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Quality Assessment of Water Resources in Northern Nile Delta: A Case Study in Kafr El-Sheikh Governorate

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THE SCARCITY of water makes it difficult and expensive to expand the cultivated lands or even protect soils with natural cover. In Egypt, there is a growing concern that the very limited water resources are becoming increasingly polluted because of the misuse and improper management of resources which jeopardize any attempt for sustainable agricultural development. The overall objective of this research was to assess the water resources quality for an agroecological area in Kafr El-Sheikh Governorate. To achieve this objective, water samples (irrigation and drainage) were collected from the waterways that supply this agroecosystem on a spatiotemporal basis over two years. Water quality assessment was carried out using the U.S.

Salinity Laboratory Staff procedure and further evaluated according to the guidelines of water quality for irrigation . A primary water samples were collected in year 2000 and based on the variation that found water resources monitoring scheme was designed over a year period (July 2001, October 2001 and March 2002). Water samples locations were georeferenced using GPS technology. The assessment showed that most irrigation water samples classified as medium-salinity with low-sodium hazard. On the other hand, most drainage water samples were classified as high-salinity with low-sodium hazard and some samples falls in high-salinity with medium-sodium hazard class. The average biological oxygen demand (BOD) and chemical oxygen demand (COD), were higher in drainage water than in irrigation water samples, taking into consideration that drainage water are used for irrigation in some areas. Heavy metals concentrations were less than the recommended concentration in most of the water resources in the case study, nevertheless there was contamination with cadmium in the irrigation and drainage samples which collected in October 2001 samples. It was clear that water resources quality is an alarming issue in the studied area hindering potential agriculture development.

Keywards: Water resources, Quality assessment, Agriculture development .

The key for the future is to develop sustainable farming systems, which maintain acceptable yields, while causing minimal pollution to the environment. The production of grain and protein has increased so dramatically since the industrialization of agricultural systems in the 1950s, that supply now exceeds demand in most developed countries. This made only possible through the agricultural intensification and the extensive use of agrochemicals (*i.e.* fertilizers and pesticides). This has drawn public, political and research attention from issues of food supply and security to those of maintaining or improving environmental quality (National Research Council, 2000). Water resources in Egypt are becoming the forefront issue and the main constraints for any agricultural expansion where the Egyptian agriculture depends mainly on irrigation from the River Nile. (FAO, 1992) reported that Egypt is facing increasing water needs, demanded by a rapidly growing population, by increased urbanization, by higher standards of living and by an agricultural policy which emphasizes expanded production in order to feed the growing population. This compels the policy makers to use all sources of water, conventional and non-conventional, (*i.e.* groundwater, drainage water and treated sewage effluents) for the expansion of irrigated agriculture. So that the Ministry of Public Works and Water Resources recycles about 5 billion m^3 of drainage water officially and its goal is to increase that volume to 7 billion m^3 (Abu-Zeid, 1992; Abu-Zeid & Hefny, 1992; Willardson *et al.*, 1997 and Kotb *et al.*, 2000). Direct use of drainage water for irrigation with salinity varying from 2 to 3 dS/m, is common in the districts of Northern Delta. Farmers in Kafr-El-Sheikh Governorates have successfully used drainage water directly for periods of 25 years to irrigate over 10 000 ha of land, using traditional farming practices (Mashali, 1985).

Environmental issues have become of great concern because the water supply system relies heavily on re-use of the waste- and drain-water so there is a great need for monitoring, assessment of water quality. Water quantity and quality are key factors for the cultivation of crops. In general, water quality is a complex concept. Water quality can be limited to the concentrations of specific ions and phytotoxic substances relevant for plant nutrition as well as the presence of organisms and/or substances that can clog the irrigation systems (Tognoni *et al.*, 1998). Investigations of irrigation water quality have focused mainly on chemical assessments (Abbas *et al.*, 1993; Avila and Alarcon, 2003 and Ayers and Westcot, 1985). U.S. Salinity Laboratory Staff (1954) has proposed diagram for evaluating waters for irrigation on the basis of SAR and EC (μ mhos cm-1). According to Ayers & Westcot (1985), water quality refers to the characteristics of water supply that will influence its suitability for specific use.

