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ENVIRONMENTAL IMPACT OF IRRIGATION DEVELOPMENT

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ABSTRACT

This study aims to evaluate water quality of irrigation development project and its impact on the environment. To achieve this goal, represent tive samples of irrigation, ground and drainage water, cultivated plants were collected at the beginning and tail end of each mesqas of wasat, manaifa and mahmoudia.

The obtained results showed that, irrigation water is of a good quality, ground water is classified as high saline and moderately to highly saline and drainage water is classified as restricted for irrigation purposes. In case of pollutants of water resources, (i) macro, micronutrient and heavy metals are considered below the permissible limits in all sites, (ii) total and fecal coliform in irrigation and ground water samples of manaifa and mhmoudia are free except main drain (2) of manaifa, while at wassat, the three types water samples are contaminated at the head of mesqa, (iii) irrigation and ground water samples of the representive sites are free of salmonela and shigella except drainage water, (iv) COD, in all water samples are below permissible limits except main drain of wassat and manifa, while BOD are below the permissible limits.

With regard to soil, EC values reduced almost (26%) compared to the previous data collected. The extractable elements for locations under study still less than the maximum permitted metal loading. Concerning plant assessment, the sequence of micro nutrients for plant shoots and roots in the investigated sites followed the order of : Fe > Mn > Cu > B while total coliform was found in mahmoudia but still under the permissible limits.

Keywords: irrigation , drainage water, trace elements , heavy metals . biological parameters.

INTRODUCTION

Sustainable development and efficient management of water are an increasingly complex challenge. Increasing population, growing urbanization, and rapid industrialization combined with the need for raising agricultural production generates competing claims for water. Egypt faces multidimensional challenges in sustaining the current level of reuse and promoting more drainage water reuse over the next decades (MWRI, 2008). Therefore, assessment of drainage water quality is important to ensure its suitability for reuse. (Saad et al.,2011) . It is widely acknowledged that irrigation can play a major role in improving food productivity, reducing poverty and sustaining rural livelihoods (Hussain and Hanjra, 2004).

Environmental impacts of irrigation and drainage schemes are concerned with changes in quantity and quality of irrigation water as well as in soil physical and chemical characteristics. The intensification of agriculture and use of excess water can lead to groundwater pollution related to the increased use of pesticides and fertilizers. Careful planning of agricultural schemes can however avoid the negative impact on environment and human health. If included in the priorities for managing water, the irrigation sector can, through the provision of large amounts of water close to human settlements, significantly improve the health of the population and thereby increase the value of irrigation water (Meinzen, 1997). Efforts for improvement in irrigation system in Egypt begun early by starting Water Use Project in 1977 aimed at improving social and economic conditions of Egyptian farmers through the development and use of improved irrigation water management and associated practices(Clasen and Bastable,2003).

Environmental and health impacts of irrigation are generally site specific and are multiple, varied and complex. They depend on a range of factors, including the scale of development, bio-physical conditions, management and operation, as well as the extent to which safeguards are implemented. The potential negative environmental impacts of large capital-intensive irrigation schemes are extensively documented (e.g., Kay, 1999**)**.

Therfore , the current work aimed to:

- Baseline studies monitoring of irrigation water, ground water and soil fertility in order to ascertain the extent of salinization problems and pollution.
- Evaluate water quality (irrigation & drainage water) as well as soil characteristics of the irrigation development project.
- Identify the environmental impacts of irrigation development activities on soil and plant.

MATERIALS AND METHODS

Fieldwork:

To achieve the aforementioned target, field work was carried out at representative sub-basins of the three sites areas which are subjected to irrigation improvement works as follows :

Site(I): Wasat: in Middle Delta, a sub-area of the Meet-Ya-Zeed command area; District Al-Riad,Kafr El-Sheikh Governorate.

Site(II):Manaifa: Northern edge of Middle Delta, a sub-area of the Manaifa command area immediately south of Lake Burulus. District Desooq, Kafr El-Sheikh Governorate.

Site(III): Mahmoudia: Northern edge of West Delta; a sub-area of the Mahmoudia command area.District Kafr El-Dawar, Al -Beheira Governorate.

Water & Soil samples:

The tested double water samples of irrigation water and groundwater were taken at the beginning and tail-end of each mesqas located on the branch canals . Water samples were collected in 1liter bottles for chemical and biological analysis. Samples were transported in an icebox to keep it in good conditions.

The representative samples of irrigation water source, groundwater, drainage water, soils and cultivated plants were collected at the beginning and tail-end of each mesqas located on the branch canals as follows:

I-Wasat

- **Main canal:** Meet-Ya-Zeed canal.
- **Branch canal :** Koom Al-Wahal.

Manaifa :

- **Main canal :** Manaifa canal .
- **Branch canal :** Al-Shabassia Al-Qeblia .

Mahmoudia:

- **Main canal:** Mahmoudia canal.
- **Branch canal :** Bisentawy .

- This work are divided into two parts the first part is to compare the chemical characteristics of soil and water according to the data for the project area comes from a compilation of land surveys carried out (tables1&2) . The second part is the baseline of pollution assessment - in the studied areas

(1):Baseline of Chemical analysis of different water resources in the studied areas.

