J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 6 (8): 927 - 943 , 2015

ENVRINMENTAL IMPACT ASSESSMENT OF CLEANING IRRIGATION CANALS AND OPEN DRAINS

El-Kholy, M.M.; S.A. El-Tohamy and S.M. Ahmed
Soils, Water and Environment Research Institute, ARC, Giza, Egypt

ABSTRACT

Irrigation canals and open drains can be contaminated by domestic, industrial and agriculture waste. Weed earth or aquatic macrophytes (emergent, floating, leaved, Submerged and algae) infection can seriously impeded the flow of canal water not only in tropical conditions but also in semi-arid climates. Another hazard of weed infection is the shelter and good breeding conditions. They offer for vectors (mosquitoes, snails etc.) of debilitating diseases.

The lake of interest by farmers in participating in maintenance work is the main reason for state of disrepair of the tertiary canals as water courses for which the farmers may have been made responsible. The aim of this study is to protect the environment from diseases by reducing floating plants and weeds growth as well as increase of cross sections area of both irrigation and drain canals therefore, reduce leakage of available water and improve the equity of water distribution. For conducting two sites have been selected; Therefore, the first site is Ezbet El-Nusra at Kafer El-Sheikh, and the second is Ezbet El Qasr at El-Behira governorate. Water sample are collected from the selected canals and drains at three check points (first, middle and end) at three times (before and after cleaning). Sediments, floating plant and weed samples are taken from the same check point. Discharge and cross sectional measurements take place in the work.

The results showed that: macro, micronutrients and heavy metals before and after cleaning are considerably below the permissible limits in all investigated sites. Ammonium-N concentration at the upstream of the irrigation canals is exceeded the critical limits for irrigation which indicated that an anaerobic condition taking place.

Total and fecal coliforms values of both canals and drains of the collected water samples show a clearly decrease after cleaning process in Kafer El-Sheigh investigated area. Salmonella & Shigella are found in high values of canals and drains and followed the same trend of total and feacal coliforms. The Chemical and biological oxygen demand of irrigation canals and drains show high level of COD & BOD exceeding the maximum limits and decree of agriculture reuse (unrestricted crop) in Egypt. Except of the first location of drainage canal which is below the permissible limit.

All the collected water samples of both irrigation and drain canal of Kafer El Sheigh and El Beheira are contaminated with Entamiba coli and plantidium coli before and after cleaning ditches the determined chlorophyll (A & B) of the collected water samples from irrigation and drain canal of Kafer El Sheigh and El Beheira are in excellent category due to its less than they permissible limit (<3 mg l^{-1}) before and after cleaning the ditches.

Keywords: Irrigation Canals, Drains, Pathogenic indicators, Heavy metals, Pollution Macro- and Micro-nutrients.

INTRODCTION

The irrigation network is perhaps the most costly element of an irrigation scheme and is designed to last for a long time. However, all the irrigation schemes not long constructed bear little resemblance to the original construction and design. Silt deposition, weed infestation, malfunctioning of structures and other undesirable situations make it practically impossible to control the flow in these irrigation networks. As a result, the system is unable to deliver and distribute the necessary water it equitably. It is not surprising that farmers working in those irrigation schemes sometimes feel frustrated because they know the potential benefits of irrigation and yet cannot realize their expectations. The maintenance of open drains is very similar to that of earth irrigation canals. However, all too often drainage networks receive much less attention than the irrigation ones.

Surface water can be contaminated by domestic, industrial and agricultural waste. Weed earth or aquatic macrophytes (emergent, floating leaved, submerged and algae) infestation can seriously impeded the flow of canal water not only in tropical conditions but also in semi-arid and arid climates. Another hazard of weed infestation is the shelter and good breeding conditions they offer for vectors (mosquitoes, snails, etc.) of debilitating diseases.

The Government of Egypt used to implement cleaning main canals as well as main drains in a regular basis to ensure that discharges of irrigation water are enough at the tail end of these canals and the good performance of drainage network. The intervals of regular maintenance should not exceed 2-3 years between two consecutive cleanings. Farmers should participate in such effort by cleaning their own field canals (small canals with ≤ 3 meters of bottom width and drains and remove weeds, wastes, and floating plants on the surface of the water.

The main objectives of this study are to introduce a friendly environmental package and a set of recommendations that:

1. Prolong the life of irrigation canals.
2. Reduce floating plants and weeds growth.
3. Reduce the leakage of the available water and improve the equity of water distribution.
4. Increase of cross sectional area of both irrigation and drain networks.
5. Protect the environment from diseases and save life of farmers.
6. Enhance the capacity building of the staff working in the field of environmental impacts.
7. Improve public awareness to and raise farmer knowledge on the best methods performance of cleaning irrigation canals.

