.63	9.78	20.6
		Mean	8.45	12.5	17.9	8.02	11.83	20.5	8.65	10.5	21.6

RESULTS AND DISCUSSION

1- Chemical analysis of irrigation water sources

a) Water salinity

The presented values of EC (dSm^{-1}) of the tested water sources in Table (2) were varied widely depending on water source. According to the values of EC, the testes sources taken the following order Bahr Hadoos drain > Bahr El-Bakar drain > El-Salam canal. These values indicate that, the water in these sources is classified as moderate salinity **(Ayers and Westcot, 1985 and Kandial, 1990)**. The previous trend for the used water sources are mainly due to water derived from both Bahr El-Bakar and Bahr Hadoos drains included drainage water contaminated with sewage effluent , but El-Salam canal water was derived from fresh Nile water mixed with drainage one **(Hassanin et al., 1993)**.

Table (2) chemical analysis of the used water sources

Water Sources	pH	EC (dS/m)	Soluble Cations (meq)				Soluble Anions (meq)				SAR
			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO^{-2}_{3}	HCO^{-}_{3}	Cl^{-}	SO^{-2}_{4}	
Bahr El-Bakar drain	8.21	2.38	4.6	5.8	12.9	0.59	Nil	3.7	8.7	11.26	5.66
El-Salam canal	8.26	1.83	3.2	4.5	10.3	0.36	Nil	2.5	7.6	8.22	6.54
Bahr Hadoos drain	8.38	2.31	3.7	5.2	11.8	0.25	Nil	3.4	10.2	9.52	5.26

Also the variations in the EC values obtained during leaching periods may be attributed to dilution effect for the internal seepage of the agriculture drainage water as result of variations in the amounts of water used at different seasons. These results are in agreement with the findings of **El-Sherbieny et al. (1998)**. As for the specific ions of soluble ions, data in Table (2) indicates that, the tested irrigation water sources varied widely in their content of soluble cations and anions, where the arrangement for the content of these ions was similar in all sources of irrigation waters under study. This arrangement was $Na^{+} > Mg^{+2} > Ca^{+2} > K^{+}$ for soluble cations and $Cl^{-} > SO_4^{-2} > HCO_3^{-}$ for soluble anions. These water sources were free from soluble CO^{-2}_{3}. The variations in the content of soluble ions may be resulted from the variation of salinity of drained soil **(El-Sebeay, 1995)**. Regarding to the concentration of Ca^{+2} **+** Mg^{+2} and CO^{-2}_{3} **+** HCO^{-}_{3}, these sources of irrigation water may be considered as a good source for irrigation water. The concentration of CO^{-2}_{3} + HCO^{-}_{3} was higher than of Ca^{+2} + Mg^{+2} **(El-Sherbiny et al., 1998 and Shaban, 1998)**. The obtained values in Table (2) also show that, according to the values of SAR, the tested water sources takes the order of Bahr Hadoos drain > Bahr El-Bakar drain > El-Salam canal. The classification of these sources according to **Ayers and Westcot (1985**) and based on their values of SAR, it can be said that, these sources located in the first and second categories for Bahr El-Bakar drain SAR <6 , and both of Bahr Hadoos drain and El-Salam canal (SAR < 9) respectively. Also, according to the previous system of irrigation water classification the tested water are slight – moderate as a degree of restriction on use Therefore these waters can be safety used as a source of irrigation in the studied soils. Also, the data of Table (2) reveal that, the pH values of the tested waters were in normal range, according to **Ayers and Westcot (1985).**

Each value represents the mean values of the determined values during the leaching process

b) The content of macronutrients

Data in Table (3) showed that, the tested waters were varied widely in their content of both NH4-N and NO_3-N where these sources can be arranged according to this content as follows: Bahr Hadoos drain > Bahr El-Bakr drain > El-Salam canal. According to **Ayers and Westcot (1985)**, it can be concluded that, the values of NO_3-N which ranged between < 5.0 – 30 mg/l in the tested waters sources located within in the range of slight–moderate category. Regarding to the tested waters content of P, the tabulated data in Table (3) showed that, this content was varied from one to another. In general the content of P trend to increase in the irrigation water sources according to this order: Bahr Hadoos drain > Bahr El-Bakar drain > El-Salam canal. **Shaban (1998) and Mostafa (2001)** obtained on similar results. On the other hand, the arrangement of these water sources according to their content of K was Bahr El-Bakar drain > Bahr Hadoos drain > El-Salam canal. This was means that, K concentrations tend to increase in the drainage water contaminated with sewage water **(Mostafa, 2001)**.