Source	T.S.S	EC	*Cations (meq. / L)*				*Anions (meq. / L)*				*SAR*
	P.P.m	dSm^{-1}	Na^+	K^+	Ca^{++}	Mg^{++}	$CO^=_3$	HCO^-_3	Cl^-	$SO^=_4$	
EL – Manaifa.											
Irrigation	506.0	0.79	3.48	0.36	2.50	1.34	-	3.30	2.34	2.04	2.51
Drainage	-	-	-	-	-	-	-	-	-	-	-
W.table	3808.0	5.95	33.1	2.45	18.08	9.83	-	4.38	23.75	35.7	8.85
EL - Wasat.											
Irrigation	653.0	1.02	5.66	0.32	2.80	1.64	-	4.40	4.38	1.64	3.79
Drainage	922.0	1.44	9.40	1.60	2.78	1.73	-	4.75	5.0	5.76	6.26
W.table	1824.0	2.85	23.7	0.25	3.65	2.5	-	8.0	9.35	12.75	13.5
Mahmodia											
Irrigation	410.0	0.64	2.40	0.30	3.10	1.2	-	4.80	1.60	0.6	1.64
Drainage	621.0	0.97	4.60	0.3	3.10	1.6	-	4.13	2.55	2.92	3.0
W.table	5856.0	7.32	56.8	0.43	14.92	9.20	-	9.60	26.33	45.42	16.37

Table(2): Baseline of chemical analysis of extracted soil paste from the investigated areas.

Depth	**EC**	*Cations (meq. / L)*				*Anions (meq. / L)*			
(cm)	dSm^{-1}	Na^+	K^+	Ca^{++}	Mg^{++}	$CO^=_3$	HCO^-_3	Cl^-	$SO^=_4$
EL – Manifa.									
0-30	1.68	10.47	0.10	3.49	3.11	-	3.50	7.50	6.17
30-60	1.77	11.52	0.10	3.64	2.65	-	3.09	7.50	7.32
60-90	1.85	12.15	0.10	3.85	3.45	-	3.18	7.49	8.88
EL - Wasat.									
0-30	3.61	20.30	0.48	12.60	6.89	-	2.77	13.70	23.80
30-60	3.88	21.81	0.43	14.28	6.16	-	3.05	12.46	27.17
60-90	3.91	21.02	0.39	14.29	6.29	-	3.04	12.33	26.62
Mahmodia									
0-30	3.68	24.92	0.47	7.81	6.09	-	4.12	14.5	20.67
30-60	3.92	25.02	0.30	5.40	4.23	-	3.93	9.07	21.95
60-90	3.02	20.12	0.30	6.23	4.44	-	3.95	11.25	15.89

Methods:

Soil and water sampling:

Soil samples were collected from the investigated soils, from the studied three areas (i.e.,) Each of the collected soil sample, which represents a mixture of ten sub-samples, was air-dried, gently crushed, passes through 2 mm screen, placed in sealed plastic bag and kept for chemical and biological analysis. As for, the tested double water samples were removed in 1liter bottles for chemical and biological analysis. Samples were transported in an icebox to keep it in good conditions.

Methods of Analysis:

Soil & Water analysis

- Saturation soil paste extract was analyzed for determining ECe and soluble ions, as well as, soil pH was measured in the soil water suspension 1:2.5 (Jackson, 1973).
- Available nitrogen form (NO3- and NH4+) was determined according to Markus *et al.* (1982), by using Technicon Auto Analyzer, Method No. 763-85 (GT).
- Available P, Fe, Mn, Zn , Cu and heavy metals were extracted by ammonium bicarbonate AB-DTPA according to Soltanpour (1991) and determined by (ICP-Plasma JY).
- Available potassium was determined by using Flame photometer according to Jackson, 1973) , chemical parameters (pH, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) were determined according to HMSO,(1980) and Jirka and Carter(1975), respectively.

Microbiological determination:

Pathogenic indicator bacteria Total and Feacal coliforms as well as Salmonella sp. were counted in collected samples using selective culture media according to Standard Methods **(**APHA, 1989).

Plant analysis

- Dried plant materials (grain &straw of wheat and maize plants) were digested by using a mixture of concentrated sulphuric- perchloric acids according to the procedure of Chapman and Pratt(1982) and the elements under study were determined by (ICP-Plasma JY)
- Total N was determined using the Kjeldahl method described by (Jackson, 1973).

RESULTS AND DISCUSSIONS

A previous baseline data collection and analysis was carried out focusing on water quality (irrigation and drainage) and soil characteristics (Tables 1&2). In reality, as many of possible water uses, there are always quality standards/ guidelines that should be taken into account before using the water.

Assessment of the investigated water:

Irrigation water :

Salts are one of the most important parameters for assessing agricultural water quality. The salinity of the soil could be partly related to the salinity of the irrigation water, therefore, negatively affect plant growth, type and quantity of agricultural product. The value of electrical conductivity (EC dSm^{-1})of the investigated irrigation areas is presented in table (3) . Data revealed that the average mean value of Irrigation water salinity varied from 0.47 to 0.49, 0.40 to 0.58, and 0.63 to 0.69 dSm-1for sites Wasat , Manaifa and Mahmodia respectively and the EC values were slightly lower than the previous collected data shown in Table (1) at the same three sites. The values of the EC measurement in the field are all below the threshold value of non saline given by Ayers &Westcot(1985). This indicates no problems with salinity caused by the available water source.