MATERIALS AND METHODS

Site description:

Two sites were selected to conduct this study and to fulfill the proposed objectives. The first site is El-Nusra village at Kafr El-Sheikh governorate. The village is located nearby (10 km) Kafr El-Sheikh town. The total cultivated area is about 1250 feddans. It follows Butatia Cooperative that includes 793 beneficiaries. The main source of irrigation is Ibrahim Afendy canal that is 545 m long. It is a branch canal that takes its water from El-Ganbia El-Thaltha sub-main canal, and El-Zawia main canal. The main drain serving this area is located between El-Sakia area and El-Menshawia area. It is 818 m long. The two water bodies, i.e. irrigation canal and drain, are in a bad condition because both contain a lot of emergent, floating, and submerged plants, algae, garbage, mosquitoes, snails, and etc.

The second site is El-Qasr village at El-Beheira governorate. The total cultivated area is about 1898 feddans. It follows El Qasr Cooperative which includes 1024 beneficiaries. The main source of irrigation is El-Safouna canal. It is 845m long, takes its water from El-Mahmudia main canal, and serves about 250 feddans. The selected drain is El-Kushk drain which is about 890m long. The conditions of the water bodies good because both contain a lot of earth and aquatic weeds, floating leaved plants, submerged plants, algae, and garbage. Some farmers discharge their home sewage water to the drain through pipeline and the other irrigated their land from drains as supplementary irrigation.

Sampling:

Water samples were collected from the selected canals (I1, I2, and I3) and drains (D1, D2, and D3) as well as three times (before cleaning (zero time), and after 1st and 2nd weeks from cleaning). Sediments, floating plants, and weeds samples were also collected from the same check points.

Discharge and cross sections measurements:

The following parameters in at different check points are measured: water discharge levels and cross sectional areas of irrigation canals and open drains before and after cleaning. A current meter was used for water velocity measurements as $m^3\ sec^{-1}$. The cross sectional area is calculated as the sum of the areas between two adjacent verticals. The discharge in the section between verticals in the calculated by multiplying the average of the two discharges per unit width with the distance between the verticals. The average velocity is the discharge divided by the cross-section (needs more elaboration)

$Q(m^3 sec^{-1})$=(average of water velocity,m sec^{-1})×(canal or drain cross sectional area, m^2)

Methods of Analysis:

- Electrical Conductivity (EC) was determined according to **Jackson** (1973).
- Cations and anions were determined by titration method according to Jackson (1973).
- Macro(N, P, K), micro-nutrients (Fe, Zn, Mn,Cu), and heavy metals (Co, Ni, Pb,Cr) were determined by using plazma ICP according to Soltanpour et al. (1979).
- Pathogenic indicators (Total coliform, fecal coliform, Salmonila and Sheglla) were determined according to the methods described by Mahmoud (1988).
- Chemical oxygen demand (COD) and biological oxygen demand (BOD) were determined according to APHA (1992).

- Parasites were estimated by using centrifugation floatation methods according to Egyptian Code 501/ (2005).
- Cholorophyl A & B were filtrated by 0.45mm filters and were extracted using 90% acetone and measured Spectrophotometrically according to Strike and Parsons (1972).
- Total pesticides samples were collected in a separating funnel; sodium chloride was added and shaked vigorously to dissolve salts. The aqueous phase was liquid-liquid extracted with dichloromethane following the standard method of AOAC official method 990.06 (2012). The contents were evaporated to near to dryness using turbo evaporator (PCi Analytics, India) and reconstituted with ethyl acetate.

RESULTS AND DISCUSSION

Water quality evaluation at the investigated areas:

Chemical analysis:

Total soluble salts: Total soluble Salts are one of the most important parameters for assessing agricultural water quality. Results in Fig. 1 illustrated the chemical analyses of irrigation canal and drain before and after cleaning at selected area at Kafr El-Sheikh governorate. The EC values of canal water varied from 0.60, 0.51 to 0.52 dS m^{-1} before cleaning, and after 1st and 2nd weeks from cleaning. The obtained values are below the threshold values of water use for irrigation. The Sodium Absorption Ratio (SAR) values ranged from 0.25 to 2.54 for most samples collected from the examined sites .With regard to pH values of all irrigation water samples; they varied between 7.17 and 7.8. Results indicated that water samples were free from residual sodium carbonates (RSC). From the obtained results it could be concluded that, canal water is classified of as non-saline according to Ayers and Westcot (1985).