Table (3) Macro-and Micro-nutrients and Pb content in irrigation water

Water Sources	Nitrogen (mg/l)		P (mg/l)	K (mg/l)	Micro nutrients (mg/l)				Pb (mg/l)
	NO_3–N	HN_4-N			Fe	Mn	Zn	B	
Bahr El-Bakar drain	8.61	19.46	6.3	10.21	0.92	0.39	0.66	0.045	0.45
El-Salam canal	4.94	12.78	4.8	12.43	0.63	0.52	0.38	0.087	0.21
Bahr Hadoos drain	6.34	16.24	5.6	9.78	0.51	0.31	0.52	0.046	0.32

Each value represents the mean values of the determined values during the leaching process.

The content of trace elements

The presented data in Table (3) show the water sources contents of Fe, Mn, Zn, B and Pb were varied widely, but according to **National Academy of Science and National Academy of Engineering (1972)** (Table 4) were presented within safe or permissible limits and possible using these water sources for irrigation in the studied soils **(FAO, 1992 and Farag and Mohana, 2000).** According to the content of the studied trace elements, the tested water sources can be arranged as follows: Bahr El-Bakar drain > El-Salam canal > Bahr Hadoos drain.

Table (4) Safe limits of trace elements concentrations National Academy of Science and National Academy of Engineering (1972)

Time use	Trace elements concentration (mg/l)				
	Fe	Mn	Zn	B	Pb
Long term use *	5.0	0.2	2.0	0.75	5.0
Sorts-term use**	15.0	10.0	1.0	2.0	10.0

* For water used continuously on all soils
** For water used a period of up to 20 years fine – textured neutral or alkaline soils

These results are in agreement with the findings of **Shaban (1998) and Mostafa (2001)**.

Effect of leaching water quality on the trace elements availability

Data in Table (5) show the soil content (mg/kg soil) of Fe, Mn, Zn, B and Pb at various soil depth as affected by quality of irrigation water, leaching period and cultivated plant. The concentrations of trace elements were increased with increasing the leaching periods under fish-pond farm as well as after rice and wheat crops cultivation. In all experimental units the concentrations of trace elements were decreased with the increase the depth of soil.

This is mainly due to their surface accumulations from the used irrigation water; especially these are contaminated with sewage effluent such as Bahr El-Bakar drain as well as soil management practices and micro-organisms activities in top soil which positively affected the availability of these elements in the soil. Similar results were obtained by **Mostafa (2001) and Tantawy (2004)**.

The calculated values of relative increase (RI) of trace elements concentrations as a percentage (%) of their initial concentrations (Table 5) were recorded in Table (6). The obtained values of RI were varied widely according to water source, leaching period and soil depth.

Table (5) The content of available trace elements in the studied soils as affected by the studied treatments