The pH values for all samples of irrigation water (Table 3) varied between 7.54 and 8.33, i.e., within the range issued by the law 48 for 1982 (art. 68). In general, the secondary monitoring study cleared that, irrigation water used in the investigated case studies is of good quality with regard to Ayers &Westcot standards for water used in agriculture and does not spell any risk for irrigation purposes.

Ground water :

Groundwater salinity values varied from 1.45 to 18.07; 1.75 to 6.93 and 1.23 to 8.64 $dSm^{-1}$for Wasat , Manaifa and Mahmodia sites respectively due to accumulation of salts in the aquifer. It is classified as high saline and moderately to highly saline for irrigation according to(Ayers &Westcot,1985) and slightly higher than the previous collected data shown in table (1) at the same three sites generally, It is well known that drainage water is generally saline, and may contain some polluting substances which impede its utilization (El-Mowellhey, 1993). In many parts of the North Nile delta ,farmers use drainage water in irrigating their fields ,because it considered the only source for irrigation purposes.

Drainage water :

The secondary monitoring EC of drainage water canal are 1.64 , 1.77 and 1.44 $dSm^{-1}$of Wasat , Manifa and Mahmodia respectively while the previous one, the EC values were 1.44 and 0.97 of Elwasat & Mahmodia respectively and classified as restricted for irrigation . As for, it used as a supplementary source when fresh water is not adequate. Typically salt concentrations in drainage water are 2 to 10 times higher than in irrigation water, (Hotes and Pearson, 1977).

pHc values are helpful in assessing potential clogging problems from calcium carbonate precipitation on drip irrigation systems and in predicting scaling problems on pump bowls. pHc values above 8.4 indicate a tendency to dissolve lime from soil through which the water moves; values below 8.4 indicate a tendency to precipitate lime from waters applied. In this respect, the data presented in table (3) show that, pHc of the water sample in all areas under study were below 8.4 except of the irrigation site at Wasat investigated area (Irw-B).

With regard to the (Adj. SAR), values over 6.0 will cause soil permeability problems from sodium buildup are likely is being incorporated in many new water quality guidelines and will probably be widely used in the future.

By increasing the water use efficiency, the discharge volume from the system will usually be reduced . The goal of this management measure is to reduce movement of pollutants from land into ground or surface water from the practice of irrigation. The quantity of drainage water can be reduced by good irrigation management though this will tend to have the effect of making the quality worse. Reducing salt inputs is one way for improving drain water quality.

Table (3): Chemical Analysis of Collected Water Samples of the investigated Areas.

Site	WT (cm)	pH	EC dS/m	Na^+	Ca^{++}	Mg^{++}	K^+	$CO_3^{==}$	HCO_3^-	Cl^-	$SO^{4=}$	pHc	SAR
				meq/l									
Wasat													
Irw-A	-	8.33	0.47	3.2	0.8	1.0	0.1	0.0	3.0	1.7	0.4	7.87	3.39
Irw-B	-	8.3	0.49	3.3	0.8	1.1	0.1	0.0	3.0	1.2	0.8	8.67	3.46
Gw-A1	50	7.61	1.45	9.8	2.3	3.2	0.1	0.0	7.5	5.7	2.3	6.98	5.93
Gw-A2	50	7.57	5.74	39.0	9.2	12.6	0.6	0.0	18.5	27.3	15.6	6.15	11.82
Gw-A3	50	7.8	5.82	39.6	9.3	12.8	0.6	0.0	15.0	27.7	19.6	6.28	11.9
Gw-B1	175	7.57	18.07	122.9	28.9	39.8	1.8	0.0	11.0	86.0	96.3	6.35	20.97
Gw-B2	130	7.68	7.39	50.3	11.8	16.3	0.7	0.0	11.5	35.2	32.4	6.35	13.41
Gw-B3	45	7.66	3.95	26.9	6.3	8.7	0.4	0.0	13.5	18.8	10.0	6.37	9.8
Drain-1	-	7.78	1.64	12.0	2.8	3.9	0.2	0.0	7.5	8.4	3.0	6.94	6.32
Manaifa													
Irw-A	-	8.15	0.40	2.6	0.6	0.9	0.1	0.0	2.5	1.0	0.7	7.9	3.08
Irw-B	-	8.13	0.58	4.0	0.9	1.3	0.1	0.0	3.5	1.8	1.0	7.63	3.78
Gw-A1	70	7.7	1.75	11.9	2.8	3.9	0.2	0.0	7.5	8.3	2.9	6.93	6.53
Gw-A2	140	7.47	6.71	45.6	10.7	14.8	0.7	0.0	16.5	31.9	23.4	6.19	12.78
Gw-A3	155	7.99	2.64	18.0	4.2	5.8	0.3	0.0	21.0	12.6	5.3	6.4	8.02
Gw-B1	190	7.97	6.93	47.1	11.1	15.2	0.7	0.0	12.0	33.0	29.2	6.28	12.99
Gw-B2	150	8.05	2.26	15.4	3.6	5.0	0.2	0.0	10.5	8.8	4.9	6.68	7.42
Gw-B3	190	7.97	6.93	47.1	11.1	15.2	0.7	0.0	12.0	33.0	29.2	6.3	12.99
Drain-2	-	8.02	1.77	12	2.8	3.9	0.2	0.0	7.5	8.4	3.0	6.95	6.56
Mahmodia													
IrwA	-	7.9	0.63	4.3	1.0	1.4	0.1	0.0	3.6	3.0	0.1	7.54	3.93
IrwB	-	7.54	0.69	4.7	1.1	1.5	0.1	0.0	3.0	3.3	1.1	7.03	4.0
Gw1-1	85	7.86	3.97	27.0	6.4	8.7	0.4	0.0	15.5	18.9	8.1	6.3	9.83
Gw1-2	86	7.85	2.69	18.3	4.3	5.9	0.3	0.0	15.0	12.8	1.0	6.5	8.09
Gw1-3	90	7.53	1.23	8.4	2.0	2.7	0.1	0.0	7.2	5.9	0.1	7.0	5.47
Gw2-1	100	7.04	3.31	22.5	5.3	7.3	0.3	0.0	15.0	15.8	4.7	6.4	8.98
Gw2-2	70	7.81	4.07	27.7	6.5	9.0	0.4	0.0	23.0	19.4	1.2	6.2	9.95
Gw2-3	58	8.32	8.64	58.6	13.8	19.0	0.9	0.0	17.5	41.1	33.8	6.15	14.50
Drian-3	-	8.0	1.44	9.8	2.3	3.2	0.1	0.0	7.5	6.8	1.0	6.97	5.92

