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# Evaluation of the contamination caused by human activities on el-zomor canal, el-giza governorate.

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## ABSTRACT

To assess the extent of the contamination of human activities on irrigation water of El-Zomor canal on soil and grown crop, soil, water, sediment and plant samples were taken from El-Zomor area during the growing season (2011-2012). Results showed that the measured trace elements as well as COD & BOD are below the permissible limit. While, the pathogenic indicators exceeded the permissible limits in water and sediments according to the Recommended Maximum limits. According to the calculated ratio EF; sediment mud samples are contaminated with Cd followed by Pb and Co. Ni & Cd were not found along El-Zomor canal. Soil samples are contaminated with Cd & Ni while the rest are within the normal range. BCR of plant tissues are showed a specified capability to accumulate Fe, Mn, Co in cauliflower tissue ; Zn, Cd are accumulated in clover shoot and ( Cr & Ni) are accumulated in wheat shoot.

Public awarance and control bad human activities at the relevant state agencies are necessary.

**Keywords:** Pathogenic indicator, Trace elements, El-Zomor canal, irrigation water contamination.

## INTRODUCTION

Water quality comprises the physical, chemical, and biological characteristics of a water body. The water body acquires these characteristics from a suite of complex interactions among the water, atmosphere, soils, and lithology .Human activities affect change land use and land cover, which changes the water balance and usually changes the relative importance of processes that control water quality. Furthermore, most human activities generate waste ranging from gases to concentrated radioactive wastes. Although each issue can be subdivided into a myriad of individual processes or activities , the primary water- quality issues affected by human activities include organic material , trace elements (heavy metals ) , acidic atmospheric deposition and runoff , salinization , nutrients (primarily nitrogen and phosphorus) , pathogenic agents including bacterial pathogens , enteric viruses , and protozoans , suspended sediment , oil and grease , synthetic organic compounds , thermal pollution , exotic and invasive species , pesticides and herbicides , and radioactivity . In addition to the various issues, each human activity has a potential cyclical and cascading effect on water quality and quantity along hydrologic pathways.

Monitoring programmers and research on heavy metals in aquatic environments samples have become widely important due to concerns over accumulation and toxic effects in aquatic organisms and to humans through the food chain Otchere *et al.,* (2003).

The aquatic environment with its water quality is considered the main factor controlling the state of health and disease in both man and animal

Rashed, (2004).Nowadays, Bio-monitoring is a regular systematic use of living organisms to evaluate changes in environmental or water quality in laboratory or field conditions, by assessing either bioaccumulation, biological effect, health (occurrence of disease) and/or ecosystem integrity Van Der Oost *et al*., (2003).

Contaminants can persist for many years in sediments in both freshwater and marine systems where they hold the potential to affect human health and the environment Mackevičiene *et al*., (2002).

Sediments accumulate contaminants and may act as long-term stores for metals in the environment Spencer and MacLeod (2002). Toxic chemical substances introduced into the environment may be transported by the air, water and living organisms and may become a part of the natural biogeochemical cycle and accumulate in the food chain Gadzała-Kopciuch *et al*., (2004).

Bioconcentration ratio of plant tissues (BCR) may sometimes be better indicator because the use of element concentration does not take into account the trace element concentration in the substrate Zhu *et al.,* (1999). The bioconcentration ratio, (BCR) is an adequate measure to compare the capacities of different plant species for metal adsorption, translocation from roots to leaves and bioaccumulation in plant El-Sokary and Sharaf (1996).

Therefore, the current work aimed at assessing the chemical and biological pollution caused in El- Zomor irrigation canal to human activities and the impacts on soils and plants grown in.

## MATERIALS AND METHODS

I. **Area description**:

El Zomor Canal is no longer valid for irrigation for many years ago. It has long distance for irrigation; about 16 kilometers and service to irrigate about 50 thousand feddans in Giza Governorate. It become a serious source of transmission due to severe contamination , urban sprawl and random immigration that surround it. As well as, exploited in a bad way for garbage, receives agricultural drainage and municipal waste water, and dangerous increases with no cleaning on a regular basis.

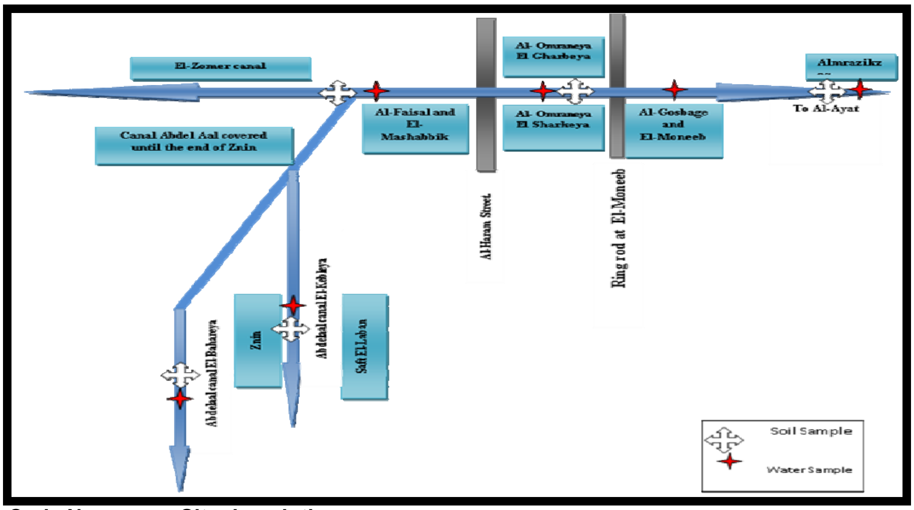
El-Zomor canal received its water from El- Ayat branch canal and passing through many villages i.e. El- Ayat , Al-Badrasheen, Al-Hawamdya , El-Moneeb then passes from Boulaq El-Dakrour and Ard El-Lewaa until reach to Kanater El-Delta. El-Zomor canal is delivering to Abdelaal canal which divided to, sub meska i.e. Abdelaal El-Kebleya and El-Gharbeya.