Concerning the evaluation of the drainage water of the investigated drains, results indicated that the mean values of EC were 1.06, 1.43, and 1.02 dS m^{-1} and the SAR values were 2.21, 2.45, and 2.30 before cleaning, and after 1st and 2nd weeks from cleaning, respectively. The increase in EC values after one week from cleaning is mainly due to increasing drainage water movement into as result of cleaning process which gives an opportunity for removing salts from soil profiles by leaching. The collected samples were free from RSC. The drainage water is classified as moderately saline according to Ayers and Westcot (1985). It could be concluded that a slight degree of restriction should be given to use this water for irrigation and salt tolerant crops should be cultivated.

Concerning El-Beheira site, as well the EC values of the irrigation canal and open drain are presented in Fig. 1 Results reveal that, the EC values of irrigation water were 0.77, 0.89, and 0.91dS m^{-1} and for the open drain were 0.94, 0.93, and 1.63 dS m^{-1} for the head, middle, and tail end of irrigation canal and open drain, respectively. The EC values are below the threshold value of the saline water given by Ayers and Westcot (1985). This indicates that, there are no problems of using both sources in irrigating field crops. The SAR values ranged from 1.46 to 3.80 for most of the examined sites in irrigation canal and open drain, which gives a slight degree of restriction on the use of such water for irrigation. Results indicated that water samples were free from residual sodium carbonates (RSC).

With regard to pH values for all irrigation and drainage water samples results showed that, the pH values varied between 7.1 and 7.39 for the canal water and from 7.13 to 7.56 for the drain water. In general, the monitoring study cleared that the two sources of water used in the investigated case studies is are of good quality according to Ayers and Westcot (1989) and do not represent any risk for irrigation purposes.

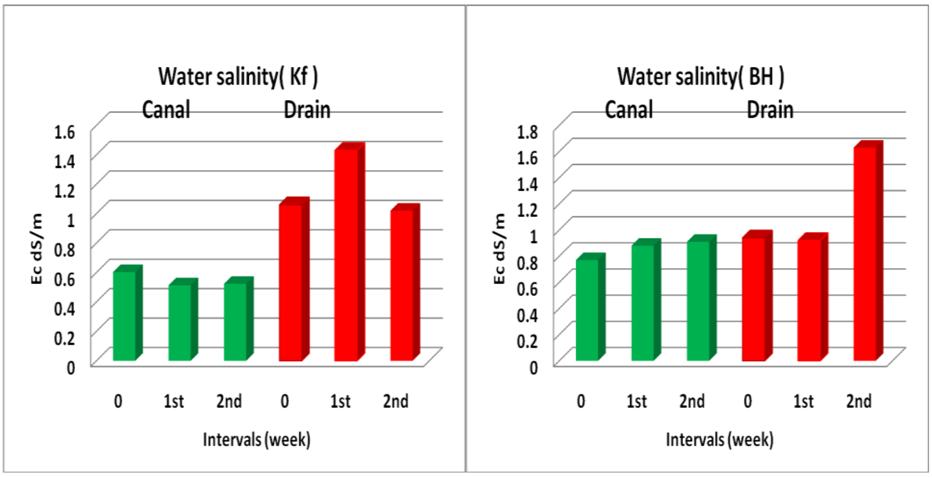


Fig.1 EC values of irrigation canals and drains before, one and two weeks after cleaning at Kafr El-Sheikh (KF) and El-Beheira (BH) areas.

Macro and micronutrients and heavy metals:

According to FAO (1992) guidelines, results indicate that concentrations of all determined elements at Kafr El-Sheikh and El-Beheira areas were considerably below the permissible limits in the collected from irrigation and drainage water before and after cleaning. As for, Nitrogen was considerably below the permissible limits in the investigated (canals & drains) before and after cleaning except of Ammonium–N was exceeded the critical limit for irrigation at the upstream of the irrigation canal before cleaning ; indicating that anaerobic condition is taking place at kafer ElSheigh area before cleaning. While, after cleaning ammonium concentration in canal were considerably below the permissible limits indicated the aerobic conditions are taking place. FAO, (1992)conclude that, sensitive nitrogen crops may be affected by high nitrogen concentration above 5 mg l^{-1} in the form of nitrates or ammonium and at more than 30 mg L^{-1} nitrogen, severe problems are expected

Total and fecal coliforms bacteria:

Coliforms are probably the most frequently used bacterial as a bio-indicator for water pollution since years ago and up till now. The coliforms may be used as a group for the detection of water pollution or examined as fecal coliforms of which E. coli being the most favored species for this purpose. Results in Fig. 2 illustrated the determined total and fecal coliforms, Salmonila, and Sheglla bacteria in the collected water samples from irrigation canals and open drains at Kafr El-Sheikh and El-Beheira.