Irw :irrigation water GW: Ground water

Pollution Loads of water resources:

Water Pollution; any chemical, biological, or physical change in water quality that has a
harmful effect on living organisms or makes water unsuitable for desired uses. The pollution load is calculated for TDS, BOD, COD, TSS , macro , micro nutrients, and heavy metals.

- **Macro , micro nutrients, and heavy metals analysis:**

  The recent baseline values of Macro , micro nutrients, and heavy metals determined in all water sources in the three investigated areas are presented in tables (4). Generally, the measured micronutrients and heavy metals are considerably below permissible limits in all sites according to FAO (1992) guidelines .

Table (4): Macro, Micro-Nutrients and Heavy Metals Content in the Collected Water Samples of the investigated Areas

Site	NH_4	NO_3	P	Fe	Mn	Zn	Cu	Ni	Pb	B	Cd	Co	Cr
	mg/l												
Wasat													
Irw-A	2.52	1.89	0.222	0.032	0.005	0.000	0.003	0.000	00.017	0.011	0.000	0.002	0.005
Irw-B	2.52	0.00	0.000	0.083	0.004	0.000	0.012	0.000	00.000	0.012	0.000	0.000	0.003
Gw-A1	1.89	0.00	0.000	0.181	0.022	0.002	0.068	0.000	0.020	0.054	0.000	0.000	0.004
Gw-A2	1.26	0.63	0.000	0.059	0.001	0.000	0.004	0.000	0.000	0.448	0.000	0.005	0.001
Gw-A3	1.89	0.00	0.000	0.060	0.002	0.000	0.005	0.000	0.000	0.483	0.000	0.002	0.001
Gw-B1	2.52	0.00	0.000	0.072	1.602	0.000	0.036	0.000	0.000	0.193	0.000	0.006	0.001
Gw-B2	2.52	0.00	0.000	0.097	0.761	0.025	0.216	0.000	0.002	0.180	0.000	0.005	0.002
Gw-B3	2.52	0.00	0.000	0.047	0.110	0.003	0.010	0.000	0.000	0.301	0.000	0.003	0.003
Drain1	1.26	1.26	0.409	0.058	0.017	0.002	0.007	0.000	0.000	0.084	0.000	0.002	0.003
Manaifa													
Irw-A	1.26	0.00	0.000	0.028	0.004	0.001	0.011	0.000	0.035	0.005	0.000	0.001	0.006
Irw-B	1.89	0.00	0.000	0.292	0.014	0.006	0.016	0.000	0.022	0.022	0.000	0.004	0.004
Gw-A1	2.52	0.00	0.000	0.296	0.063	0.000	0.020	0.000	0.000	0.043	0.000	0.005	0.001
Gw-A2	1.89	0.63	0.000	0.035	0.449	0.001	0.005	0.000	0.000	0.156	0.000	0.006	0.004
Gw-A3	1.89	0.63	0.000	0.065	0.008	0.000	0.009	0.000	0.000	0.174	0.000	0.006	0.004
Gw-B1	1.89	0.63	0.000	0.065	0.008	0.000	0.009	0.000	0.000	0.174	0.000	0.006	0.004
Gw-B2	1.89	0.63	0.000	0.219	0.010	0.000	0.013	0.000	0.000	0.189	0.000	0.003	0.000
Gw-B3	1.89	0.63	0.000	0.219	0.010	0.000	0.013	0.000	0.000	0.189	0.000	0.003	0.000
Drain2	1.26	1.26	0.000	0.051	0.016	0.000	0.023	0.000	0.021	0.083	0.000	0.006	0.001
Mahmoudia													
Irw-A	2.52	0.63	0.138	0.006	0.003	0.001	0.020	0.008	0.000	0.008	0.000	0.000	0.000
Irw-B	2.52	0.63	0.000	0.019	0.003	0.079	0.042	0.003	0.000	0.073	0.000	0.000	0.003
Gw-A1	7.56	1.26	0.095	0.083	0.032	0.026	0.057	0.000	0.083	0.796	0.000	0.004	0.104
Gw-A2	5.04	2.52	0.000	0.004	0.010	0.023	0.020	0.000	0.006	0.723	0.000	0.006	0.000
Gw-A3	2.52	3.78	0.000	0.002	0.001	0.008	0.016	0.000	0.036	0.064	0.000	0.005	0.001
Gw-B1	2.52	1.26	0.000	0.000	0.003	0.042	0.017	0.000	0.000	0.212	0.000	0.004	0.001
Gw-B2	1.89	0.63	0.000	0.013	0.008	0.013	0.020	0.000	0.002	1.306	0.000	0.003	0.003
Gw-B3	1.89	0.63	0.000	0.000	0.003	0.009	0.018	0.000	0.000	2.583	0.000	0.005	0.003
Drain3	1.26	1.26	0.409	0.058	0.017	0.002	0.007	0.000	0.000	0.084	0.000	0.002	0.003

