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DRAINAGE WATER ASSESSMENT IN SOME REGIONS OF NILE DELTA FOR BOTH POLLUTION AND QUALITY FOR IRRIGATION

Seyam, H.M.M. and A.A.M. Ragab
Soils, Water and Environ. Res. Inst., Agric. Res. Center Giza, Egypt.

Key Words: Drainage water, Salinity, Pollution, Macro-and micronutrients.

ABSTRACT

Lack of water is an obstacles confronting development in many countries of the arid and semiarid regions as Egypt. Drainage water could be used for irrigation to partially satisfy the need of water. Samples of drainage water were collected from four main regions of Nile Delta (Helwan, Giza, Qualubia and Dakhahlia) through two years (2002-2003). Soluble salts, macronutrients (N and P) and micro- nutrients (Fe, Mn, Zn, Cu, B, Co, Pb, Cd and Ni) were determined to study the pollution and the quality of this water for irrigation.

Results showed that all canals in this study are considered good water for irrigation and also all drains and mixed canals are considered under division of increasing salinity problems of irrigation water. Finally the main drain is considered highly saline for irrigation and classified as sever salinity problems.

On the other hand, results shows that the values of both macro- and micronutrients as pollution point of view in all sites, except the main drain, are still below the critical limits and could be used for irrigation without any problems.

INTRODUCTION

Most of drainage water is suitable for re-use as irrigation water either directly from the drains or after mixed with fresh Nile water. The brackish water have salt concentration a high enough to cause a damage to crops, through influence on several facets of plant physiology like osmotic potential; specific ion effect and or ion uptake, when normal irrigation practice are used. On the other hand, excessive use of chemical fertilizer and pesticides may cause a contamination of drainage water by some chemical compounds and cause the pollution of drainage water by heavy metals.

Ayers and Westcott (1985) classified the quality of saline water respect to its total salinity, climate and crop tolerance. They considered water of electrical conductivity (EC) of < 0.75 dS/m not to cause salinity problems, water of EC 0.75-3.0 dS/m caused increasing salinity problems and EC higher than 3.0 dS/m cause severe salinity problems.

Another classification has been suggested previously by **Gupta (1979)** who suggested five classes including C_1, normal water (EC < 1.5 dS/m), C_2 low salinity water (EC1.5-3.0 dS/m), C_3 medium salinity water (EC 3.0-5.0 dS/m), C_4, saline water (EC 5.0-10.0 dS/m) and C_5 high saline water (EC > 10.0 dS/m).

Using drainage water in irrigation should be limited by its content of total salinity, salt tolerance of grown crops and costs of obtaining as compared to price of the available good water, according to **Knapp and Dinar (1984)**. **EL-Nahal et al. (1983)** added that the drains contain variable amounts of salinity could be diluted with Nile water before being used for irrigation, the best dilution ratio being 1:1.3 as it contains salinity less than 1000 ppm.

Shehata et al. (1983) suggested that possibility of using drainage water in irrigation generally depends on physical and chemical properties of the cultivated soil beside its total content of soluble salts particularly Na^+ ones.

Amer and Van der zel (1983) found that salinity of Egyptian drainage water generally differs from one drain to another with an average concentrations ranged from 400 to 5000 ppm. The higher concentrations were found in the areas subjected to upward seepage of saline ground water.

El-Sokary and Sharaf (1996) found that irrigation water mixed with agriculture drainage water with either domestic or industrial effluents or both have salinity built up toxicity hazards.

El-Gazzar (1996) stated that the values of EC in Idko drain were 1.79 dS/m during summer and 1.90 dS/m in winter. He also added that the distribution pattern of soluble cations followed the order $Na^+ > Ca^{++} > Mg^{++} > K^+$, whereas, the soluble anions were dominant with Cl^- followed by HCO^-_3 then $SO^=_4$.

Ragab (2001) found that salinity of Idko drain water ranged from 1.61 to 5.31 dS/m, while the values of SAR ranged between 4.44 to 12.76, the values of EC and SAR of irrigation water presented are only indication values to the true concentration of irrigation water, since the salinity values of irrigation water differs with time during the agriculture season. **El-Sheikh (2003)** indicated that in Idko region, the mixed water had EC values range between 1.34-1.58 dS/m with a mean value of 1.42 and SAR values ranged between 4.35-5.08 with a mean value of 4.75 had the quality classes of the irrigation water classified as C_3S_1 (high salinity, low sodium hazard), according to **Richard (1954)**. While the drainage water had EC values ranged between 3.09-3.21 dS/m with a mean value of 3.15 dS/m and SAR values ranged between 9.61-10.0 with a mean value of 9.82 had the quality classes of the irrigation water classified as C_4S_1 (very high salinity, low sodium hazard) according to **Richard (1954)**.