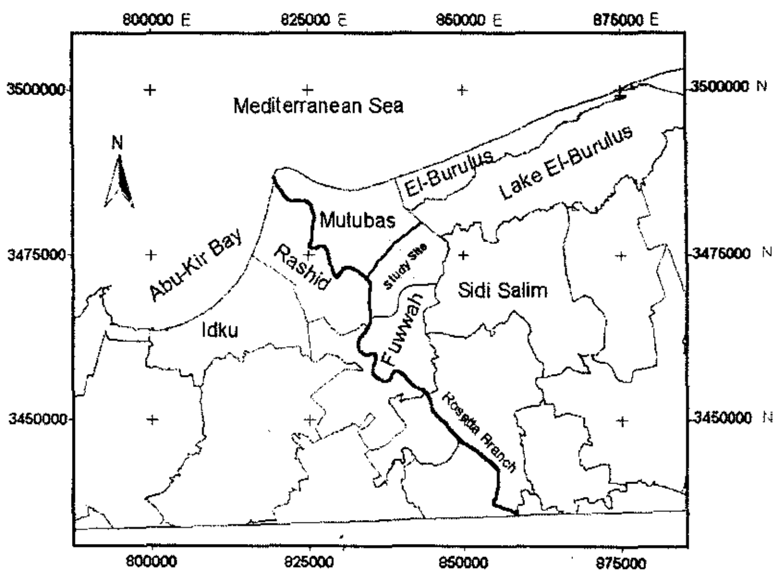
Gaber *et al.* (2003) assessed land resources in the Motobus District, Kafr El-Sheikh Governorate and reported that there are approximately 18 % of area was classified as moderate vulnerability to contamination. Ayman *et al.* (2002) concluded that applying the developed water quality indicators to some drains in the Delta of Egypt has shown that most drains generally have poor water quality.

This paper deals with quality assessment of water resources in a representative area in the Motobus District, Kafr El-Sheikh Governorate. The assessment based on variation in water resources quality, water monitoring protocol was designed to collect samples over a period of one year at three different dates (1/7/2001, 1/10/2001 and 1/3/2002) in attempt to capture the seasonal variations and the temporal changes in water resources quality. Each sampling location was geo-located using the GPS and geo-referenced on the satellite image.

Material and Methods

Monitoring area

The area is located in the northwestern of Kafr El-Sheikh governate; between 834703 - 847693 E, and 3465647 - 34870797 N (UTM zone 36). Located in the southern part of Mutubas district (Markaz). Map 1 illustrates the location of the area. Each sampling location was geo-located using the Garmin 12XL GPS (Garmin corporation, 1997) and geo-referenced on the satellite image (Landsat ETM+, 1999).



Map 1. Location of the monitoring area.

Water sampling

Based on preliminary water resources investigation in year 2000 from 15 sites (15 irrigation samples and 15 drainage samples), water monitoring protocol was designed to collect samples over a period of one year at three different dates. Twenty-six geo-referenced water samples (12 irrigation and 14 drainage samples) for monitoring program were collected at three different dates (July 2001, October 2001 and March 2002) in attempt to capture the seasonal variations and the temporal changes in water resources quality. Each sampling location was geo-located using the GPS and geo-referenced on the satellite image (Fig. 1).