Irw :irrigation water Gw: ground water Drain: drainage water

- **Chemical & Biological Oxygen Demand (COD & BOD):**
- Generally, the total pollution load of COD in all water samples are below the permissible limits (40 mg/L), except, the main drains of Wasat and Manaifa areas. The same trend was observed for BOD in all water samples which are below the permissible limits (20 mg/L), except , the irrigation water samples and drainage water of Manaifa area. Metcaff and Eddy (1995) observed that if wastewater discharged untreated to the environment, the biological stabilization of biodegradable organics can lead to the depletion of natural oxygen resources and to the development of septic conditions.
- **Total and faecal coliforms :**

Coliforms are probably the most frequently used bacterial bio-indicator for years ago and up till now. The coliforms may be used as a group for the detection of water pollution or examined as a fecal coliforms of which E. Coli being the most favored species for this purpose. This is because coliform of enteric origin comes close to match the general characteristic required for a water pollution bio-indicator. Consequently, two bacteriological criteria are most frequently used by responsible authorities to define the water pollution, i.e., a certain concentration of either total coliforms or/and fecal coliform both of which differ according to the country and the purpose of water use (Said 1996). Generally, The obtained data in table (5) show that, total coliforms and fecal coliform counts are of similar trend . The data of all irrigation and groundwater samples in Manaifa and Mahmodia sites are free. The sample from main drain 2 of Manaifa site is contaminated. At Wassat site irrigation water , groundwater and drainage water samples of the head of mesqa are contaminated, the values exceeded the permissible limits (more than 1000 CFU/100ml) according to the Recommended Maximum limits of Egypt based on the Decree No. 16 of law 93 / 1962 recommended by Committee (1995) as well as (WHO 1989). The data reveal that the maximum pollution with total and fecal coli were found at the beginning of wassat irrigation canal may be attributed to the discharge of raw sewage into canals and drains without treatment due to the lack of rural sanitation services to most villages in the command area. Also since several of the main canals and drains pass through heavily populated areas, dumping municipal solid waste into the canals and drains deteriorates the water quality. As for, the decreased to reach zero at the tail-end of the irrigation canal , might be attributed to the dilution factor throughout the long distance from the pollution points.

Salmonila and Sheglla bacteria:

all irrigation and groundwater samples are free from Salmonila and Sheglla. While, the drainage water samples in the three main drains of the representative sites are contaminated.

Soil assessment:

The EC should be one of the main factors to analyze in assessing the degree of soil degradation due to prolonged irrigation (Nunes et al.2007) . The recent EC values of all analyzed soils were reduced almost (26%) compared to the available previous collected data as shown in table (6) . This is may be due to the increase of the quantity of water after irrigation improvement project . Data revealed that Irrigation water salinity values varied from 2.16 to 2.46, 1.61 to 2.17, and 1.76 to 1.86 dSm-1 for sites Wasat , Manaifa and Mahmodia respectively which is far below the threshold value of 4 dS/m . Therefore they are not affected by salinization . According to the Ministry of Water Resources (2002) can be rated as non saline. The data in table(7) also observed that no deficient content of macronutrients .As for, Results given in Table (7) show the DTPA-extractable Ni,Pb,Cd,Co and Cr in the surface soil samples collected from the studied area and the concentrations are ranged from 0.13 to 0.92 , 0.66 to 1.31 , 0.012 to 0.24, 0.020 to 0.034 and 0.02 to 0.08 mg kg-1 soil, respectively. Results given in Table (7) show the DTPA-extractable Fe, Mn, Zn & Cu in the surface soil samples collected from the studied area as a result of irrigation with different water quality. Concentrations of DTPA-extractable micronutrients ranged from 49.72 to 96.88, 1.93 to 2.83, 0.87 to 1.51 and 4.7 to 10.03 mg kg-1 soil, respectively. This findings could be attributed to the lower concentrations of heavy metals in the irrigation water as aforementioned, chemical and physical properties of the soils, downward movement of heavy metals from surface to subsurface layer or ground water with water filtration process and/or their removal from soil by grown plants (Lokeshwari and Chandrappa, 2006). Accumulation of these metals in the studied soils still less than the maximum permitted metal loadings in soil (mg kg-1) established by the U. S. Environmental Protection Agency 503 regulations (Mcbride,1995).