Results reveal that, average mean values of total and fecal coliforms in the collected water samples at Kafr El-Sheikh of both irrigation and drain water canals showed a clear decrease after cleaning process. This is mainly due to increasing drainage water flow to the drain which speeded up the oxidation process and resulted in natural stream purification. Generally, the count of both bacteria was below the permissible limits according to WHO (1989). While, the average mean values at El-Beheira canal and drain indicated high coliform values. The total coliforms and fecal coliform counts are of similar trend before and after cleaning process of both irrigation and drain water samples. This means that contamination is existed. The high coliform counts may be attributed to the fact that the irrigation canal and open drain received wastewater from houses along water ways stream.

Salmonila and Sheglla bacteria:

Results in Fig.2 Show that, all the collected water samples from irrigation canal and open drain at Kafr El-Sheikh were free from Salmonila and Sheglla bacteria before and after cleaning process. While, the investigated water streams at El-Beheira governorate contained high values of Salmonila and Sheglla bacteria before and after cleaning process. The presence of Salmonila and Sheglla is due to the disposing of domestic wastewater in the water streams.

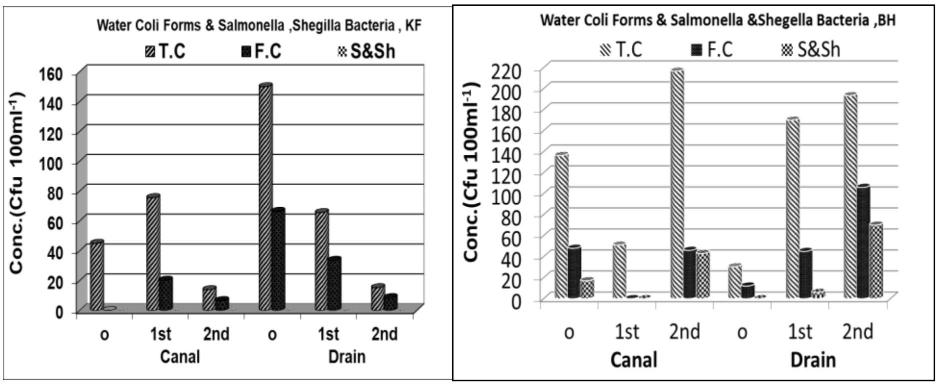


Fig. 2 Total coliforms, Salmonila, and Sheglla bacteria determined in water of both canals and drains at Kafr El-Sheikh (KF) and El-Beheira (BH).

Parasites:

All the collected water samples from irrigation canals and open drains at Kafr El-Sheikh and El-Beheira were contaminated with Entamiba coli and plantidium coli before and after cleaning process. The presence of parasites can represent a vital microbiological risk and could have a serious effect on farmers' health.

COD & BOD

Average COD and BOD values in the collected water samples from irrigation canal were 74, 128, and 200 and 38, 50 and 4 (mg l^{-1}), before cleaning, and 1st and 2nd weeks from cleaning, respectively in Kafr El-Sheikh investigated area as shown in Fig. 3. Concerning the collected water samples from the drain, the average COD and BOD values were 94, 103, and 16 and 48, 38, and 9 (mg l^{-1}) before cleaning, and 1st and 2nd weeks from cleaning, respectively. The recorded values were reduced after cleaning process and below the permissible limits according to (FAO, 1992). The reduction of COD and BOD values were mainly due to the oxidation process taking a place after the cleaning process. While, results indicated high levels of COD and BOD before and after cleaning process of irrigation canal and open drain in El-Beiheira area. The measured values exceeded the permissible limits for using such water for irrigation (FAO, 1992 and Decree no. 16 of law 93/1962, 1995). As for the biological stabilization of biodegradable organics, it can lead to the depletion of natural oxygen resources and to the development of septic conditions.

Total pesticides:

Pesticides are one of the many components used in modern agriculture. Pesticides are chemicals used to control or kill the pest species, which include plants that are not required. Pesticides are used to increase crop yields, can be applied either directly or indirectly and their residue may accumulate not only in crops, but also in the soil, surface water and other environmental matrices (Wesseling et al., 1997). Pesticide can enter the drains or canal either dissolved or carried by soil particles (Joseph, 1997). Data illustrated in Figs 3 reveal the total pesticides determined in the collected water samples of both irrigation and drain canal of Kafer El Sheikh and El Beheira. All the collected samples are contaminated with pesticides before and after cleaning in both irrigation and drain canal. The values are ranged up 3.0 to 4.4 mg l^{-1}.

Their presence in irrigation water can cause yield reduction and decrease product quality.