Six check points along El-Zomor canal were selected as the point of view of pollution occurring there on and are listed blow and illustrated in Fig.1

**II. Sampling:**

**Water**:

Tested double water samples were taken at 25 cm below the water surface of El- Zomor canal. Water samples were collected in bottles of 1 liter volume and used for both chemical and biological analysis .Samples were transported in an ice box to the lab.




| Code No. | Site description |
|---|---|
| Z1 | 5 km from Almrazik |
| Z2 | El-Moneeb down bridge |
| Z3 | El-Omraneya El Sharkeya |
| Z4 | Faisal metro station |
| Z5 | Abdelaal canal El-Kebleya |
| Z6 | Abdelaal canal El-Bahareya |

**Fig. 1 Check points and samples locations.**

**Sediments & Soil :**

Sediment mud samples were collected from the previous sites along El-Zomor canal. Surface soil samples (0-30 cm) were collected from the same locations of each water sample except of site No. Z2 & Z4. Samples were air dried, gently crushed, passed through 2 mm screen and were kept for chemical and biological analyses.

**Plant:**

The cultivated cropping pattern of El-Zomor are (Clover, Lettece , Zea maize , Cauliflower , Cabbage , Sugar beat , Hibiscus , Wheat , Onion , Daraoh , Watercress). Crop samples were obtained at the harvest time. Total micronutrients and heavy metals were evaluated in the investigated crops.

**III. Methods of analysis:**

Water samples were analyzed (EC, pH anions and cations) according to the methods descried by Jackson (1973). Available, P, K, Fe, Mn, Zn, Cu, B, Cd, Pb, Co, Ni and Cr were extracted by using AB-DTPA according to Soltanpour and Schwab (1991). Soil samples were digested by using aqua regia according to Cottenie *et. al.* (1982). Plant samples were digested according to AOAC (1995). Soluble & available and total N were determined according to Chapman *et al.,* (1961) by using Micro Kieldahl. K determined by flame-photometer.

(P, Fe Mn, Cu, Zn, Cd, Co, Cr, Ni, Pb and B) of irrigation water, soil and plant were determined by using Inductively Coupled Plasma Spectrophotometer (ICP) - Model Ultima-2.

Pathogenic indicators including Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Suspended Solid (TSS) according to the methods described in APHA (1992) .Total Coliform, Faecal Coliform, Salmonella and Shigella population were determined according to the methods described by Mahmoud (1988).

To evaluate the accumulation of heavy metals in sediments, soil and plant of the studied area, the following equations were calculated as follow:

*A.* Metal Enrichment Factors (EF); According to Singh *et al.* (2002).

$$= \frac{\textbf{Metals in sediments Total concentration of heavy metals}}{\textbf{Average shale concentration (unpolluted sediment)}}$$

given by Turekian and Wedephol (1961) .

*B.* Bio concentration Ratio (BCR); According to Zhu *et al.* (1999).

$$= \frac{\textbf{Concentration of element in plant tissue}}{\textbf{Available concentration of element in soil}}$$

## RESULTS AND DISCUSSION

**I.Water:**

**Salts:**

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 $dSm^{-1}$) along El-Zomor Canal is presented in Table 1. Data reveal that the average mean value of irrigation water salinity varied from 0.51 to 0.99 $dSm^{-1}$. SAR values are ranged from 0.93 to 2.69 for and RSC is free. No salinity hazard occurred according to the guidelines of Ayers & Westcot (1985). Data also observed that, there are a slightly increase in salinity in summer season compared to the other season. This is may be due to the evaporation process taking place.

**Nitrate and ammonium:**

The concentrations values of $NO_3^-$ -N as well as $NH_4^+$ -N are listed in Table 2. Generally, ammonium was found in appreciably higher concentration (2.23 – 5.33 mg $L^{-1}$) than nitrate ( 0.543 - 3.240 mg $L^{-1}$) in all investigated water samples which indicate a serious state of pollution due to higher reduction conditions . Martijn and Huibers (2001) found that when nitrogen eventually reaches surface water, then eutrofications process taking place, leading to anaerobic conditions, causes general environmental hazards such as loss of aerobic aquatic life .The values are below the critical limits of FAO (1992). No seasonal effect has been observed on both $NO_3^-$ -N and $NH_4^+$ -N.