*Water resources	Period leaching (year)	Depth (cm)	Available micronutrients and trace elements (mg/kg soil)														
			After a fish-pond farm					After a rice field					After a wheat field				
			Fe	Mn	Zn	B	Pb	Fe	Mn	Zn	B	Pb	Fe	Mn	Zn	B	Pb
Bahr El-Bakar drain	0	0 – 30	8.3	3.73	0.46	0.22	5.90	9.2	5.10	0.66	0.54	6.80	9.9	5.73	0.85	0.62	6.20
		30 – 60	7.40	3.43	0.28	0.18	4.60	8.9	4.40	0.58	0.39	5.60	7.8	4.60	0.75	0.45	5.70
		60 – 90	7.30	3.10	0.16	0.17	4.30	7.2	3.60	0.26	0.26	4.80	7.5	3.63	0.46	0.40	4.10
		Mean	7.60	3.43	0.30	0.19	4.90	8.40	4.33	0.50	0.39	5.70	8.40	4.63	0.89	0.49	5.33
	3	0 – 30	11.2	5.37	0.49	0.29	6.80	11.5	6.40	0.97	0.61	7.20	13.1	6.73	1.42	0.66	7.50
		30 – 60	9.70	4.10	0.37	0.27	5.20	9.20	5.10	0.69	0.43	5.40	10.1	5.43	1.21	0.50	5.90
		60 – 90	6.10	3.27	0.32	0.16	4.60	7.30	3.57	0.34	0.35	3.20	8.2	3.76	0.92	0.43	4.25
		Mean	9.0 0	4.26	0.39	0.24	5.51	9.30	5.03	0.67	0.46	5.50	10.4	5.30	1.18	0.53	5.90
	5	0 – 30	12.6	6.03	1.92	0.30	7.00	12.4	6.73	2.61	0.65	7.70	15.2	7.36	2.57	0.75	8.00
		30 – 60	9.20	4.7	0.85	0.25	5.50	10.7	5.03	1.54	0.55	5.50	11.7	5.73	1.36	0.65	6.10
		60 – 90	7.80	3.30	0.38	0.21	5.10	8.80	3.70	0.88	0.45	4.90	9.8	4.03	0.78	0.45	5.00
		Mean	9.80	4.67	1.04	0.25	5.80	10.6	5.13	1.68	0.55	6.00	12.2	5.70	1.57	0.61	6.30
El-Salam canal	0	0 – 30	6.60	3.10	0.31	0.15	3.20	7.80	3.40	0.32	0.28	4.30	9.3	3.35	0.58	0.34	3.80
		30 – 60	5.80	2.80	0.25	0.09	3.10	6.90	3.23	0.29	0.16	3.50	6.9	3.30	0.42	0.20	3.10
		60 – 90	4.20	2.23	0.21	0.04	2.80	6.50	2.47	0.25	0.11	3.70	6.7	2.60	0.31	0.14	2.90
		Mean	5.50	2.70	0.25	0.09	3.00	7.10	3.03	0.29	0.18	3.80	7.40	3.10	0.44	0.23	3.30
	3	0 – 30	7.80	3.40	0.38	0.27	4.30	10.0	5.30	0.58	0.41	5.50	12.2	3.73	0.93	0.36	5.40
		30 – 60	6.20	3.27	0.24	0.19	3.00	9.90	3.37	0.44	0.30	3.90	10.5	3.35	0.75	0.22	3.90
		60 – 90	5.50	2.97	0.21	0.17	2.80	8.10	2.93	0.29	0.15	3.10	8.9	2.72	0.46	0.19	3.70
		Mean	6.50	3.20	0.28	0.21	3.40	9.50	3.87	0.43	0.29	4.20	10.5	3.27	0.71	0.26	4.33
	5	0 – 30	8.20	4.10	0.42	0.29	5.50	11.9	5.53	0.75	0.40	6.10	13.1	3.75	1.13	0.40	5.90
		30 – 60	6.90	3.13	0.36	0.21	3.90	9.80	3.60	0.52	0.35	5.00	11.6	3.26	0.88	0.27	4.50
		60 – 90	6.10	2.77	0.16	0.19	3.20	8.90	3.33	0.35	0.25	4.00	10..9	2.83	0.65	0.22	3.90
		Mean	7.1	3.33	0.31	0.23	4.20	10.2	4.17	0.54	0.33	5.00	11.8	3.40	0.89	0.30	4.80
Bahr Hadoos drain	0	0 – 30	6.30	2.71	0.35	0.08	3.70	7.70	3.28	0.34	0.18	3.10	10.4	3.77	0.62	0.12	2.90
		30 – 60	4.80	2.70	0.21	0.06	3.20	6.60	3.12	0.17	0.15	2.90	9.20	2.96	0.55	0.10	2.50
		60 – 90	4.40	2.40	0.15	0.04	2.80	4.90	2.73	0.14	0.08	1.80	7.10	2.80	0.37	0.05	1.70
		Mean	5.20	2.61	0.24	0.06	3.20	6.40	3.05	0.22	0.14	2.60	8.90	3.17	0.51	0.09	2.40
	3	0 – 30	8.60	3.67	0.48	0.18	4.10	9.50	4.33	0.63	0.33	6.40	11.3	4.23	0.83	0.26	3.80
		30 – 60	7.10	2.66	0.26	0.12	3.80	7.80	3.26	0.35	0.20	4.20	9.70	3.07	0.76	0.12	3.10
		60 – 90	5.30	2.40	0.18	0.11	3.90	6.90	3.20	0.29	0.15	3.30	8.50	2.37	0.58	0.08	2.50
		Mean	7.00	2.90	0.30	0.14	3.90	8.10	3.60	0.42	0.23	4.60	9.83	3.26	0.72	0.15	3.13
	5	0 – 30	9.80	4.26	0.57	0.25	5.30	13.1	5.20	0.86	0.45	6.90	12.1	4.40	0.94	0.35	4.50
		30 – 60	7.60	2.70	0.31	0.20	4.60	9.20	4.03	0.72	0.32	5.10	10.6	3.70	0.83	0.22	3.80
		60 – 90	6.20	2.63	0.21	0.16	3.80	8.10	3.07	0.54	0.30	4.50	7.10	2.43	0.69	0.10	2.70
		Mean	7.80	3.20	0.36	0.20	4.60	10.1	4.10	0.71	0.36	5.50	10.1	3.51	0.82	0.22	3.70