Table (5) : Microbial, Pesticides and Parasites Status of the Collected Water Samples of the investigated Areas.

Site	Parasites	Pesticides residues		COD	BOD	Total Coliform	Fecal Coliform	Salmonila & Shegila
	Ova/ml	Positive	Negative	mg/l	mg/l	Cfu/ml	Cfu/ml	Cfu/ml
Wasat								
Irw-A	+++	+	-	10	5.0	55×10^2	30×10^2	nd
Irw-B	++	+	-	10	5.0	nd	nd	nd
Gw-A1	Nil	+	-	7.0	4	10×10^2	6×10^2	nd
Gw-A2	Nil	+	-	7.0	4	9×10^2	3×10^2	nd
Gw-A3	Nil	+	-	7.0	4	8×10^2	4×10^2	nd
Gw-B1	Nil	+	-	39	20	7×10^2	nd	nd
Gw-B2	Nil	+	-	20.0	10	6×10^2	nd	nd
Gw-B3	Nil	+	-	17.0	9	nd	nd	nd
Drain-1	++	+	-	77	3	148×10^2	92×10^2	1040
Manaifa								
Irw-A	+	+	-	46	23	nd	nd	nd
Irw-B	+	+	-	77	35	nd	nd	nd
Gw-A1	Nil	+	-	7.0	3.0	nd	nd	nd
Gw-A2	Nil	+	-	26.0	13.0	nd	nd	nd
Gw-A3	Nil	+	-	17.0	9.0	nd	nd	nd
Gw-B1	Nil	-	-	17.0	9.0	nd	nd	nd
Gw-B2	Nil	+	-	17.0	9.0	nd	nd	nd
Gw-B3	Nil	-	-	17.0	9.0	nd	nd	nd
Drain-2	+++	+	-	58	23	42×10^2	22×10^2	650
Mahmodia								
Irw-A	+	+	-	13	6	110	40	30
Irw-B	++	+	-	10	5	60	40	30
Gw-A1	Nil	+	-	12	6	120	30	nd
Gw-A2	Nil	+	-	14	7	130	50	Nd
Gw-A3	Nil	+	-	10	5	150	40	Nd
Gw-B1	Nil	+	-	13	6	190	20	Nd
Gw-B2	Nil	+	-	9	5	200	30	Nd
Gw-B3	Nil	+	-	20	10	180	40	Nd
Drain-3	++	+	-	18	9	280	13	10

Irw :irrigation water Gw: ground water (+)pesticides are found nd: not found
Cfu: colony forming unit

Table (6) : Chemical Analysis of Collected Soil Samples of the investigated Areas

Site	pH	EC dS/m	SAR %	Na^+	Ca^{++}	Mg^{++}	K^+	$CO_3^{==}$	HCO_3^-	Cl^-	$So^{4=}$
				meq/l							
Wasat											
A	8.2	2.16	7.3	14.7	3.5	4.8	0.2	0.0	4.5	10.3	8.3
B	8.45	2.46	7.7	16.7	3.9	5.4	0.2	0.0	5.5	11.7	9.1
Manaifa											
A	8.18	2.17	7.3	14.8	3.5	4.8	0.2	0.0	4.0	10.3	8.9
B	8.21	1.61	6.3	10.9	2.6	3.5	0.2	0.0	5.5	7.7	4.1
Mahmoudia											
A	7.96	1.86	6.7	12.6	3.0	4.1	0.2	0.0	2.5	8.9	8.5
B	8.28	1.76	6.5	12.0	2.8	3.9	0.2	0.0	3.0	8.4	7.5

A: Locations for soil samples at the beginning of the canal. - B: Locations for soil samples at the end tail of the canal

Table (7): Macro; Micro-Nutrients and Heavy Metals Concentration in the Collected Soil Samples

Site	N	P	K	Fe	Mn	Zn	Cu	Ni	Pb	B	Cd	Co	Cr
	mg/kg												
Wasat													
A	50.40	63.19	313.60	50.39	1.93	1.02	4.70	0.19	0.66	0.092	0.012	0.020	0.060
B	50.40	20.31	127.00	68.98	2.69	1.51	6.91	0.13	0.85	0.094	0.020	0.032	0.032
Maniafa													
A	50.40	55.87	299.20	49.72	2.52	1.44	6.10	0.38	0.73	0.120	0.024	0.034	0.022
B	50.40	15.87	271.40	53.11	4.22	1.40	8.72	0.78	0.97	0.144	0.020	0.032	0.022
Mahmoudia													
A	63.00	6.98	244.80	96.88	2.83	1.31	10.03	0.92	1.31	0.332	0.024	0.032	0.034
B	63.00	4.63	258.00	69.78	2.79	0.87	5.51	0.75	1.16	0.334	0.014	0.028	0.080

A: Locations for soil samples at the beginning of the canal
- B: Locations for soil samples at the end tail of the canal

Elements in grown plants:

Plants may represent an important source of trace elements for humans as it is well known that metals in soil may be taken up by plants and enter the food chain. The study of this metals pathway will be useful in environmental monitoring and help in taking up the remedial measures by regulatory agencies, Sekar *et al.* (2004). Plants physical and biochemical mechanisms offer an alternative way of absorption, accumulation and exudation of toxic heavy metals and forming metal- bound compounds (Maiti et al., 2004). Generally, the obtained data of all collected plants samples have a sufficient content of macro and micro nutrients at the three investigated sites. The sequence of micronutrients in the plant shoots and roots, in general, was in the following order:Fe > Mn > Zn ≥ Cu > B. This behaviour of micronutrients in the plant tissues may be attributed to the variation in soil chemical and physical properties, total element content in soil, their chemical fractionation forms, element type and its essential role in plant metabolism, and plant genotype (Cataldo and Wilddung, 1978, Kabata Pendias and Pendias, 1992, and Wang and Stuanes, 2003). Total content of heavy metals in both shoots and roots of crop sugar beet, wheat (shoot &

grains) , berseem and sugar beat were presented in Table (8). Obtained results show that concentrations of Ni,Pb,Cd,Co and Cr in all concerned plant tissue, to a great extent, were in the normal range according to Kabata-Pendias and Pendias (1992). The sugar beet data reveal that all the tested micronutrients and heavy metals except boron, tended to be accumulated at substantially higher concentration in roots than in shoots. Numerous studies conducted on both natural and constructed wetlands have shown that the highest concentrations of metals are found in plant root and by far lower concentration are found in above ground parts, i.e. in stems and leaves (Brix 1993, Vymazal 1995, Qian *et al.* 1999 and Ximenez *et al.* 2001).The higher concentration of B in plant shoot may be attributed to that B moves into the plants during active transpiration across a concentration gradient and once in the plant, it moves readily through the xylem in the transpiration stream and accumulates at the point where is lost through stomata of the leaf (Powell et al., 1997).

Table (8): Macro, Micro Nutrients and Heavy-Metal Content in plant tissues samples of the investigated areas.

Site	plant	N	P	K	Fe	Mn	Zn	Cu	Ni	Pb	B	Cd	Co	Cr
				%										mg/kg dry matter
Wasat														
A1	SBS	0.85	0.12	4.07	0.03	58.70	27.00	20.60	1.30	57.80	5.60	0.29	0.30	4.80
A1	SBR	2.50	0.05	0.91	0.02	40.40	76.00	131.90	0.10	3.10	0.90	0.79	0.20	2.90
A2	WS	1.15	0.05	2.70	0.05	15.00	37.70	16.50	4.60	6.10	3.60	0.19	0.30	15.00
A2	WG	2.65	0.37	0.39	0.00	17.20	22.60	15.50	0.30	0.50	0.00	0.19	0.00	6.00
A3	SBS	2.25	0.21	3.86	0.04	40.40	20.60	14.30	0.30	158.70	10.80	0.19	0.10	2.60
A3	SBR	4.35	1.01	11.53	0.31	286.30	91.00	49.00	10.60	56.30	37.60	0.59	1.50	18.90
B1	WS	1.00	0.03	3.07	0.02	15.70	25.90	8.40	1.60	2.20	0.00	0.19	0.00	5.80
B1	WG	2.50	0.30	0.30	0.00	17.90	23.30	12.30	0.20	85.30	7.90	0.99	0.00	2.70
B2	Ber	1.75	0.25	2.27	0.05	25.90	28.00	16.50	2.00	174.90	57.70	0.39	0.20	8.60
B3	Ber	2.55	0.27	1.57	0.02	29.10	39.50	21.70	2.40	122.10	36.30	0.39	0.20	6.70
Manaifa														
A1	WS	0.75	4.90	1.22	0.04	203.00	288.40	156.90	3.60	3.00	43.00	0.69	0.10	10.60
A2	WG	2.10	0.12	6.53	0.11	49.90	22.10	17.00	190.60	90.00	79.00	0.59	0.00	165.80
A3	Ber	2.45	0.05	1.43	0.02	8.40	31.80	6.90	4.50	91.20	15.60	-0.01	1.10	13.00
B1	WS	0.80	0.03	1.36	0.07	21.00	100.50	20.40	3.70	24.30	46.80	-0.01	0.10	10.90
B1	WG	1.75	3.07	5.42	0.07	142.50	207.10	47.90	3.80	77.50	46.70	0.89	0.00	20.80
B2	WS	0.90	0.03	3.86	0.04	10.30	19.10	6.00	0.90	4.10	2.30	0.29	0.00	3.70
B2	WG	2.04	4.69	3.86	0.11	208.50	182.40	57.10	2.90	35.10	13.20	0.69	0.40	8.40
B3	Ber	2.40	0.26	2.98	0.03	18.40	33.90	11.60	1.50	2.90	18.10	0.59	0.30	4.50
Mahmoudia														
A1	Ber	2.80	0.35	2.27	0.04	27.90	65.50	37.10	1.60	2.80	22.00	0.39	0.30	4.70
A2	Ber	0.50	0.11	2.88	0.03	16.10	85.40	8.90	2.50	2.40	1.10	0.49	0.10	4.60
A3	WS	1.35	0.12	2.10	0.04	17.20	29.70	9.00	0.40	83.20	2.40	0.19	0.00	4.10
A3	WG	1.50	0.35	0.44	0.01	22.30	20.90	11.00	2.00	107.80	0.00	0.09	0.00	6.30
B1	Ber	4.85	0.35	0.85	0.08	34.70	46.60	**23.90**	2.00	**190.10**	19.10	0.09	0.80	**10.20**
B2	Ber	3.10	0.26	0.85	0.00	25.70	30.40	13.90	0.60	**182.10**	14.60	0.07	0.83	4.60
B3	Ber	3.30	0.19	0.64	0.00	31.90	23.70	**11.6**	0.00	0.00	17.60	0.03	0.63	1.90

SBS: Sugar beet shoot, SBR: Sugar beet root; WS: Wheat Straw
WG: Wheat Grain; Ber: Berseem

With regard to the plants polluted with total coliform, it was found that table(9) show that, plants grown at mahmoudia area has detected total coliform in their tissues but still below the permisible limits according to (WHO 1989).