**Table 1. Chemical analysis of El-Zomor water Canal.**

| Location No. | Seasons | EC (dS/m) | TDS (mg/L) | Anions (me/L) | | | | Cations (me/L) | | | | RSC | SAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $CO_3^{=}$ | $HCO_3^-$ | $Cl^-$ | $SO_4^{=}$ | $Ca^{++}$ | $Mg^{++}$ | $Na^+$ | $K^+$ | | |
| Z1 | Winter | 0.61 | 391.31 | 0.00 | 1.41 | 1.62 | 3.14 | 2.50 | 1.98 | 1.56 | 0.12 | 0.00 | 1.03 |
| | Spring | 0.64 | 407.89 | 0.00 | 1.95 | 1.68 | 2.76 | 1.99 | 2.49 | 1.78 | 0.14 | 0.00 | 1.18 |
| | Summer | 0.87 | 554.67 | 0.00 | 2.27 | 2.02 | 4.38 | 2.67 | 1.73 | 4.07 | 0.19 | 0.00 | 2.68 |
| | Autumn | 0.70 | 445.87 | 0.00 | 2.51 | 2.41 | 2.09 | 2.10 | 1.87 | 2.67 | 0.35 | 0.00 | 1.96 |
| Average | | 0.70 | 449.94 | 0.00 | 2.04 | 1.93 | 3.09 | 2.32 | 2.02 | 2.52 | 0.20 | 0.00 | 1.71 |
| Z2 | Winter | 0.60 | 383.15 | 0.00 | 1.77 | 1.35 | 2.20 | 2.99 | 1.32 | 1.57 | 0.12 | 0.00 | 1.12 |
| | Spring | 0.51 | 326.70 | 0.00 | 1.57 | 1.25 | 2.34 | 1.94 | 1.69 | 1.33 | 0.19 | 0.00 | 1.04 |
| | Summer | 0.90 | 578.13 | 0.00 | 2.95 | 3.19 | 2.96 | 3.20 | 1.84 | 3.77 | 0.28 | 0.00 | 2.27 |
| | Autumn | 0.65 | 413.87 | 0.00 | 2.34 | 1.73 | 2.43 | 2.79 | 1.56 | 1.99 | 0.16 | 0.00 | 1.37 |
| Average | | 0.66 | 425.46 | 0.00 | 2.16 | 1.88 | 2.48 | 2.73 | 1.60 | 2.17 | 0.19 | 0.00 | 1.45 |
| Z3 | Winter | 0.63 | 402.29 | 0.00 | 1.95 | 1.72 | 2.66 | 2.27 | 2.27 | 1.56 | 0.23 | 0.00 | 1.10 |
| | Spring | 0.64 | 407.47 | 0.00 | 3.14 | 1.71 | 1.60 | 3.07 | 1.74 | 1.46 | 0.18 | 0.00 | 0.95 |
| | Summer | 0.64 | 407.47 | 0.00 | 3.14 | 1.71 | 1.60 | 3.07 | 1.74 | 1.46 | 0.18 | 0.00 | 0.95 |
| | Autumn | 0.75 | 480.85 | 0.00 | 2.55 | 1.69 | 2.95 | 2.84 | 2.74 | 1.75 | 0.19 | 0.00 | 1.07 |
| Average | | 0.66 | 424.52 | 0.00 | 2.69 | 1.71 | 2.20 | 2.81 | 2.12 | 1.56 | 0.19 | 0.00 | 1.02 |
| Z4 | Winter | 0.57 | 364.19 | 0.00 | 1.72 | 2.06 | 1.97 | 2.13 | 1.73 | 1.62 | 0.27 | 0.00 | 1.54 |
| | Spring | 0.65 | 416.00 | 0.00 | 3.38 | 1.71 | 1.43 | 2.91 | 1.71 | 1.74 | 0.17 | 0.00 | 1.11 |
| | Summer | 0.73 | 467.20 | 0.00 | 2.61 | 2.45 | 2.29 | 2.97 | 1.85 | 2.23 | 0.30 | 0.00 | 1.34 |
| | Autumn | 0.72 | 462.51 | 0.00 | 2.36 | 1.80 | 2.75 | 3.70 | 1.51 | 1.82 | 0.21 | 0.00 | 0.93 |
| Average | | 0.67 | 427.47 | 0.00 | 2.52 | 2.01 | 2.11 | 2.93 | 1.70 | 1.85 | 0.23 | 0.00 | 1.23 |
| Z5 | Winter | 0.60 | 385.83 | 0.00 | 2.17 | 1.31 | 2.58 | 2.39 | 1.89 | 1.56 | 0.22 | 0.00 | 1.57 |
| | Spring | 0.74 | 476.59 | 0.00 | 2.48 | 1.79 | 3.06 | 3.16 | 2.00 | 2.15 | 0.15 | 0.00 | 1.20 |
| | Summer | 0.76 | 486.40 | 0.00 | 2.95 | 2.44 | 2.26 | 3.08 | 2.30 | 2.06 | 0.20 | 0.00 | 1.22 |
| | Autumn | 0.75 | 477.87 | 0.00 | 2.92 | 1.59 | 3.01 | 2.77 | 2.22 | 2.25 | 0.29 | 0.00 | 1.19 |
| Average | | 0.71 | 456.67 | 0.00 | 2.63 | 1.78 | 2.73 | 2.85 | 2.10 | 2.01 | 0.22 | 0.00 | 1.29 |
| Z6 | Winter | 0.65 | 415.70 | 0.00 | 2.03 | 1.94 | 2.57 | 2.67 | 1.71 | 1.91 | 0.24 | 0.00 | 1.56 |
| | Spring | 0.70 | 446.08 | 0.00 | 2.81 | 1.64 | 2.20 | 3.32 | 1.47 | 2.02 | 0.17 | 0.00 | 1.20 |
| | Summer | 0.99 | 631.47 | 0.00 | 3.47 | 3.24 | 3.20 | 2.91 | 3.07 | 3.77 | 0.16 | 0.00 | 1.94 |
| | Autumn | 0.77 | 492.80 | 0.00 | 3.16 | 2.36 | 2.24 | 3.50 | 1.78 | 2.19 | 0.29 | 0.00 | 1.18 |
| Average | | 0.78 | 496.51 | 0.00 | 2.87 | 2.30 | 2.55 | 3.10 | 2.01 | 2.47 | 0.22 | | 1.47 |

**Phosphorus:**

The concentration of phosphorus along El-Zomor water Canal is presented in Table 2.The data is ranged from 0.00 to 0.427 mg $L^{-1}$.the highest value for P found in site No. Z6 this is may be due to the canal receives wastewater from houses.