Table (6) Relative increase of Fe, Mn, Zn, B and Pb concentrations in the leached soils as affected by the studied treatments

*Water resources	Period leached (year)	Depth (cm)	RI (%) of trace elements concentrations														
			After fish-pond farm					After rice field					After wheat field				
			Fe	Mn	Zn	B	Pb	Fe	Mn	Zn	B	Pb	Fe	Mn	Zn	B	Pb
Bahr El-Bakar drain	3	0 – 30	34.9	43.9	6.5	31.2	15.3	25.0	25.5	46.9	13.0	6.0	32.3	17.5	67.0	6.5	20.9
		30 – 60	31.1	19.5	32.1	50.0	13.0	3.4	15.9	18.9	10.3	3.6	29.5	18.0	61.3	11.1	3.5
		60 – 90	16.9	54.8	100	5.9	6.9	1.4	0.8	30.8	34.6	29.6	9.3	3.6	100	7.5	3.7
		Mean	27.6	39.4	46.2	14.0	11.7	9.93	14.1	32.2	19.3	13.1	23.7	13.0	76.1	8.4	9.4
	5	0 – 30	51.2	61.7	317.4	8.0	18.6	34.4	31.9	295	20.4	13.2	53.5	28.4	202	20.9	29.0
		30 – 60	24.3	37.0	203.5	38.9	19.6	39.3	14.3	165	41.0	1.8	50.0	24.5	81.3	44.4	7.0
		60 – 90	6.8	6.5	137.5	23.5	18.6	22.2	28.0	238	73.1	14.0	30.7	11.0	69.6	12.5	22.0
		Mean	27.4	35.1	219.5	23.7	18.9	31.9	24.7	232	44.8	9.7	44.7	21.3	117	25.9	19.3
El-Salam canal	3	0 – 30	5.1	9.7	22.6	80.0	34.4	28.2	55.8	81.2	46.4	57.1	31.1	11.3	60.3	5.9	42.1
		30 – 60	6.9	17.0	4.0	111.1	3.2	43.4	11.5	51.7	87.5	9.3	52.2	1.51	78.6	10.0	25.8
		60 – 90	30.9	33.2	100	325.0	0.0	24.6	18.6	16.0	36.4	11.4	32.8	3.85	48.4	35.7	27.6
		Mean	14.3	19.9	42.2	172.0	12.5	32.1	28.3	49.6	56.8	25.9	38.7	5.6	62.4	17.2	31.8
	5	0 – 30	24.2	32.2	22.6	93.3	77.4	52.6	62.6	134	42.9	41.9	40.9	11.9	94.8	17.6	55.3
		30 – 60	19.0	11.8	4.00	133.3	39.3	42.0	11.4	79.3	84.4	42.8	68.1	1.21	109	35.0	45.2
		60 – 90	45.2	24.2	0.00	375.0	17.5	36.9	34.8	40.0	127	8.11	62.7	8.88	109	57.1	5.4
		Mean	29.5	22.7	8.8	200.5	44.7	43.8	36.3	84.4	84.8	30.9	57.2	7.3	104	36.6	35.3
Bahr Hadoos drain	3	0 – 30	36.5	35.9	35.5	125.0	10.8	23.4	32.0	85.3	83.3	106	8.65	12.7	33.8	116	31.0
		30 – 60	47.9	1.5	71.4	100	18.7	18.2	4.5	106	33.3	44.8	5.43	3.7	38.2	20.0	24.0
		60 – 90	18.1	34.6	23.8	175	39.3	40.8	17.2	107	87.5	83.3	19.7	15.3	56.7	60.0	47.1
		Mean	34.2	24	43.6	133.3	22.9	27.5	17.9	99.4	68.0	78.0	11.3	10.6	42.9	65.3	34.0
	5	0 – 30	55.5	57.2	37.1	212.5	42.2	70.0	36.9	153	150	122	16.3	16.7	51.6	191	55.2
		30 – 60	58.3	0.0	73.3	233.3	43.7	39.4	2.2	324	200	75.8	15.2	25.0	50.1	120	52.0
		60 – 90	40.9	8.7	20	300.0	35.7	65.4	12.5	286	275	205	0.00	14.2	86.4	100	58.8
		Mean	51.6	21.9	43.5	248.6	40.5	58.3	17.2	254	208	134	10.5	18.6	62.7	137	55.3