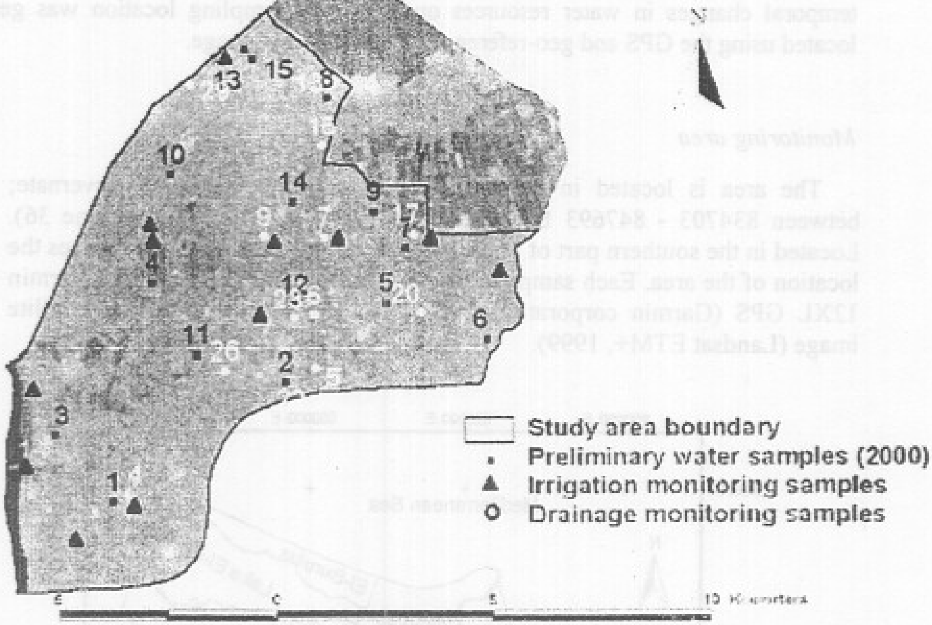


Fig. 1. Geo-spatial distribution of water sampling location in the monitoring area.

Water analyses

Water samples were filtered when necessary and preserved appropriately according to STM (1998). Laboratory analyses were done according to Hand book No.60 (U.S. Salinity Laboratory Staff, 1954). The pH was measured by pH-meter (Jenway, pH-meter model 3305); and the water salinity (dS/m) was measured by Jenway conductivity meter model 4310. Complex-metric EDTA titration was employed for determining the concentration of soluble calcium and magnesium, while soluble sodium and potassium were determined using flame photometer (Corning 400). Soluble carbonate and bicarbonate were determined by titration with sulfuric acid and silver nitrate was used to determine soluble chloride. Boron was determined coloremetrically using carmine indicator method. Flame atomic absorption spectrometry (Varian Spectr AA 220) was used for measuring iron, zinc, manganese, copper, cadmium, lead, nickel and chromium.

Biological oxygen demand (BOD) was determined according to STM 5210-B method (STM, 1998) while chemical oxygen demand (COD) was determined according to STM 5220-C method. Ammonium, nitrate, and nitrite were determined by the steam distillation method (Mulvaney, 1996) while soluble phosphorus was determined by the ascorbic acid colorimetric method (STM 4500-P/E).

Water quality assessment

Irrigation and drainage water samples were assessed according to the U.S. salinity laboratory staff method (1954) and further evaluated according to the guidelines of water quality for irrigation (Ayers & Westcot , 1985).

Results and Discussion

Water samples were collected from irrigation and drainage canals in year 2000 showed a variation in its characteristics. Table 1 summarizes the descriptive statistical parameters of the chemical characteristics (pH, E.C., SAR, cations and anions). It was observed that there is a range of water salinity that used for irrigation purposes, where the minimum salinity concentration was 0.43 dS/m while the maximum salinity concentration was 7.29 dS/m. Consequently, there is a high variation between the different irrigation samples in SAR value which varied from 1.06 to 15.12. Data indicated that Na^+ and Cl^- were the dominant soluble ions in the relatively saline water samples and pH ranged between 6.83 and 9.28. While the majority of the irrigation water resources salinity were less than 1.0 dS/m (ten samples out of sixteen samples), one sample was measuring 7.29 dS/m (sample No. 9) which may be due to mixing irrigation and drainage water, as it is one of the water policy used in the Nile Delta for meeting requirements for agriculture activity.

TABLE 1. Descriptive statistics for irrigation water characteristics.

	Unit	Max.	Min.	Average	Variance	Standard Deviation	Skewness
pH	-	9.28	6.83	7.99	0.51	0.71	0.29
EC	dS m^{-1}	7.29	0.43	1.42	3.16	1.78	2.82
Ca^{+2}	meq/L	18.00	1.00	3.85	16.97	4.12	3.04
Mg^{+2}		18.00	0.50	4.18	17.68	4.21	2.64
Na^+		64.13	1.69	7.77	230.97	15.20	3.85
K^+		1.03	0.14	0.42	0.06	0.25	1.10
Cl^-		60.00	1.00	8.73	223.09	14.94	3.13
HCO_3^-		10.00	2.50	4.16	3.72	1.93	2.15
SAR	-	15.12	1.06	3.13	11.11	3.33	3.49

Table 2 shows the summary statistics of drainage water chemical characteristics (pH, E.C., SAR, cations and anions). Data showed that salinity of drainage water in the study area varied from 0.56 to 22.80 dS/m and the SAR values differed from 2.15 to 64.03. One water sample was very high in salinity (22.8 dS/m, sample No. 4) while the majority of samples were less than 3 dS/m (11 out 16 samples).

TABLE 2. Descriptive statistics for drainage water characteristics.