**Table 2. Macro, micro-nutrients and heavy metals concentration of El-Zomor water Canal.**

| Location No. | Seasons | Macro-nutrients ($mg\ l^{-1}$) | | | Micro-nutrients -nutrients ($mg\ l^{-1}$) | | | | | Heavy elements ($mg\ l^{-1}$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $NH_4$-N | $NO_3$.N | P | Fe | Mn | Zn | Cu | B | Cd | Co | Cr | Pb | Ni |
| Z1 | Winter | 2.640 | 2.110 | 0.063 | 0.016 | 0.003 | 0.002 | 0.006 | 0.019 | Nd | nd | nd | 0.006 | nd |
| | Spring | 2.083 | 0.427 | 0.049 | 0.006 | 0.001 | 0.005 | 0.026 | 0.037 | 0.001 | nd | nd | nd | nd |
| | Summer | 1.787 | 0.843 | 0.017 | 0.016 | 0.003 | 0.007 | 0.005 | 0.032 | Nd | nd | 0.001 | 0.004 | nd |
| | Autumn | 2.537 | 0.653 | 0.000 | 0.021 | 0.003 | 0.009 | 0.005 | 0.022 | Nd | nd | nd | nd | nd |
| Average | | 2.262 | 1.008 | 0.032 | 0.015 | 0.003 | 0.006 | 0.011 | 0.027 | 0.001 | nd | 0.001 | 0.005 | nd |
| Z2 | Winter | 2.950 | 2.740 | 0.096 | 0.027 | 0.013 | 0.006 | 0.011 | 0.032 | Nd | 0.001 | nd | 0.007 | 0.007 |
| | Spring | 2.233 | 0.617 | 0.092 | 0.007 | 0.002 | 0.006 | 0.028 | 0.055 | 0.002 | 0.001 | 0.001 | nd | nd |
| | Summer | 2.507 | 1.663 | 0.056 | 0.021 | 0.005 | 0.029 | 0.008 | 0.043 | Nd | nd | 0.002 | 0.007 | 0.007 |
| | Autumn | 3.137 | 1.053 | 0.001 | 0.029 | 0.011 | 0.009 | 0.008 | 0.044 | Nd | nd | 0.001 | nd | nd |
| Average | | 2.707 | 1.518 | 0.061 | 0.021 | 0.008 | 0.013 | 0.014 | 0.044 | 0.002 | 0.001 | 0.001 | 0.007 | 0.007 |
| Z3 | Winter | 5.327 | 2.553 | 0.198 | 0.148 | 0.085 | 0.016 | 0.019 | 0.027 | 0.001 | 0.002 | nd | 0.012 | 0.012 |
| | Spring | 2.850 | 0.733 | 0.262 | 0.018 | 0.005 | 0.009 | 0.103 | 0.052 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| | Summer | 3.550 | 1.587 | 0.116 | 0.046 | 0.019 | 0.046 | 0.024 | 0.043 | Nd | nd | 0.003 | 0.009 | 0.009 |
| | Autumn | 3.790 | 1.210 | 0.001 | 0.119 | 0.117 | 0.017 | 0.011 | 0.261 | 0.003 | 0.001 | 0.001 | 0.006 | 0.006 |
| Average | | 3.879 | 1.521 | 0.144 | 0.083 | 0.057 | 0.022 | 0.040 | 0.096 | 0.002 | 0.002 | 0.002 | 0.007 | 0.007 |
| Z4 | Winter | 4.700 | 2.913 | 0.121 | 0.035 | 0.050 | 0.006 | 0.012 | 0.027 | 0.001 | 0.001 | nd | 0.018 | 0.018 |
| | Spring | 3.067 | 0.543 | 0.270 | 0.012 | 0.003 | 0.007 | 0.050 | 0.058 | 0.001 | 0.001 | 0.001 | 0.011 | 0.011 |
| | Summer | 3.563 | 0.850 | 0.153 | 0.028 | 0.059 | 0.037 | 0.019 | 0.041 | Nd | nd | 0.002 | 0.016 | 0.016 |
| | Autumn | 4.110 | 0.900 | 0.000 | 0.069 | 0.079 | 0.011 | 0.010 | 0.045 | Nd | 0.001 | 0.002 | 0.001 | 0.001 |
| Average | | 3.860 | 1.302 | 0.136 | 0.036 | 0.048 | 0.015 | 0.023 | 0.043 | 0.001 | 0.001 | 0.002 | 0.012 | 0.012 |
| Z5 | Winter | 3.863 | 3.240 | 0.150 | 0.041 | 0.033 | 0.005 | 0.014 | 0.042 | Nd | 0.003 | nd | 0.011 | 0.011 |
| | Spring | 2.833 | 1.083 | 0.266 | 0.014 | 0.002 | 0.017 | 0.021 | 0.058 | 0.001 | 0.002 | 0.001 | 0.001 | 0.001 |
| | Summer | 2.810 | 1.100 | 0.210 | 0.047 | 0.062 | 0.057 | 0.026 | 0.041 | Nd | 0.001 | 0.002 | 0.011 | 0.011 |
| | Autumn | 3.150 | 1.300 | 0.052 | 0.055 | 0.118 | 0.019 | 0.014 | 0.047 | Nd | nd | 0.001 | nd | nd |
| Average | | 3.164 | 1.681 | 0.170 | 0.039 | 0.054 | 0.025 | 0.019 | 0.047 | 0.001 | 0.002 | 0.002 | 0.007 | 0.007 |
| Z6 | Winter | 4.137 | 2.803 | 0.190 | 0.030 | 0.066 | 0.012 | 0.009 | 0.021 | Nd | nd | nd | 0.010 | 0.010 |
| | Spring | 2.683 | 1.010 | 0.427 | 0.009 | 0.007 | 0.070 | 0.013 | 0.052 | 0.001 | 0.002 | 0.001 | nd | nd |
| | Summer | 3.097 | 1.353 | 0.124 | 0.034 | 0.073 | 0.080 | 0.034 | 0.042 | Nd | nd | 0.003 | 0.005 | 0.005 |
| | Autumn | 2.830 | 1.127 | 0.313 | 0.093 | 0.144 | 0.133 | 0.012 | 0.050 | Nd | nd | 0.001 | 0.001 | 0.001 |
| Average | | 3.187 | 1.573 | 0.264 | 0.042 | 0.073 | 0.074 | 0.017 | 0.041 | 0.001 | 0.002 | 0.002 | 0.005 | 0.005 |

**Trace elements:**

The trace elements content in all locations along El-Zomor Canal are presented in Table 2. The average values of (Fe, Mn, Zn, Cu, B, Cd, Co, Cr, Pb, and Ni) content are (0.043, 0.046, 0.028, 0.022, 0.052, 0.002, 0.001, 0.002, 0.008, and 0.008), respectively. The values are considerably below the permissible limits according to FAO (1992). This is mainly due to sediment mud trapping of the investigated elements from water stream. Data also observed that there are no differences on the concentration of heavy metals between the investigated seasons.

**(COD and BOD):**

The values of COD and BOD in El-Zomor Canal are presented in table (3). The data reveal that the chemical and biological oxygen demand show low levels varying between (0.0 to 33.80 mg $L^{-1}$) and (0.0 to 10.00 mg $L^{-1}$), respectively. The values are below the permissible limits according to FAO (1992). As well as no clear trend of COD & BOD with different season.