Generally the values of RI for all studied trace elements were increased with leaching period increases from 3 to 5 years under fish-pond farm. These increases were more related to residual organic compounds that directly nourish the fish after different biochemical and chemical changes, which led to released more available trace elements. The effect of water sources on the values of RI was varied from element to other where these sources according to this effect takes the order of Bahr Hadood drain > El-Salam canal > Bahr El-Bakar drain for Fe, B and Pb, Bahr El-Bakar drain > El-Salam canal > Bahr Hadoos drain for Mn and Bahr Hadoos drain > Bahr El-Bakar drain > El-Salam canal for Zn. Also, the values of RI for trace elements concentrations were affected by water sources where these values takes the order of Mn > B > Fe > Zn > Pb; B > Pb > Fe > Zn > Mn and B> Zn > Fe > Pb > Mn, for the water source of Bahr El-Bakar drain, El-Slam canal and Bahr Hadoos drain, respectively.

Also, the obtained data in Tables (5 and 6) shows that, the soil content (mg/kg) of the tested trace elements at different soil depths and its relative increase (%) after either of rice or wheat planting have a wide variations where these variations were more related with both water source and the trace element. For example, the arrangement of the used water sources according to its effect on the concentrations of trace elements in the soil and its relative increase under rice cultivation was Bahr Hadoos drain > El-Salam canal > Bahr El-Bakar drain with Fe, Mn, B and Pb and its was Bahr El-Bakar drain > Bahr Hadoos drain > El-Salm canal with Zn. On the other hand, this arrangement under wheat cultivation was El-Salam canal > Bahr El- Bakar drain > Bahr Hadoos drain with Fe; Bahr El-Bakar drain > Bahr Hadoos drain > El-Salam canal with Mn; Bahr Hadoos drain > Bahr El-Bakar drain > El-Salam canal for Zn and Bahr Hadoos drain > El-Salam canal > Bahr El-Bakar drain for B and Pb. The calculated of RI values for Fe, Mn, Zn, B and Pb were varied depending on the used water source. For example, the arrangement of trace elements according to RI values of their concentration with used the water of Bahr El-Bakar drain was Zn > Pb > B > Fe> Mn and Fe > Zn > B >Mn > Pb, and with water of El-Salam canal was Zn > B > Fe > Mn > Pb and was Mn > Zn > Pb > Fe > Mn and B > Zn > Pb > Fe > Mn with the water of Bahr Hadoos drain under rice and wheat plants conditions, respectively. The previous arrangements for the values of RI of trace elements concentrations showed there unclean effect for the cultivated plants on these values.

Finally, from the obtained data it can be concluded that, a) The tested water sources can be used in the leaching process of saline soils also its can be used in the irrigation these soils especially at short-time, b) These water sources contents of trace elements were in safe limits, c) The accumulation rates of trace elements in the soils followed by leaching and irrigation soils were high where their increased with the increase the used periods and d) The accumulation rates of trace elements related to water source , water used period, the type of elements, cultivated plant and soil depth.

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