Zein El-Abedine et al. (2004) obtained that the mean values of both electrical conductivity (EC_{iw}) and SAR for irrigation waters collected from El Moheet drain, Sharaf canal and El Mahmoudia canal were 4.81, 1.55 and 0.74 dS/m and 1.92, 3.88 and 11.19, respectively.

Hafez (2004) obtained that the results drains of Shubrakhit, El-Lowia, El-Khairy, El-Atf, El-Shamasma and Idko along the studied locations have a salinity less than 3 dS/m and were classified as slight to moderate grade, while both El-Kosore drain and Toson drain more than 3 dS/m and were classified as severe for irrigation.

Regarding to heavy metals, its content in soil, water and plant has become of increasing interest due to their impact on polluting natural resources and public health .The amounts of heavy metals in drains that received industrial wastes were higher than that observed in those received only municipal refuses in both the levels of heavy metals where they found to be higher than that in Nile water **(Rabie, 1986)**. Lead and zinc were found in measurable levels in Ohio River, reaching 23 and 64 ug/l, respectively **(Kopp and Korner, 1967)**.

Ghazy (1988) found that heavy metals contents of El-Gharbiya main drain were lower than the concentration of critical levels in both winter and summer seasons except the concentration of Cd in summer, which was a bit higher than the permissible level.

In Egypt, **Lasheen et al. (1979)** determined trace elements in water samples collected along the River Nile, their results reveal that the River Nile water contains concentrations of trace elements (Cd, Pb, Cu and Zn) in level far below limits of U.S. Environmental Protection Agency's, the concentration of these elements ranged between 0.02-2.0, 0.05-10.8, 0.09-7.8 and 0.66-36 ug/l of Cd, Pb, Cu and Zn, respectively. All heavy metals are aggressive environmental pollutants, it's easily taken up by plants and its strong stress factors for plant metabolism and plant menial nutrition **(Sidlecka, 1995)**.

Abdellah (1995) and **Hegazi (1999)** mentioned that the concentrations of boron and trace elements did not exceed the normal limits and still within the permissible ranges.

Khalil (2000) pointed out, in spite of the relatively high contents of macro and trace elements in the used low quality waters at El Fayoum Governorate, yet they did not reach the hazard effects.

Hafez (2004) obtained that the concentrations of elements; Fe, Mn, Zn, Cu, N, P, Cd, Co and Ni were under the permissible limits for crop production, he added that the sewage waste came from El-Khairy and some where from El-Atf drain had an effective role that made Idko drain reached to the highest impermissible pollution limits.

The purpose of their present investigation is to study the quality of irrigation water in some regions of Nile Delta through evaluating the saline conditions and soluble of both macronutrients and heavy metals.

MATERIAL AND METHODS

Samples of from different sources; canals, drains and mixed canal with drain; were collected from Nile Delta at different regions to investigate the quality assessment as well as the pollution status. These regions (Helwan, Giza, Qalubia and Dakhalia) were divided to many parts as followed:

1-Nile water

As a control site 1

2-Helwan

a) El-Hager canal site 2

b) El-Khashab canal site 3

3-Giza

a) Marutaia canal site 4

b) Mixed canal with drain sites 5, 6, 7, 8 (Abu Rawash No.1, 2, 3 and 4), 9 (Nahia) and 10 (Zenien)

c) Abu Rawash main drain site 11

4-Qalubia

a) Meet Nama canal site 12

b) Mixed canal with drain site 13 (Kaha)

5-Dakhahlia

a) Mixed canal with drain site 14 (Talkha)

b) Drains of Gamasa sites 15, 16 (pump st. 1 & 2) and 17 (drain No.3)

These samples were randomizing collected four times through two years (2002-2003) from the same deferent sites and chemically analyzed, similar trend of the data was obtained for two years. Therefore, combined analysis was carried out for each character over two years, where means value were noted in tables.

Analyses:

* P^H, EC and both soluble cations and anions were determined according to standard the methods described by **Jackson (1973)**.

* Soluble N (NO_3 & NH_4) was analyses using Kjeldahl methods, **Jackson (1973)**.

* Soluble P, B, Fe, Mn, Zn, Cu, Co, Pb, Cd and Ni were determined by using Inductively Couplet Plasma Spectrometry I C P (plasma 400).

RESULTS AND DISCUSSION

Irrigation with drainage water was used in large areas due to the deficit of good water. Re-used of drainage water for irrigation are limited by 1) its content of total salts, 2) its content of heavy metals, 3) both toxicity and 4) salt tolerance of grown crops.