**Table 3. Pathogenic indicators and biological parameter of El-Zomor Canal.**

| Location No. | Seasons | mg $L^{-1}$ | | | Cell $L^{-1}$ ml | | |
|---|---|---|---|---|---|---|---|
| | | COD | BOD | TSS | Total coliforms | Fecal coliforms | Salmonella .& Shigella |
| Z1 | Winter | 3.30 | Nd | 10.00 | Nd | nd | nd |
| | Spring | 5.50 | Nd | 81.00 | Nd | nd | nd |
| | Summer | 1.20 | Nd | 10.00 | 30.00 | 20.00 | nd |
| | Autumn | 0.00 | Nd | 30.00 | 300.00 | 100.00 | 12.00 |
| Average | | 2.50 | Nd | 32.75 | 165.00 | 60.00 | 12.00 |
| Z2 | Winter | 2.40 | Nd | 19.00 | 600.00 | 100.00 | 4.00 |
| | Spring | 3.30 | Nd | 85.00 | 1000.00 | 300.00 | 550.00 |
| | Summer | 7.30 | Nd | 40.00 | 1200.00 | 200.00 | 20.00 |
| | Autumn | 0.00 | Nd | 59.00 | 1500.00 | 800.00 | 200.00 |
| Average | | 3.25 | Nd | 50.75 | 1075.00 | 350.00 | 193.50 |
| Z3 | Winter | 10.00 | 5.00 | 30.00 | 11000.00 | 300.00 | 40.00 |
| | Spring | 5.51 | Nd | 106.00 | 3500.00 | 600.00 | 100.00 |
| | Summer | 2.90 | Nd | 14.50 | 200.00 | 700.00 | 120.00 |
| | Autumn | 0.00 | Nd | 14.80 | 13900.00 | 5800.00 | 1000.00 |
| Average | | 4.60 | 5.00 | 41.33 | 7150.00 | 1850.00 | 315.00 |
| Z4 | Winter | 13.30 | 10.00 | 27.00 | 2000.00 | 80.00 | 35.00 |
| | Spring | 9.20 | Nd | 81.00 | 1500.00 | 120.00 | 30.00 |
| | Summer | 3.10 | Nd | 43.00 | 180.00 | 80.00 | 50.00 |
| | Autumn | nd | Nd | 61.60 | 14900.00 | 8900.00 | 60.00 |
| Average | | 8.53 | 10.00 | 53.15 | 4645.00 | 2295.00 | 43.75 |
| Z5 | Winter | 5.00 | Nd | 98.00 | 6000.00 | 100.00 | 40.00 |
| | Spring | 33.80 | Nd | 311.00 | 10000.00 | 3000.00 | 550.00 |
| | Summer | 1.35 | Nd | 11.00 | 1200.00 | 200.00 | 20.00 |
| | Autumn | 0.00 | Nd | 31.20 | 14200.00 | 5400.00 | 200.00 |
| Average | | 10.04 | Nd | 112.80 | 7850.00 | 2175.00 | 202.50 |
| Z6 | Winter | 3.30 | Nd | 21.00 | 300.00 | 250.00 | 2.00 |
| | Spring | 12.80 | Nd | 6.00 | 3500.00 | 1000.00 | 150.00 |
| | Summer | 1.65 | Nd | 103.50 | 1200.00 | 550.00 | 60.00 |
| | Autumn | nd | Nd | 34.80 | 3400.00 | 1800.00 | 100.00 |
| Average | | 5.92 | Nd | 41.33 | 2100.00 | 900.00 | 78.00 |

**Total Suspended Solids (TSS):**

The total suspended solids of El-Zomor Canal are presented in (Table 3). The values are ranged from 6.00 to 311.0 mg $L^{-1}$ for TSS, respectively. The values exceed the recommended maximum limits of wastewater treatment for agricultural reuse in Egypt. FAO (1992). The highest values are observed in spring and summer seasons. TSS could be arranged in the followings descending order: spring > winter > autumn > summer. This is may be due to human activity take place in this condition. Causing 20-30 % reduction in hydraulic conductivity may occur during the irrigation season with using unfiltered sewage effluents Feigin *et al.* (1991). As well as, soil pore clogging occurs mainly in the top-soil and there is interaction between fine suspended solids, entry proliferation of mucous biomass that may agglomerate with soil particles and pores Abo-Gobar (1993).

**Total and Faecal coliforms:**

Coliforms are probably the most frequently used bacterial bioindicator for years ago and up till now. 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 Faecal coliform both of which differ according to the country and the purpose of water use, e.g. potable water, swimming pool water irrigation water, aquaculture etc. Said (1996). Total coliforms and faecal coliform of El-Zomor Canal is presented in Table 3. The obtained data show that, total coliforms and Faecal coliform counts are exceeded the permissible limits in all check points along the canal, FAO (1992).

Spring and autumn seasons are the mostly polluted than summer and winter seasons. The higher coliforms bacteria in the investigated locations may be attributed to the fact that receives wastewater from building along the investigated water stream.

**Salmonella and Shigella:**

Salmonella and Shigella showed a high numbers in all locations. The obtained values ranged from 2.00-1000 cell $ml^{-1}$; exceeding the permissible limits of WHO (1989). Irrigation water should be free from salmonella and shigella bacteria. This results illustrates that the canal is highly contaminated may be due to some people have bad behavior, they throw the dead animals in water canl as well as receives sewage water from trench resulting in dangerous to human health.

**II.Sediments:**

Sediments are important sinks for various pollutants like heavy metals and also play a significant role in the remobilization of contaminants in aquatic systems under favorable conditions and in interactions between water and sediment. Considering average shale concentration given by Turekian and Wedepohl (1961) as lithogenic fraction, source of anthropogenic fraction in total heavy metals concentration estimated of stream sediments was estimated for each metal Table 4. show EF vales of trace elements content. The EF values are following the descending order (B > Cu > Zn >Fe > Mn) in the investigated seasons; were derived from anthropogenic source in the dominant investigated locations. Cd was found in all investigated locations and reached of 87.31% followed by Pb and Co while Ni & Cd were not found along El-Zomor canal. High percentage of anthropogenic fraction indicates tremendous easy availability of these toxic metals to biotic components river's ecosystem. It may possibly enter into the food chain under suitable physico-chemical conditions and exposing millions of people in one or another way Singh *et al.* (2002).