	Unit	Max.	Min.	Average	Variance	Standard Deviation	Skewness
pH	-	8.97	6.95	7.86	0.29	0.54	0.34
EC	dS m^{-1}	22.80	0.56	4.47	38.45	6.20	2.21
Ca^{+2}	meq/L	46.00	1.50	9.72	138.01	11.75	2.30
Mg^{+2}		46.00	2.00	12.52	199.85	14.14	1.42
Na^{+}		321.74	3.04	42.50	6222.91	78.89	3.32
K^{+}		5.64	0.21	1.03	1.86	1.36	2.94
Cl^{-}		220.00	2.00	34.14	3308.97	57.52	2.63
HCO^{-}_{3}		16.50	3.00	5.84	12.66	3.56	2.13
SAR	-	64.03	2.15	10.29	228.57	15.12	3.35

Data analyses illustrated that the mean salinity value of irrigation water samples was around 0.6 dS/m, while 75% of the samples were less than 0.8 dS/m (Fig. 2). Only two irrigation water samples were higher than 1.0 dS/m (16 and 21) where irrigation canals receive mixed irrigation and drainage waters. This result was consistent in the three sampling dates. On the other hand, the mean salinity value of the drainage water samples was about 1.5 dS/m, while 75% of drainage samples were less than 1.8 dS/m (Fig. 3). With only few exceptions most of the drainage water samples show total salinity less than 3 dS/m.

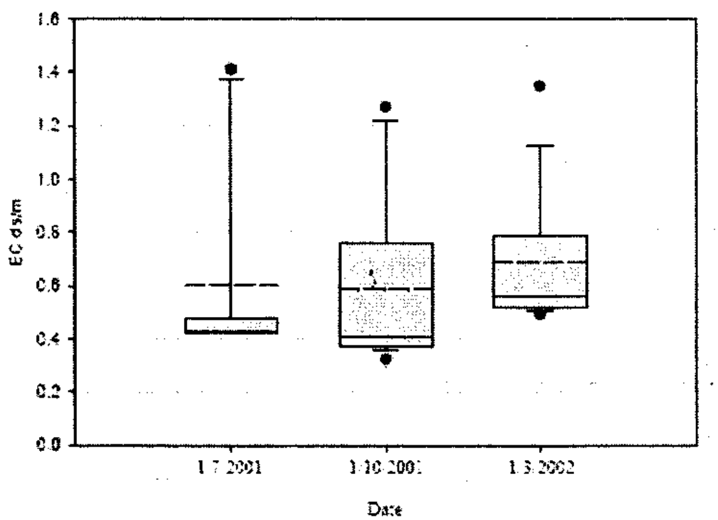


Fig. 2. Spatiotemporal variability of irrigation water salinity.

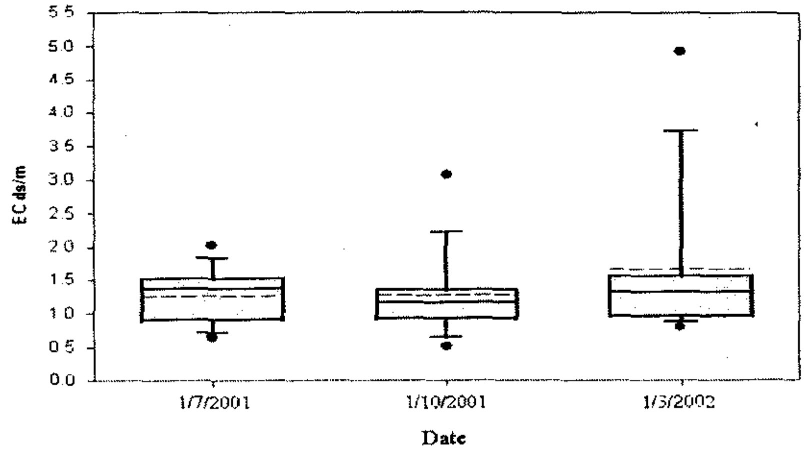


Fig. 3. Spatiotemporal variability of drainage water salinity.

In general, the SAR mean value was around 2.0 in irrigation water samples where the highest values ranged between 5.5 and 3.5 (Fig. 4). The drainage water samples showed mean SAR values ranged between 3.75 and 6.0 where the highest values ranged between 10.0 and 18.0 over the three sampling dates (Fig. 5).