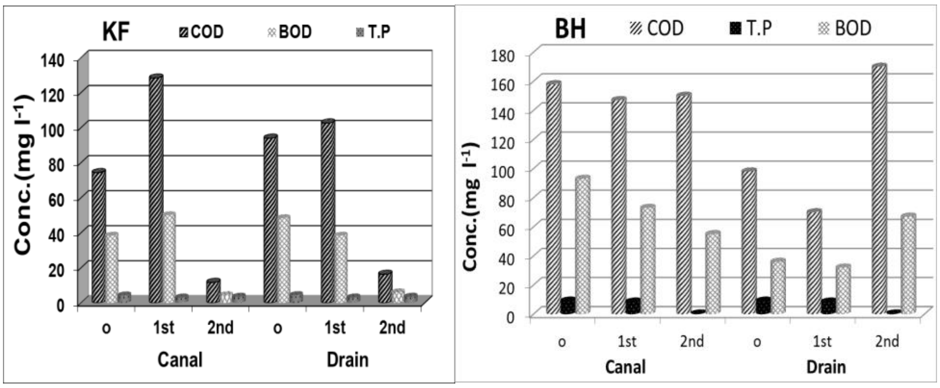


Fig. 3 Total pesticides (TP), COD and BOD determined in water samples from canals and drains at Kafr El-Sheikh (KF) and El-Beheira (BH).

Chlorophyll A & B:

The use of chlorophyll measurements by water utilities indicated the quality of raw water supplies. Because measuring chlorophyll in simpler and less expensive than algal counting eventually it may replace algae counting. Their appearance in which correlations between chlorophyll found in water gives an estimation of the concentration of algae. Chlorophyll (A & B) concentrations of the collected water samples from irrigation and drain canal of Kafer El Sheigh and El Beheira are in excellent category due to its less than they permissible limit (<3 mg l^{-1}) before and after cleaning the ditches.

Sediment mud assessment:

Chemical analysis of sediments:

One of the major problems in quantification of heavy metals enrichment in sediments is to know the baseline concentration of heavy metals in unpolluted / natural sediments (Singh et al., 2002). Average shale concentration given by Turekian and Wedepohl (1961) is a worldwide standard that satisfies the bases to be used as a reference for unpolluted sediments.

Fig. 4 shows the determined micronutrients and heavy metal indicators of the collected sediment of both irrigation and drain canal before and after cleaning the ditches. No changes had been observed before and after cleaning for the most determined elements of both Kafer El-Sheigh and El-Behira investigated areas. Concerning, the calculated enrichment Factor (EF) of the collected sediment of both irrigation and drain canal of Kafer ElSheigh is in the permissible limits except of Cd. The values are ranged up (6.1- 7.12) and (6.21 - 7.27 mg l^{-1}) for irrigation and drain canal, respectively. This means contamination of Cd is exist according to Müller (1979). Geo- accumulation index is the quantitative measure of heavy metals pollution in sediments, when the concentration of toxic heavy metals is 1.5 or more times greater than their lithogenic shale^{-1} background values. Concerning, the maximum EF values of El -Behira investigated canal and drain were recorded only for Cd & Zn. Their fore, the EF index is the quantitative measure of heavy metals pollution in sediments, when the concentration of toxic heavy metals is 1.5 mg l^{-1} or more times greater than their lithogenic shale^{-1} background values.

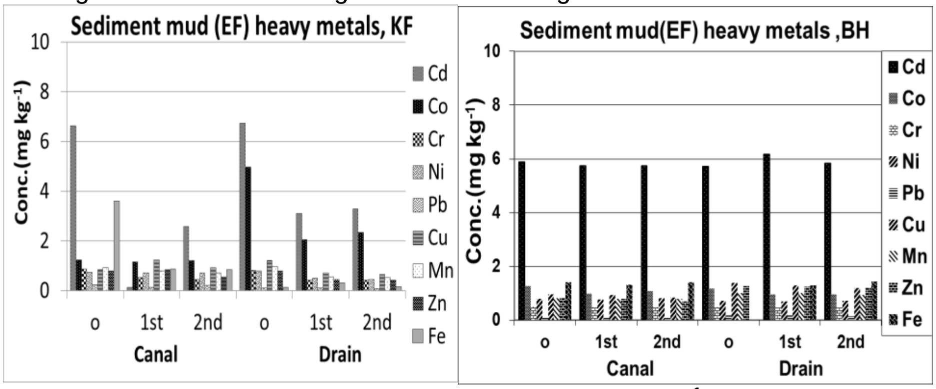


Fig.4 Enrichment Factor (EF) heavy metals (mg kg^{-1})of the collected sediment mud of both canal and drain of Kafer El Sheikh(KF) and El Beheira(BH).

Total and fecal coliforms bacteria:

Data illustrated in Fig.5 show that, total and faecal coliform of sediment of Kafer El-Sheigh investigated area. The data observed the counts are of similar trend before and after cleaning. Generally, the coliforms are observed in irrigation canal and drain. While the maximum values were observed in all investigated locations after 2 weeks from cleaning process. The higher coliforms bacteria in the investigated locations may be attributed to the fact that receives wastewater from building along the investigated water stream.