**Table. 4 Trace elements content of sediments samples.**

| Location No. | Seasons | Fe | Mn | Zn | Cu | B | Cd | Pb | Co | Ni | Cr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lithogenic (mg $kg^{-1}$) | | | | | | | | | |
| | | **42500** | **846.00** | **94.70** | **45.30** | **90.00** | **0.00** | **20.00** | **18.90** | **68.20** | **90.00** |
| | | Anthropogenic (%) | | | | | | | | | |
| Z1 | Winter | 5.34 | 6.07 | 3.27 | 18.67 | -53.04 | 80.59 | -62.60 | -12.50 | -109.20 | -244.83 |
| | Spring | -2.12 | -40.86 | -10.76 | -24.69 | 49.83 | 87.31 | -76.99 | 19.92 | -50.88 | -146.58 |
| | Summer | 3.28 | 2.78 | 9.29 | 25.37 | 33.72 | 86.25 | -43.88 | 32.38 | -26.88 | -106.42 |
| | Autumn | 3.28 | -15.84 | 7.25 | -18.90 | 49.33 | 86.80 | 22.48 | 32.98 | -20.28 | -52.54 |
| Z3 | Winter | 2.70 | -212.06 | 34.60 | -21.12 | 28.32 | 70.00 | -42.86 | 79.23 | -109.20 | -141.94 |
| | Spring | -8.77 | -218.88 | -20.95 | -23.43 | -3.42 | 78.00 | -98.02 | -209.84 | -128.86 | -134.38 |
| | Summer | -13.71 | -95.20 | 35.27 | 50.94 | 17.18 | 72.50 | 55.46 | 50.00 | -394.20 | -307.24 |
| | Autumn | -42.16 | -144.58 | 90.17 | 16.93 | 9.32 | 85.00 | 68.05 | 45.38 | -212.84 | -183.91 |
| Z5 | Winter | -8.32 | -100.76 | 9.29 | 21.76 | 39.11 | 78.00 | 43.18 | -30.34 | -104.80 | -250.19 |
| | Spring | -13.71 | -95.20 | 35.27 | 50.94 | -67.16 | 84.29 | 16.67 | 10.85 | -125.08 | -138.10 |
| | Summer | -3.32 | -30.61 | 35.34 | 39.52 | 32.49 | 85.33 | 57.31 | 26.46 | -51.89 | -114.80 |
| | Autumn | 13.43 | 7.62 | 18.36 | 29.22 | 46.45 | 87.31 | 70.15 | 42.02 | -34.38 | -70.78 |
| Z6 | Winter | 9.82 | -42.56 | 31.89 | 52.66 | 66.95 | 78.00 | -16.28 | -30.34 | -44.00 | -205.08 |
| | Spring | 8.22 | -144.58 | 27.60 | 47.04 | 64.50 | 80.59 | 8.26 | -16.67 | -100.59 | -160.12 |
| | Summer | -6.30 | -134.15 | 42.04 | 53.23 | -11.58 | 63.33 | 21.57 | -20.00 | -8.95 | -200.50 |
| | Autumn | 15.78 | 14.36 | 41.62 | 41.92 | 56.53 | 82.63 | 69.42 | 30.51 | -37.78 | -130.77 |

## III.Trace elements in soil:

Trace elements are not normally included in routine analysis of regular irrigation water. Attention should be paid to them when using sewage effluents, particularly if contamination with industrial wastewater discharges are expected (Martijn and Huibers, 2001). Data presented in Table 5 show that the total concentration of Fe, Mn, Zn, Cu, B, Cd, Co, Cr, Pb and Ni of soil samples irrigated with El-Zomor canal. Data showed that all investigated micronutrients are below the permissible limits except of Fe in location Z1 in autumn was contaminated 1.13 times according to Kabata-Pendias (1992). Cd & Ni content reached to 1.8 and 18.5 times, while the other elements are within the normal range compared to the normal ranges given by to Kabata-Pendias (1992).

**Table 5. Total micro nutrients and heavy metals of the soils of El-Zomor area.**

| Location No. | Seasons | Micro-nutrients -nutrients (mg $l^{-1}$) | | | | | Heavy elements (mg $l^{-1}$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fe | Mn | Zn | Cu | B | Cd | Co | Cr | Pb | Ni |
| Z1 | Winter | 37584.30 | 651.90 | 106.50 | 27.50 | 36.70 | 2.60 | 47.00 | 35.40 | 7.10 | 51.50 |
| | Spring | 40996.50 | 614.70 | 90.60 | 94.90 | 147.55 | 1.90 | 85.20 | 45.95 | 55.85 | 45.70 |
| | Summer | 39223.75 | 567.35 | 117.30 | 56.08 | 147.55 | 2.20 | 25.75 | 38.50 | 9.75 | 45.90 |
| | Autumn | 56321.80 | 591.30 | 128.80 | 54.70 | 88.60 | 3.50 | 39.40 | 51.60 | 28.20 | 47.35 |
| Average | | 43531.59 | 606.31 | 110.80 | 58.30 | 105.10 | 2.55 | 49.34 | 42.86 | 25.23 | 47.61 |
| Z3 | Winter | 50051.00 | 718.80 | 122.30 | 55.50 | 39.10 | 2.30 | 37.60 | 34.40 | 28.90 | 50.30 |
| | Spring | 28210.50 | 713.20 | 102.10 | 56.30 | 15.60 | 2.50 | 23.70 | 33.20 | 39.40 | 46.60 |
| | Summer | 41637.10 | 821.70 | 127.45 | 71.33 | 124.56 | 2.24 | 55.64 | 45.63 | 16.53 | 45.50 |
| | Autumn | 39651.50 | 640.00 | 151.20 | 60.20 | 69.90 | 2.10 | 27.00 | 52.30 | 21.50 | 58.34 |
| Average | | 39887.53 | 723.43 | 125.76 | 60.83 | 62.29 | 2.29 | 35.99 | 41.38 | 26.58 | 50.19 |
| Z5 | Winter | 37955.60 | 700.90 | 119.70 | 68.00 | 112.40 | 1.90 | 21.50 | 33.20 | 58.80 | 43.70 |
| | Spring | 37955.60 | 692.30 | 107.80 | 61.53 | 70.00 | 2.00 | 19.90 | 31.90 | 42.00 | 41.80 |
| | Summer | 35656.40 | 695.20 | 135.00 | 79.15 | 72.80 | 1.60 | 23.15 | 39.25 | 30.10 | 48.35 |
| | Autumn | 35149.20 | 799.00 | 116.80 | 86.90 | 59.00 | 1.40 | 20.80 | 35.10 | 56.80 | 40.30 |
| Average | | 36679.20 | 721.85 | 119.83 | 73.90 | 78.55 | 1.73 | 21.34 | 34.86 | 46.93 | 43.54 |
| Z6 | Winter | 42079.40 | 841.10 | 138.30 | 75.80 | 40.80 | 2.80 | 24.40 | 39.90 | 46.50 | 52.70 |
| | Spring | 44637.60 | 874.00 | 113.60 | 58.93 | 88.00 | 2.30 | 22.60 | 41.30 | 31.70 | 52.40 |
| | Summer | 37980.00 | 792.40 | 111.35 | 93.10 | 81.95 | 0.90 | 20.65 | 35.60 | 55.50 | 43.45 |
| | Autumn | 46271.30 | 789.05 | 154.50 | 83.30 | 110.60 | 1.90 | 26.30 | 45.20 | 61.90 | 51.80 |
| Average | | 42742.08 | 824.14 | 129.44 | 77.78 | 80.34 | 1.98 | 23.49 | 40.50 | 48.90 | 50.09 |