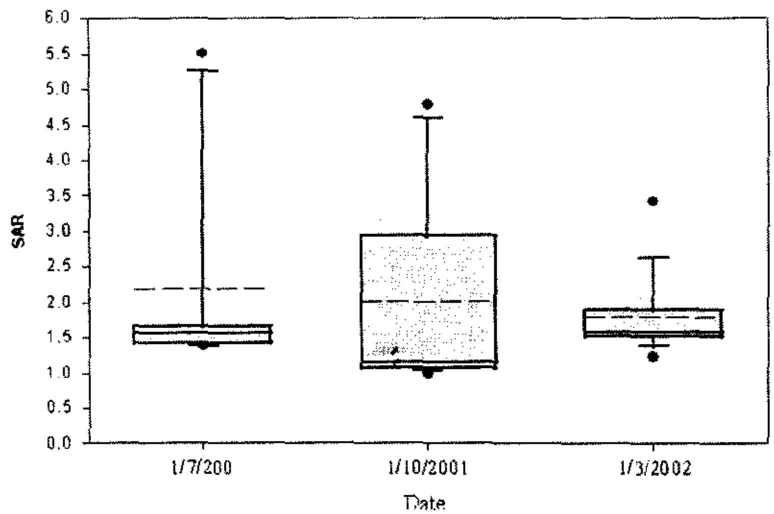


Fig. 4. Spatiotemporal variability of SAR in irrigation water.

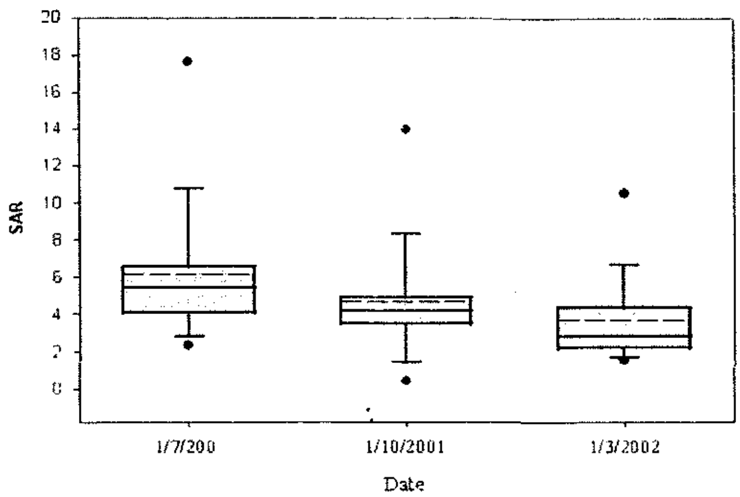


Fig. 5. Spatiotemporal variability of SAR in drainage water.

As expected, the average BOD and COD were higher in drainage water than in irrigation water samples as shown in Table 3. It shows that values of BOD and COD are more than the value of acceptable water parameters for disposal into freshwater streams and acceptable water parameters in drains receiving wastewater (Egyptian law 48/1982 articles 65) while BOD should be less than 10 mg/l and COD shouldn't be more than 15 mg/l. This indicate higher load of organic contaminants during this sampling date.

TABLE 3. Mean and standard deviation of BOD and COD values in irrigation and drainage water samples.

			October 2001	March 2002
Irrigation	COD	mg O_2/L	48.74 (22.83)¶	38.85 (11.93)
	BOD		6.82 (5.94)	16.00 (6.09)
Drainage	COD		63.36 (17.11)	53.71 (19.31)
	BOD		9.58 (7.58)	21.91 (8.93)

Values between parenthesis represented the standard deviation .

Water quality assessment

Water quality refers to the characteristics of water supply that will influence its suitability for specific use (Ayers & Westcot, 1985). For each collecting date, irrigation and drainage water samples were assessed according to the U.S. salinity laboratory staff method (1954) and further evaluated according to the guidelines of water quality for irrigation (Ayers & Westcot, 1985). The water quality assessment for the July 2001 collecting date are shown in Tables 4.a and 4.b for the irrigation and drainage water samples, respectively. The assessment showed that all irrigation water samples classified as medium-salinity with low-sodium hazard except samples number 16 and 21 which classified as high-salinity with low-sodium hazard (mixed irrigation and drainage water). On the other hand, most drainage water samples were classified as high-salinity with low-sodium hazard with some samples falls in high-salinity with medium-sodium hazard class. In addition, the assessment demonstrated that the sodium and chloride have slight to moderate degree of restriction for on use of drainage water in irrigation.