Concerning, the increase in total and feacal coliforms after 2nd week from cleaning may be due to stirring the stream bottom; the bacteria are released in water bodies and the blooming increase because of water running and trapped again to sediment mud. This result is in harmony with the presence of bioindicator bacteria of water samples which collected from the same area..

Concerning such parameters of El-Behira canal and drain the obtained data indicated that, total and Faecal coliform counts are not changed before and after cleaning process. All sediment samples are contaminated. The high coliform values may be attributed to the fact that the irrigation and drain canal receives wastewater from houses along the investigated canal and drain water stream. The presence of indicators of faecal contamination can represent a microbiological risk in what terms their presence could have repercussion on the health of the consumer.

Salmonila and Sheglla bacteria:

The collected sediment mud samples of irrigation and drain canal of Kafer El-Sheikh canal and drain are almost free from Salmonella and Shegalla bacteria after cleaning ditches. While, El-Behira investigated canal and drain, sediment samples are contaminated before and after cleaning process. This is may be due to the received wastewater from homes along water stream.

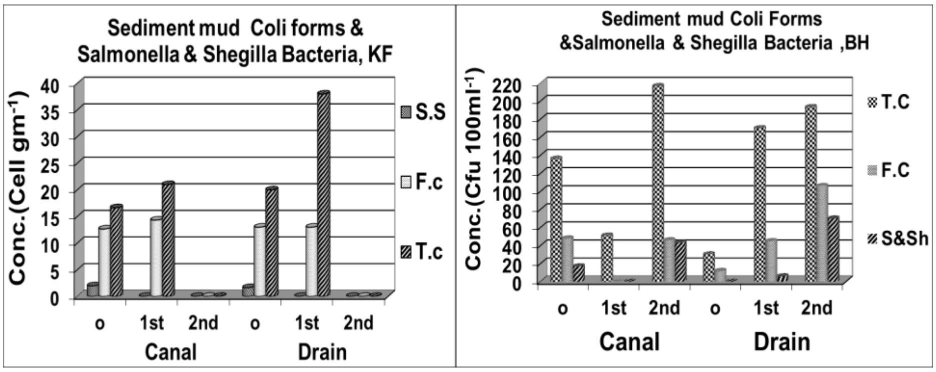


Fig. 5 Total coliforms, Salmonila and Sheglla bacteria Conc. (Cfu 100^{-1}) mldetermined in water of both canal and drain of Kafer El Sheikh (KF) and El Beheira (BH).

Assessment of aquatic Macrophytes:

Water hyacinth and reed plants are considered as aquatic plants that are naturally grown in the pathways. Water hyacinth is one of the most studied aquatic plants due to its detrimental and beneficial effects on environment, as well as being the most prolific and productive plants in the world . Its rapid growth causes a great deal of water losses as well as blocking water stream. High productivity is exploited in the process of wastewater treatment (Vymazal, 1995).

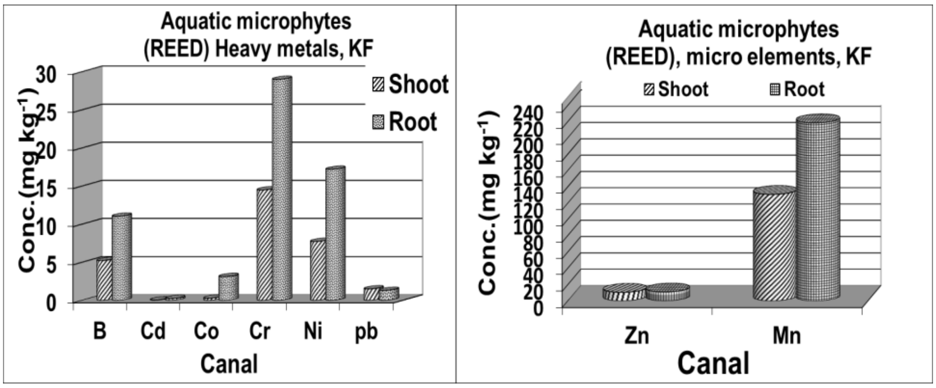


Fig.6 Micro and heavy metals content (mg kg^{-1}) in hyacinth and reed plants (shoot & root) in drain.

Furthermore, the shading provided by plant cover restricts algal growth, and hyacinth roots impede the horizontal movement of particulate matter (Dinges, 1982). With electrical charges associated with hyacinth roots are reported to react with the opposite charges on colloidal particles such as suspended solids, causing them to adhere to plant roots where they are removed from the wastewater stream and slowly digested assimilated by the plant and microorganisms (Wolverton, 1989).