1) Salinity and sodicity:

Data in Table (1) show that the Nile water and all canals (sites 1, 2, 3, 4 and 12) are considered under C_1 class, according to **Ayers and Westcott (1985)**, which found less than 0.75 dS/m of EC. It could be concluded that these waters are good water and can be used directly to irrigate the most crops in all soils without any salinity problems. Data also, show that the other sites, except site No.11, are considered under C_2 class which found between 0.75 to 3.00 dS/m of EC; it is indicated that increasing salinity problems will appear by using this water for irrigation. It well be worth to mention that the previously sites are divided as two kinds, the first already drain mixed with the Nile water and the other is drain only, the last kind must be mixed with the Nile water to reused for irrigation to far from the severe salinity problems.

It could be concluded that we can use these water for irrigation in soils having good permeability with effective drainage system, also, the leaching requirements should be considered. Furthermore, the selection of the relatively salt tolerant crops must be taken into consideration. Finally, the site No.11 is considered under C_3 class which found more than 3.0 dS/m of EC. This drain is considered a highly saline for irrigation and classified as severe salinity problems. The use of this type of water for irrigation is controlled by soil permeability with successful water management to cope with salinity problems and the selection of the relatively high salt tolerant crops.

Concerning the sodicity, data, table (1) show that the values of adj. SAR of the studied irrigation water between reached 0.70 – 2.15, 1.63 – 5.63 and 9.62 – 18.58 for the canal, mixed and drainage water, respectively. **Ayers and Westcott (1985)** reported that the high Na in the irrigation water can use severe soil permeability. SAR and the adjusted SAR have been used to evaluate the permeability hazard. The guide lines pointed that the values of adj. SAR between 2.5 and 6.0 did not caused permeability problems, but the hazard problems started over 6 adj. SAR depending on EC and the content of total salts particularly the soluble Na.

Table (1): Chemical characteristics of water samples from canals, mixed canals with drains and drains in some Nile Delta area

Site s	pH	EC dS/m	SAR	Adj. SAR	Cations meq / L				Anions meq / L			
					Na +	K +	Ca^{+} +	Mg^{+} +	CO3 =	HCO3 -	Cl -	SO4 =
1	7.20	0.44	1.13	2.15	1.30	0.23	1.70	0.97	0.00	3.09	0.75	0.36
2	7.88	0.53	0.72	1.01	1.29	0.12	1.48	2.11	0.00	0.78	1.20	3.02
3	7.54	0.72	0.80	1.04	2.03	0.17	2.61	2.45	0.00	5.68	1.20	0.38
4	7.86	0.49	0.76	1.52	1.36	0.11	1.59	2.00	0.00	2.94	0.80	1.32
5	7.79	1.36	1.68	2.86	3.66	0.36	4.94	4.51	0.00	8.43	3.00	2.04
6	7.81	1.69	0.93	2.79	5.20	0.72	6.58	4.60	0.00	11.37	4.20	1.53
7	7.87	1.10	1.20	2.88	4.06	0.21	2.95	3.80	0.00	6.08	2.80	2.14
8	7.70	1.81	2.74	4.38	9.84	0.41	2.72	4.45	0.00	7.25	9.40	0.77
9	7.78	1.07	1.50	3.30	4.28	0.22	2.84	2.86	0.00	4.31	3.20	2.69
10	8.11	1.92	2.26	3.84	8.10	1.80	6.36	0.81	0.00	9.99	6.60	0.48
11	8.80	3.74	11.61	18.58	31.86	0.20	2.50	2.99	0.00	14.31	8.80	14.44
12	7.90	0.39	0.78	0.70	1.32	0.08	1.48	1.90	0.00	2.94	0.80	1.04
13	7.89	1.01	1.25	1.63	3.41	0.31	4.09	1.40	0.00	5.88	2.80	0.53
14	7.10	1.38	3.75	5.63	6.69	0.41	3.35	3.01	0.00	6.99	3.05	3.42
15	7.16	2.67	6.41	9.62	14.62	0.32	5.52	4.88	0.00	5.68	11.59	7.75
16	7.28	2.73	6.22	9.95	13.78	0.33	7.83	7.63	0.00	5.03	12.12	12.42
17	7.11	2.55	8.27	10.75	16.66	0.43	3.07	5.05	0.00	4.67	16.52	4.02

2) Heavy metals:

Soluble macronutrients and heavy metals are presented in Table (2). These elements go in two ways; the first is beneficial to plant growth if it's below the critical limits and the other way its toxicity for crop growth if it's high concentration.