TABLE 4. a. Irrigation water quality classes and potential water problems (July, 2001).

Potential Irrigation problem	Sample Code *										
	1	2	3	8	10	16	18	19	21	24	25
Salinity (EC_w)	N	N	N	N	N	Sm	N	N	Sm	N	N
Infiltration	Sm	Sm	Sm	Sm	Sm	N	Sm	Sm	N	Sm	Sm
Na^+	N	N	N	N	N	Sm	N	N	Sm	N	N
Cl^-	N	N	N	N	N	Sm	N	N	Sm	N	N
B	N	N	N	N	N	N	N	N	N	N	N
NO_3^--N	N	N	N	N	Sm	N	N	N	N	N	N
CLASS	C2-S1	C2-S1	C2-S1	C2-S1	C2-S1	C3-S1	C2-S1	C2-S1	C3-S1	C2-S1	C2-S1

* Degree of restriction on use: N: None, Sm: Slight to moderate and S:Severe.
C1: Low-salinity water, C2: Medium-salinity water, C3: High-salinity water and C4: Very High-salinity water.
S1: Low-sodium water, S2: Medium-sodium water, S3: High-sodium water and S4: Very high-sodium water.

TABLE 4. b. Drainage water quality classes and potential water problems (July, 2001).

Potential Irrigation problem	Sample Code											
	4	5	6	7	9	13	14	15	17	20	22	23
Salinity (EC_w)	N	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm
Infiltration	Sm	N	Sm	N	Sm	Sm	Sm	N	Sm	Sm	Sm	N
Na^+	N	Sm	Sm	Sm	Sm	Sm	Sm	Sm	S	Sm	Sm	N
Cl^-	N	Sm	N	Sm	Sm	Sm	Sm	Sm	S	Sm	Sm	N
B	N	N	N	N	N	N	N	N	N	N	N	N
NO_3^--N	N	N	N	Sm	Sm	N	N	N	N	N	N	N
CLASS	C2-S1	C3-S1	C3-S1	C3-S1	C3-S1	C3-S2	C3-S2	C3-S1	C3-S4	C3-S2	C3-S1	C3-S1

For the October 2001 date, all of irrigation samples classified as medium-salinity with low-sodium hazard except samples number 8, 16, and 21 where they classified as high-salinity with low-sodium hazard (Table 5.a). On the other hand, most drainage water samples were classified as high-salinity with low-sodium hazard, while only sample number 29 was very high-salinity with very high-sodium hazard (Table 5.b). It was clear that sodium and chloride ions were the restriction factors for using the drainage water in irrigation.

TABLE 5. a. Irrigation water quality classes and potential water problems (October, 2001).

Potential Irrigation problem	Sample Code											
	1	2	3	8	10	16	18	19	21	24	25	28
Salinity (EC_w)	N	N	N	Sm	N	Sm	N	N	Sm	N	N	N
Infiltration	Sm	Sm	Sm	N	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm
Na^+	N	N	N	Sm	N	Sm	N	N	Sm	N	N	N
Cl^-	N	N	N	Sm	N	Sm	N	N	Sm	N	N	N
B	N	N	N	N	N	N	N	N	N	N	N	N
NO_3^--N	N	N	N	N	N	N	N	N	N	N	N	N
CLASS	C2-S1	C2-S1	C2-S1	C3-S1	C2-S1	C3-S1	C2-S1	C2-S1	C3-S1	C2-S1	C2-S1	C2-S1

TABLE 5.b. Drainage water quality classes and potential water problems (October, 2001).

Potential Irrigation problem	Sample Code												
	4	5	6	7	9	14	15	17	20	22	23	26	29
Salinity (EC_w)	N	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	N	N
Infiltration	Sm	Sm	Sm	Sm	N	N	Sm	N	Sm	Sm	N	Sm	N
Na^+	N	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	N	N	S
Cl^-	N	Sm	Sm	Sm	Sm	Sm	Sm	S	Sm	Sm	N	N	S
B	N	N	N	N	N	N	N	N	N	N	N	N	N
NO_3^--N	N	N	N	N	N	N	N	N	N	N	N	N	N
CLASS	C2-S1	C3-S1	C3-S1	C3-S1	C3-S1	C3-S1	C3-S1	C3-S2	C3-S1	C3-S1	C2-S1	C2-S1	C4-S4

Data in Tables 6.a and 6.b represent water quality assessment for the third monitoring date (March, 2002). All of irrigation samples were classified as medium-salinity with low-sodium hazard except samples number 8, 16, and 21, which were classified as high-salinity with low-sodium hazard. Most drainage water samples were classified as high-salinity with Low-sodium hazard with the exception of sample number 29 which was classified as very high-salinity with very high-sodium hazard and samples number 4, 23, and 26 were classified as medium salinity with low sodium hazard.