Heavy metals content of water hyacinth and reed plant may reflect the changes and status of water stream. In this regard Abd El–Haleem et al. (1992) reported that water hyacinth plants are good tools for water environmental monitoring. They added that these plants reflected the situation of the investigated water– bodies. As well as macrophyte species with high plant surface areas have been shown to be very effective at retaining metal hydroxide particles that have precipitated out of solution (Cooper et al., 1998).

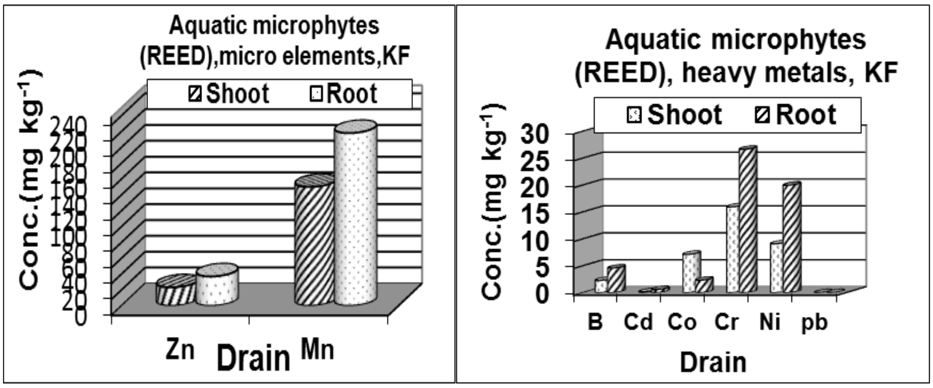


Fig.7 Micronutrients and heavy metals content (mg kg^{-1}) in hyacinth and reed plants (shoot & root) in drain.

Data illustrated in Fig.6. show the values of micro and heavy metals content in hyacinth and reed plants (shoot & root) grown along irrigation and drain canals of Kafer ElSeigh and ElBehira canal and drain investigated areas .The data reveal that all the tested element except of N , P ,K 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 than in above parts, i.e. in stems and leaves (Ximenez et al. 2001). Generally, macrophyte species with high plant surface areas have been shown to be very effective at retaining metal hydroxide particles that have precipitated out of solution.

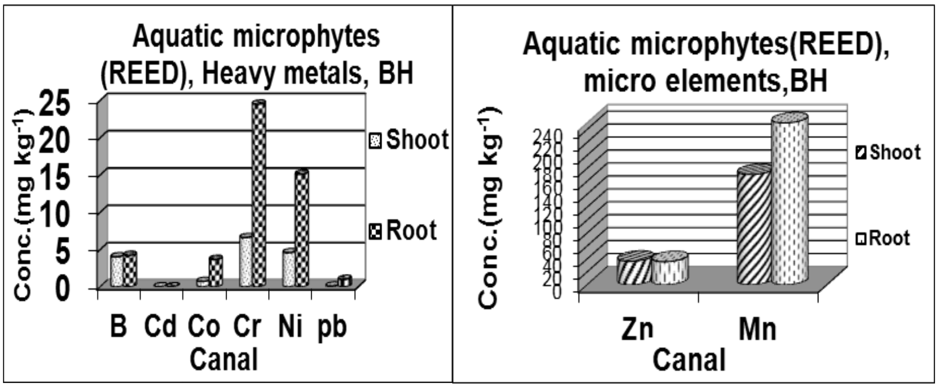


Fig. 8 Micronutrients and heavy metals content (mg kg^{-1}) in hyacinth and reed plants (shoot & root) in BH canal.

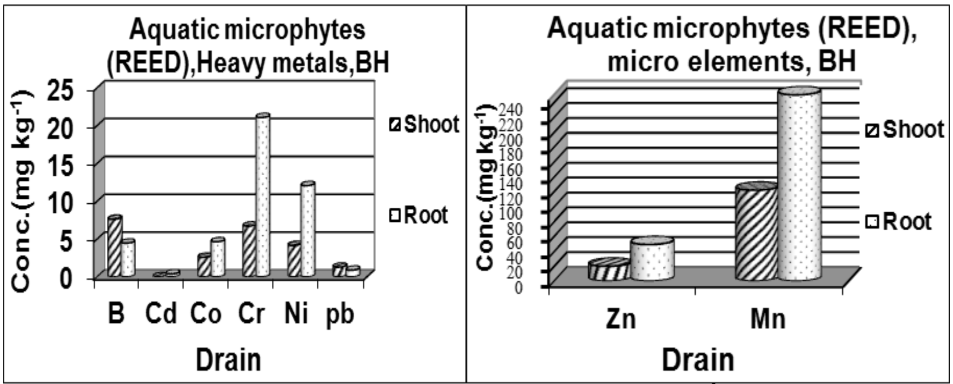


Fig.9 Micronutrients and heavy metals content (mg kg^{-1}) in hyacinth and reed plants (shoot &root) in drain BH.