**The counts of Total coliform, Fecal coliforms , Salmonella & Shigela**

The counts of Total coliform, Fecal coliforms , Salmonella & Shigela of the investigated soil and sediment mud along El-Zomar Canal are presented in Table 6. The obtained data of surface soil indicated a high coliform, Salmonella & Shigella and there are of similar trend. This is may be attributed to soils receiving animal manures as a fertilizer and poor quality irrigation water from El-Zomor canal, might be the main reasons that stand for increments in coliforms in certain locations .

**IV.Plants:**

Plants may represent an important source of elements for humans as it is well known that metals in soil may be taken up by plants and enter the food chain.

The BCR of plant tissues of the selected crops in El-Zomor canal are presented in Table 7. Data showed that, each plant has specified capability to accumulate element in their tissue i.e. Cauliflower, Watercress, Clover, Wheat are hyperaccumalator for (Fe, Mn, Co – Zn, Cd – B, Cr & Ni) respectively. This behavior could be attributed to one or more of the following processes: 1 plant adsorb heavy metals, translocate them through tonoplast and accumulate in vacuoles, thereby, protecting cell metabolism from metal toxicity, Sekar *et al.,* (2004), 2 binding of the cationic element form to the anionic sites in the cell wall Zhu, *et al.,* (1999), 3 binding to non-proteinaceous polypeptides (Phyto chelations) and accumulate in the vacuole Sacchi *et al.,* (1999).

**Table. 6 Pathogenic indicators of soil and sediment samples of El-Zomor area.**

| Location No. | Seasons | Surface soil (Cell $gm^{-1}$ ) | | | Sediment (Cell $gm^{-1}$ ) | | |
|---|---|---|---|---|---|---|---|
| | | Total coliforms | Fecal coliforms | Salmon.& Shigela | Total coliforms | Fecal coliforms | Salmon.& Shigela |
| Z1 | Winter | Nd | Nd | nd | 4000.00 | 900.00 | 120.00 |
| | Spring | Nd | Nd | nd | 2700.00 | 1200.00 | 40.00 |
| | Summer | 1000.00 | 300.00 | 50.00 | 3300.00 | 1300.00 | 180.00 |
| | Autumn | Nd | Nd | nd | Nd | Nd | nd |
| Average | | 1000.00 | 300.00 | 50.00 | 3333.33 | 1133.33 | 113.33 |
| Z3 | Winter | 450.00 | 200.00 | nd | 3533.33 | 1166.67 | 100.00 |
| | Spring | 600.00 | 180.00 | nd | 2800.00 | 950.00 | 90.00 |
| | Summer | 1500.00 | 1200.00 | 170.00 | 2766.67 | 1500.00 | 140.00 |
| | Autumn | Nd | Nd | nd | 5.00 | Nd | 45.00 |
| Average | | 850.0052 | 526.67 | 170.00 | 2276.25 | 1205.50 | 93.75 |
| Z5 | Winter | Nd | Nd | nd | 4000.00 | 2000.00 | 100.00 |
| | Spring | 300.00 | 60.00 | nd | 3300.00 | 1200.00 | 120.00 |
| | Summer | 600.00 | 160.00 | nd | 2000.00 | 1400.00 | 200.00 |
| | Autumn | Nd | Nd | nd | Nd | nd | nd |
| Average | | 450.00 | 110.00 | Nd | 3100.00 | 1533.33 | 140.00 |
| Z6 | Winter | 150.00 | 75.00 | nd | 2600.00 | 600.00 | 80.00 |
| | Spring | 500.00 | Nd | 200.00 | 2400.00 | 450.00 | 110.00 |
| | Summer | 1000.00 | 300.00 | nd | 3000.00 | 1800.00 | 40.00 |
| | Autumn | Nd | Nd | nd | Nd | nd | nd |
| Average | | 550.00 | 187.50 | 200.00 | 2666.63 | 950.00 | 76.67 |