Data show that the values in all samples of water under study, except sites No. 11 and 14, are still below the critical limits; according to **Ayers and Westcott (1985)** who pointed that the waters have mg/l < 0.75 B, 5.0 Fe, 0.2 Mn, 2.0 Zn, 0.20 Cu, 0.05 Co, 5.0 Pb, 0.01 Cd, 0.2 Ni and 5.0 N could be used continuously for irrigation in all soils without problems.

Regarding to the exceptions sites No. 11 and 14, its containing N between 20.12-28.60 mg/l and this value is considered as increasing problems to some crops, **Ayers and Westcott (1985).**

Table (2): Soluble macro and micronutrients (ppm) in water samples from canals, mixed canals with drains and drains in some Nile Delta area

Sites	N	P	Fe	Mn	Zn	Cu	B	Co	Pb	Cd	Ni
1	0.80	0.22	0.028	0.011	0.007	0.002	0.055	0.009	0.030	0.004	0.021
2	0.80	0.33	0.024	0.006	0.008	0.002	0.650	0.009	0.070	0.001	0.011
3	1.08	0.36	0.029	0.011	0.010	0.005	0.131	0.016	0.075	0.002	0.020
4	1.55	0.26	0.044	0.013	0.014	0.008	0.088	0.012	0.085	0.003	0.010
5	3.15	0.46	0.108	0.014	0.016	0.009	0.160	0.012	0.059	0.004	0.018
6	5.50	0.76	0.147	0.014	0.018	0.009	0.172	0.012	0.078	0.003	0.018
7	1.75	0.34	0.068	0.012	0.011	0.006	0.145	0.014	0.049	0.003	0.014
8	3.50	0.31	0.086	0.026	0.043	0.008	0.110	0.015	0.044	0.004	0.013
9	2.00	0.25	0.057	0.006	0.009	0.005	0.095	0.009	0.081	0.002	0.020
10	3.20	0.61	0.093	0.016	0.013	0.006	0.146	0.013	0.073	0.003	0.017
11	2 0.12	3.92	1.350	0.026	0.520	0.025	0.542	0.016	0.065	0.012	0.019
12	0.90	0.65	0.051	0.009	0.007	0.004	0.081	0.011	0.073	0.002	0.016
13	2.50	0.38	0.043	0.009	0.003	0.006	0.106	0.013	0.061	0.003	0.011
14	28.60	2.88	0.101	0.015	0.027	0.009	0.175	0.015	0.087	0.004	0.020
15	3.64	0.35	0.190	0.012	0.013	0.010	0.210	0.010	0.090	0.002	0.020
16	4.21	0.64	0.090	0.030	0.024	0.009	0.275	0.011	0.096	0.004	0.020
17	3.57	0.48	0.108	0.021	0.019	0.010	0.218	0.012	0.066	0.004	0.019

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تقييم مياه الصرف فى بعض مناطق دلتا النيل من حيث التلوث و صلاحية تلك المياه للرى

حمدى محمد متولى صيام ، عبد العزيز محمد محمد رجب

معهد بحوث الاراضى والمياة والبيئة - مركز البحوث الزراعية - جيزة - مصر

نقص المياه اصبح الشغل الشاغل لمعظم البلدان ذات الطبيعة الجافة وشبة الجافة مثل مصر ، لذا عادة ما يقترح استخدام مياه الصرف للرى كحل جزئى لمشكلة نقص مياه الرى.

تم تجميع عينات مياه الصرف مرة كل ستة اشهر خلال عامين (٢٠٠٢، ٢٠٠٣) وذلك من اربع مناطق رئيسية من دلتا النيل وهى حلوان ، الجيزة ، القليوبية والدقهلية .

تم تقدير الاملاح الذائبة وتقدير بعض العناصر الكبرى مثل النتروجين والفوسفور وكذلك تقدير بعض العناصر الصغرى مثل البورون ، الحديد ، المنجنيز ، الزنك ، النحاس، الكوبلت، الرصاص ،الكادميوم والنيكل وذلك لتقييم تلك المياه من حيث التلوث وكذلك صلاحيتها للرى.

وكانت اهم النتائج المتحصل عليها كالاتى:

١- ان مياه القنوات تحت الدراسة تعتبر مياه جيدة الاستخدام للرى فى جميع الاراضى.

٢- ان مياه المصارف وكذلك المصارف المخلوطة تعتبر تحت قسم زيادة مشاكل الملوحة بالنسبة للرى.

٣- وجد ان مياه المصرف الرئيسى تعتبر تحت قسم المشاكل العالية من حيث الملوحة للرى.

٤- بالنسبة للتلوث دلت النتائج ان جميع عينات المياه كانت خارج الحد الحرج للتلوث فيما عدا المصرف الرئيسى ، لذلك يمكن استخدام المياه تحت الدراسة للرى بعيدا عن مشاكل التلوث.