TABLE 6.a. Irrigation water quality classes and potential water problems (March, 2002).

Potential Irrigation Problem	Sample Code											
	1	2	3	8	10	16	18	19	21	24	25	28
Salinity (EC_w)	N	N	N	Sm	N	Sm	N	N	Sm	N	N	N
Infiltration	Sm	Sm	Sm	N	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm
Na^+	N	N	N	Sm	N	Sm	N	N	Sm	N	N	N
Cl^-	N	N	N	Sm	N	Sm	N	N	Sm	N	N	N
B	N	N	N	N	N	N	N	N	N	N	N	N
NO^-_3-N	N	N	N	N	N	N	N	N	N	N	N	N
CLASS	C2-S1	C2-S1	C2-S1	C3-S1	C2-S1	C3-S1	C2-S1	C2-S1	C3-S1	C2-S1	C2-S1	C2-S1

TABLE 6.b. Drainage water quality classes and potential water problems (March, 2002).

Potential Irrigation problem	Sample Code												
	4	5	6	7	9	14	15	17	20	22	23	26	29
Salinity (EC_w)	N	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	N	N
Infiltration	Sm	Sm	Sm	Sm	N	N	Sm	N	Sm	Sm	N	Sm	N
Na^+	N	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	Sm	N	N	S
Cl^-	N	Sm	Sm	Sm	Sm	Sm	Sm	S	Sm	Sm	N	N	S
B	N	N	N	N	N	N	N	N	N	N	N	N	N
NO^-_3-N	N	N	N	N	N	N	N	N	N	N	N	N	N
CLASS	C2-S1	C3-S1	C3-S1	C3-S1	C3-S1	C3-S1	C3-S1	C3-S2	C3-S1	C3-S1	C2-S1	C2-S1	C4-S4

The concentrations of some heavy metals in the water samples collected over the three dates are summarized in Table 7. Most of the tested samples for both irrigation and drainage showed concentration of heavy metals less than the permitted maximum concentration according to Ayers & Westcot (1985). However, the water samples for the second date (October, 2001) exceeded the maximum recommended concentration level for cadmium. This may be due to a specific point source pollution, which had its effect at that date.

TABLE 7. Average values of heavy metals concentrations in water samples .

	Date	Cr	Ni	Cd	Pb	Cu	Mn	Fe	Zn
		mg/L							
Irrigation	01/07/2001	0.026 (0.030)	0.004 (0.004)	0.001 (0.002)	0.035 (0.009)	0.000 (0.001)	0.041 (0.024)	0.445 (0.277)	0.058 (0.045)
	01/10/2001	0.021 (0.014)	0.013 (0.008)	0.013 (0.030)	0.051 (0.006)	0.045 (0.300)	0.074 (0.042)	0.676 (0.411)	0.119 (0.088)
	01/03/2002	0.065 (0.046)	0.014 (0.010)	0.007 (0.004)	0.004 (0.008)	0.006 (0.003)	0.119 (0.078)	0.215 (0.160)	0.052 (0.030)
Drainage	01/07/2001	0.023 (0.009)	0.008 (0.005)	0.000 (0.000)	0.044 (0.014)	0.003 (0.008)	0.110 (0.056)	0.736 (0.327)	0.164 (0.316)
	01/10/2001	0.017 (0.015)	0.013 (0.004)	0.013 (0.003)	0.048 (0.010)	0.053 (0.050)	0.135 (0.086)	0.763 (0.357)	0.097 (0.077)
	01/03/2002	0.078 (0.035)	0.016 (0.009)	0.008 (0.012)	0.011 (0.009)	0.005 (0.003)	0.203 (0.088)	0.396 (0.316)	0.074 (0.053)

Value between parentheses represents standard deviation.