**Table. 7 Bioconsentration ratio (BCR) of plant tissues of El-Zomor area.**

| Location | Seasons | Plant name | Micro-nutrients (mg $kg^{-1}$) | | | | | Heavy elements (mg $kg^{-1}$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fe | Mn | Zn | Cu | B | Cd | Co | Cr | Pb | Ni |
| Z1 | Winter | Berseem | 31.978 | 8.166 | 8.929 | 5.805 | 159.68 | 37.50 | 40.000 | 14.286 | 3.701 | 13.79 |
| Z1 | Summer | Zea maize | 7.626 | 5.858 | 17.829 | 3.376 | 62.000 | 0.000 | 1.316 | 7.500 | 0.217 | 7.188 |
| Z1 | Autumn | Clover | 18.942 | 4.580 | 4.207 | 1.166 | 101.42 | 4.688 | 17.857 | 197.92 | 0.352 | 20.91 |
| Z3 | Winter | Clover | 95.435 | 17.624 | 7.082 | 2.488 | 172.62 | 3.571 | 46.875 | 46.269 | 0.211 | 7.343 |
| Z3 | Spring | Clover | 18.744 | 9.435 | 8.253 | 1.366 | 436.84 | 0.000 | 21.429 | 3.947 | 0.199 | 16.228 |
| Z3 | Summer | Draoh | 30.857 | 10.892 | 12.439 | 1.593 | 9.524 | 1.667 | 28.125 | 17.910 | 0.306 | 11.875 |
| Z3 | Autumn | Clover | 29.006 | 6.214 | 4.662 | 1.040 | 475.00 | 6.579 | 51.471 | 16.667 | 0.453 | 16.762 |
| Z5 | Winter | Lettuce | 30.044 | 11.971 | 12.568 | 1.472 | 301.06 | 9.091 | 14.286 | 96.296 | 0.076 | 12.810 |
| Z5 | Spring | Onion | 4.769 | 4.411 | 2.820 | 0.549 | 95.833 | 7.143 | 2.000 | 45.652 | 0.074 | 11.986 |
| Z5 | Summer | Watercress | 46.321 | 12.811 | 900.46 | 4.837 | 262.50 | 27.500 | 12.500 | 23.913 | 0.485 | 6.803 |
| Z5 | Autumn | Lettuce | 25.913 | 10.624 | 34.111 | 0.977 | 131.25 | 25.000 | 76.923 | 14.423 | 0.231 | 28.846 |
| Z5 | Autumn | Berseem | 53.705 | 25.099 | 204.02 | 1.048 | 222.50 | 7.500 | 23.077 | 150.00 | 0.115 | 11.538 |
| Z5 | Autumn | Karnabeet | 21.896 | 10.822 | 13.864 | 0.626 | 178.13 | 25.000 | 86.538 | 33.654 | 0.260 | 28.846 |
| Z6 | Winter | Karnabeet | 29.179 | 12.723 | 9.982 | 1.111 | 79.787 | 1.786 | 16.667 | 400.00 | 0.745 | 8.229 |
| Z6 | Winter | Cabbage | 43.889 | 15.861 | 14.478 | 2.622 | 115.96 | 7.500 | 50.000 | 261.54 | 5.491 | 25.187 |
| Z6 | Winter | Sugar beet | 61.573 | 20.102 | 5.306 | 1.277 | 214.89 | 16.071 | 58.333 | 26.923 | 0.000 | 9.975 |
| Z6 | Winter | Khobiaza | 154.59 | 27.523 | 12.095 | 1.404 | 273.40 | 4.286 | 133.33 | 180.77 | 6.369 | 16.459 |
| Z6 | Winter | Wheat | 27.344 | 18.321 | 12.140 | 1.033 | 181.92 | 6.429 | 33.333 | 603.85 | 10.552 | 25.436 |
| Z6 | Spring | Clover | 69.333 | 17.065 | 7.792 | 7.242 | 597.50 | 7.143 | 75.000 | 18.182 | 0.052 | 25.000 |
| Z6 | Summer | Cabbage | 60.470 | 11.128 | 161.39 | 1.276 | 173.63 | 9.524 | 6.667 | 31.250 | 0.473 | 6.082 |
| Z6 | Autumn | Clover | 147.44 | 38.714 | 8.893 | 1.182 | 162.50 | 5.000 | 75.000 | 208.70 | 0.129 | 14.384 |
| Z6 | Autumn | Cabbage | 114.16 | 25.952 | 8.599 | 1.173 | 119.32 | 22.727 | 125.00 | 141.30 | 0.143 | 32.534 |
| Z6 | Autumn | Sugar cane | 10.405 | 7.857 | 4.404 | 0.211 | 167.61 | 22.727 | 62.500 | 43.478 | 0.054 | 22.260 |
| Z6 | Autumn | Khobiaza | 28.467 | 18.571 | 22.599 | 0.516 | 153.41 | 11.364 | 62.500 | 43.478 | 0.107 | 26.541 |
| Z6 | Autumn | Wheat | 16.437 | 3.095 | 57.676 | 0.399 | 53.977 | 34.091 | 100.00 | 54.348 | 0.036 | 25.685 |

The advantage of high biomass productive and easy disposal makes plants most useful to remediate heavy metals on site. Based on knowledge of the heavy metal accumulation in plants, it is possible to select those species of crops and pasturage herbs, which accumulate fewer heavy metals, for food cultivation and fodder for animals, and to select those hyper accumulation species for extracting heavy metals from soil and water.

Conclusion:

- The pathogenic indicators and heavy metals are the main source of pollution occurred in some locations through El- Zomor Canal mainly due to the wastewater that usually find its way to the drain. Fortunately sediments in the drain bottom act as active traps for heavy metals.
- The advantage of high biomass productive and easy disposal makes plants most useful to remediate heavy metals on site. Based on knowledge of the heavy metal accumulation in plants, it is possible to select those species of crops and pasturage herbs, which accumulate fewer heavy metals, for food cultivation and fodder for animals, and to select those hyperaccumulation species for extracting heavy metals from soil.
- Public awareness and contrast human activities of the relevant agencies are necessary.

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**تقييم التلوث الناجم عن الأنشطة البشرية على ترعة الزمر- بمحافظة الجيزة**

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**معهد بحوث الاراضى والمياة والبيئة**

تهدف الدراسة إلى تقييم حاله التلوث الناجم عن الأنشطة البشرية علي ترعه الزمر بمحافظة الجيزة ومدى تأثير ذلك علي التربة المروية بها وكذا النباتات المنزرعة. وقد أخذت عينات من مياه الرى والرواسب بالقاع وجوانب المجري وكذلك عينات تربة ونباتية من مناطق الزراعات المروية بها في الموسم الزراعي (٢٠١١- ٢٠١٢) .

وقد أظهرت النتائج أن تركيزات العناصر الصغري والثقيلة المقدرة في عينات المياه أقل من الحدود المسموح بها طبقاً للمعايير القياسية لمنظمة الأغذية والزراعه. كما أنخفضت قيم الأكسجين الحيوى والكيميائى عن القيم المثلى. وقد أظهر العد الميكروبى في عينات مياه الترعه والرواسب ان الثوابت الميكروبية وجدت بتركيزات عالية تفوق الحدود المسموح بها طبقاً لمعايير منظمة الصحة العالمية. وأظهرت النتائج تلوث عينات الرواسب المأخوذه بعناصر الكادميوم والرصاص والكوبالت حيث كانت قيم EF تزيد عن الحدود المسموح بها وقد أظهر النيكل والكروم عكس ذلك. كما ظهر تراكم للكادميوم والنيكل فى عينات التربة بنسب تزيد عن الحدود المسموح بها وقد أظهرت باقى العناصر عكس ذلك.

وفي دراسة تأثير الري على النباتات المنزرعه فقد أظهرت نسبة التراكم الحيوى فى أنسجة النبات (BCR) تراكم الحديد والمنجنيز والكوبالت في أنسجة القرنبيط، والزنك والكادميوم فى المجموع الخضرى للبرسيم والكروم والنيكل في المجموع الخضرى للقمح.

ولذلك فإنه يجب مراعاه التوعيه البيئية ومراقبة الأنشطة السكانية علي ترع الري من الأجهزة المعنية بالدولة.