Table (9): Bacterial analysis of the Collected Plant Samples of the investigated areas.

Site	Plant	Total Coliform	Fecal coliform	Salmonila&Shegela
		Cfu/g	Cfu/g	Cfu/g
Wasat				
A1	SB	nd	nd	Nd
A2	W	nd	nd	Nd
A3	SB	nd	nd	Nd
B1	Ber	nd	nd	Nd
B2	W	nd	nd	Nd
B3	Ber	nd	nd	Nd
Manaifa				
A1	W	nd	nd	Nd
A2	Ber	nd	nd	Nd
A3	W	nd	nd	Nd
B1	W	nd	nd	Nd
B2	Ber	nd	nd	Nd
B3	P	-	-	-
Mahmoudia				
A1	Ber	250	**nd**	Nd
A2	Ber	150	nd	Nd
A3	W	nd	nd	Nd
B1	Ber	120	nd	Nd
B2	Ber	80	nd	Nd
B3	Ber	10	20	Nd

- Plant samples from the same soil plots and irrigation sources.
- SB; Sugar beet W; Wheet Ber; Berseem P;poor

Conclusion & Recommendation:

- Improving soil properties due to the decreasing of soil salinity,
- Improve equity, reliability and convenience of on-farm freshwater delivery;
- Increase crop yields at canal tail ends due to reducing soil-water salinity and/or due to increasing the fresh-water quantity which have direct impact on increasing farm income. Finally, The Environmental Impact Assessment (EIA) is expected, with respect to improve canals and drains in Nile Delta at farm level, improve soil structure, decrease water table depth, prevent water logging and soil salinity, management of irrigation water as well as increase crop yields.
- The information obtained from monitoring and management can be extremely useful for future EIAs, making them both more accurate and more efficient. As for, highlight problems early so that action can be taken.
- Monitoring should not be seen as an open-ended commitment to collect data. If the need for monitoring ceases, data collection should cease. Conversely, monitoring may reveal the need for more intensive study and the institutional infrastructure must be sufficiently flexible to adapt to changing demands.

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المردود البيئى لمشروع تطوير الرى

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تهدف هذه الدراسة الى تقييم نوعية المياه فى مشروع تطوير الرى الحقلى وتأثير ذلك على البيئة . ولتحقيق هذا الهدف تم أخذ عينات ممثلة من مياه الرى والماء الارضى ومياه الصرف الزراعى والتربة وايضا النباتات المنزرعة من بداية ونهاية كل مسقى لكل من منطقة الوسط والمنايف والمحمودية .

وكان من أهم النتائج المتحصل عليها الاتى:

أولا: بالنسبه لعينات المياه: أوضحت النتائج ان

- نوعية مياه الرى جيده.
- تصنيف الماء الارضى من مرتفع الملوحة الى متوسط الملوحة.
- أما ماء الصرف فقد تم تصنيفه كنوعية محدوده الصلاحيه لاغراض الرى.

– بالنسبة الملوثات الموجودة فى المواقع تحت الدراسه:

- تعتبر المغذيات الكبرى والصغرى بالإضافة للعناصر الثقيلة أقل من الحدود المسموح بها فى جميع المواقع .
- مياه الرى فى كل من المنايف والمحمودية كانت خالية من بكتريا القولون فيما عدا المصرف الرئيسى(2) فى المنايف. بينما فى منطقة الوسط فان الأنواع المختلفة من المياه تعتبر ملوثة فى بدايه المسقى.
- عينات الرى والماء الأرضى فى المواقع تحت الدراسة تعتبر خالية من السالمونيلا والشيجلا فيما عدا مياه الصرف .
- اما بالنسبة لـCOD فى جميع العينات فكانت أقل من الحدود المسموح بها عدا المصرف الرئيسى لكل من منطقتى الوسط والمنايف بينما ال BOD كانت أقل من الحدود المسموح بها .

ثانيا : بالنسبه لعينات التربه:

- فيما يتعلق بقيم درجات الملوحة , فقد إنخفضت بمقدار 26 % مقارنة بالنتائج السابقة
- أما العناصر المستخلصة فى جميع المواقع تحت الدراسة فما زالت أقل من الحدود القصوى المسموح بها.
- **ثالثا : بالنسبه لعينات النبات:**

أما فيما يتعلق بعينات النبات فى المواقع تحت الدراسة فان تركيز العناصر فى كل من المجموع الخضرى والجذرى أخذ الترتيب التالى حديد , منجنيز ، نحاس ،البورون بينما بكتريا القولون اكلية أظهرت نتائج فى المحمودية ولكن لاتزال أقل من الحدود المسموح بها.