Conclusion

Water analyses indicated that mean salinity value of irrigation water samples was around 0.6 dS/m, while 75% of the samples were less than 0.8 dS/m. Only two irrigation water samples were higher than 1.0 dS/m (16 and 21), where irrigation canals receive mixed irrigation and drainage waters. On the other hand, the mean salinity value of the drainage water samples was about 1.5 dS/m, while 75% of drainage samples were less than 1.8 dS/m. In general, the SAR mean value was around 2.0 for irrigation water, while it ranged between 3.75 and 6.0 for the drainage water samples. The average BOD and COD concentrations were higher in drainage water than irrigation water, due to potential contamination. There were no potential restrictions on water use due to boron and nitrate concentrations in irrigation and drainage water; however most of drainage water samples were affected with high sodium and chloride ions. Irrigation and drainage water samples were assessed according to the U.S. salinity laboratory staff method (1954) and further evaluated according to the guidelines of water quality for irrigation according to Ayers & Westcot (1985). The assessment showed that all irrigation water samples classified as medium-salinity with low-sodium hazard except samples number 16 and 21 which classified as high-salinity with low-sodium hazard (mixed irrigation and drainage water). On the other hand, most drainage water samples were classified as high-salinity with low-sodium hazard with some samples falls in high-salinity with medium-sodium hazard class. In addition, the assessment demonstrated that the sodium and chloride has slight to moderate degree of restriction on use of drainage water in irrigation. However the analysis of water for heavy metals showed that there is no potential Irrigation problem where most samples were less than the recommended maximum concentration.

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تقويم النوعية للموارد المائية في شمال الدلتا: دراسة حالة فى محافظة كفر الشيخ

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ندرة الموارد المائية تؤدى الى صعوبة وزيادة التكلفة اللازمة للتوسع فى الأراضى الزراعية او على الأقل حماية الموارد الأرضية بغطاء طبيعى فى مصـــر، يتزايد الأهتمام بمحدودية الموارد المائية و احتمال التلوث نتيجة لسوء الأستخدام او كنتيجة لأدارة الموارد بطريقة غير مناسبة و الذى يعيق اى محاولة للتنمية الزراعية المستدامة والهدف العام لهذه الورقة البحثية هو تقويم نوعية الموارد المائية للنظام البيئى الزراعى بمحافظة كفر الشيخ، لتحقيق الهدف وقد تم تجميع عينات تمثل الموارد المائية المختلفة (مياه رى – مياه صرف زراعى للنظام الزراعى- البيئى على مدار سنتين) . عمل تقويم نوعية الموارد المائية باتباع تصنيف معمل الملوحة الأميركى بالأضافة الى الأعتماد على القواعد الأساسية التى وضعتها منظمة التغذية و الزراعة.

تم تجميع عينات مبدئية عام ٢٠٠٠ و نتيجة لتباين الموارد المائية فى خصائصها الكيماوية صمم برنامج رصد و متابعة لخصائص الموارد المائية على مدار عام (يوليو ٢٠٠١ و اكتوبر ٢٠٠١ و مارس ٢٠٠٢) حيث جمعت العينات بواسط جهاز تحديد الأحداثيات للحصول على عينات تمثل ذات الموقع من خلال الزيارات الثلاثة وصنف التقويم عينات مياه الرى على أنها متوسطة الملوحة و ذات محتوى منخفض من الصوديوم ومن ناحية أخرى صنفت معظم عينات مياه الصرف على أنها عالية الملوحة و ذات محتوى منخفض من الصوديوم مع وجود بعض العينات التى لها ملوحة عالية وذات محتوى متوسط من الصوديوم. وقد كان متوسط تركيز الأكسجين الحيوى المستهلك و تركيز الأكسجين الكيماوى المستهلك أعلى فى مياه الصرف عن متوسطيهما فى مياه الرى مما يعد مؤشرا لتلوثها ، مع الأخذ فى الأعتبار ان هناك اعادة استخدام لمياة الصرف الزراعى فى عملية الرى. كما اوضحت النتائج ان تركيز المعادن الثقيلة اقل من حدود السمية الموصى بها فى معظم الموارد المائية بمنطقة الدراسة بالرغم من وجود تلوث بالكادميوم فى عينات المياه الخاصة بـــ اكتوبر ٢٠٠١ وتقويم جودة الموارد المائية بمنطقة الدراسة يعد تنبيه عن معوقات التنمية الزراعية الممكنة.