Cross Section and Discharge measurements:

Cross sections (A) Data of Figs (10&11) indicate an increase of cross sections area of both irrigation and drain canals of Kafr El-Sheikh and El-Beheira governorates due to cleaning process. Cleaning process had sharply affected the cross section along the water ways Discharges (B) Data of Figs. (12&13) indicate that the discharge of irrigation canal is increased about 51 and 48-103% after cleaning of kafr El-Sheikh and El- Beheira selected areas, respectively. At the same time, the discharge of drains is increased about 12-20 and 115-31% after cleaning at Kafr- El Sheikh and El- Beheira selected areas.

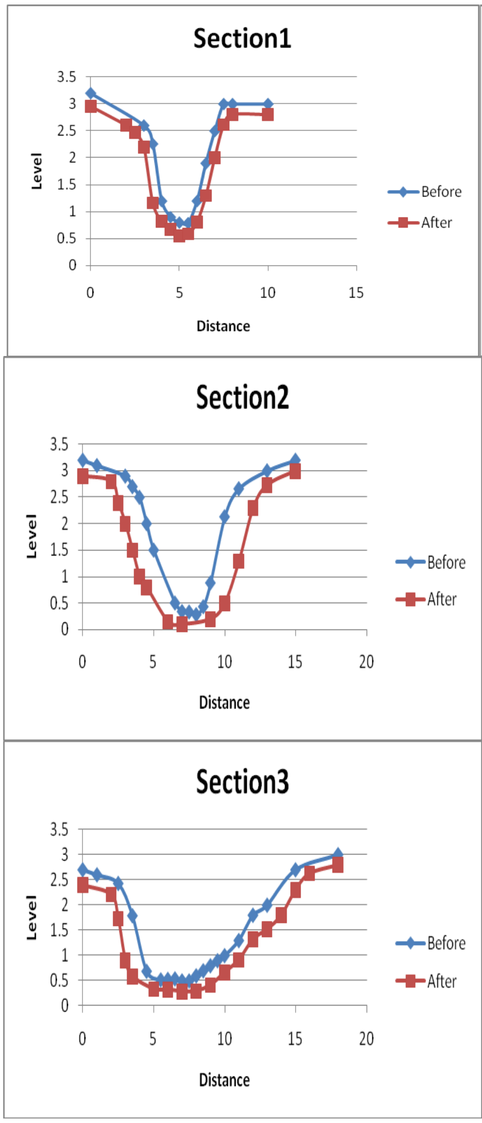


Fig.10Cross section(m) of Ibrahum Afendy canal "before and after cleaning in Kf.

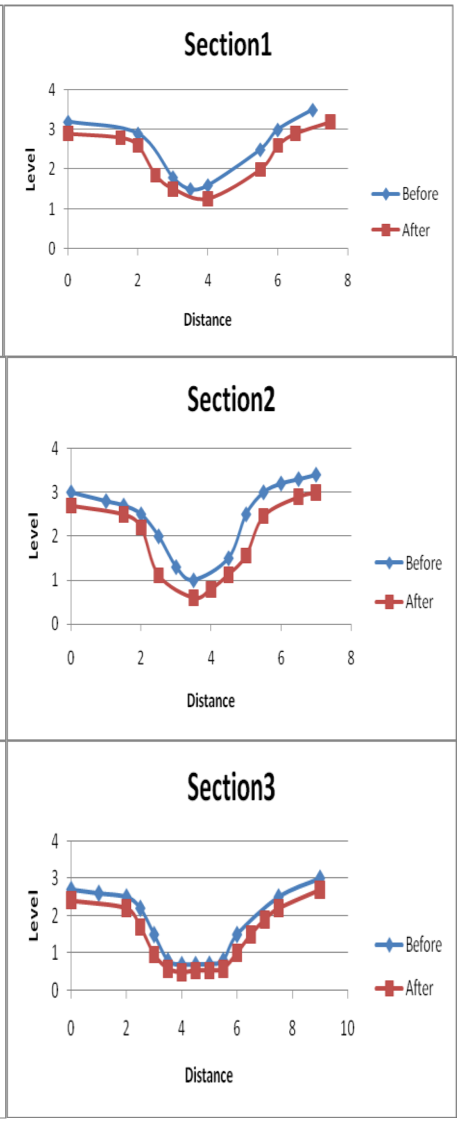
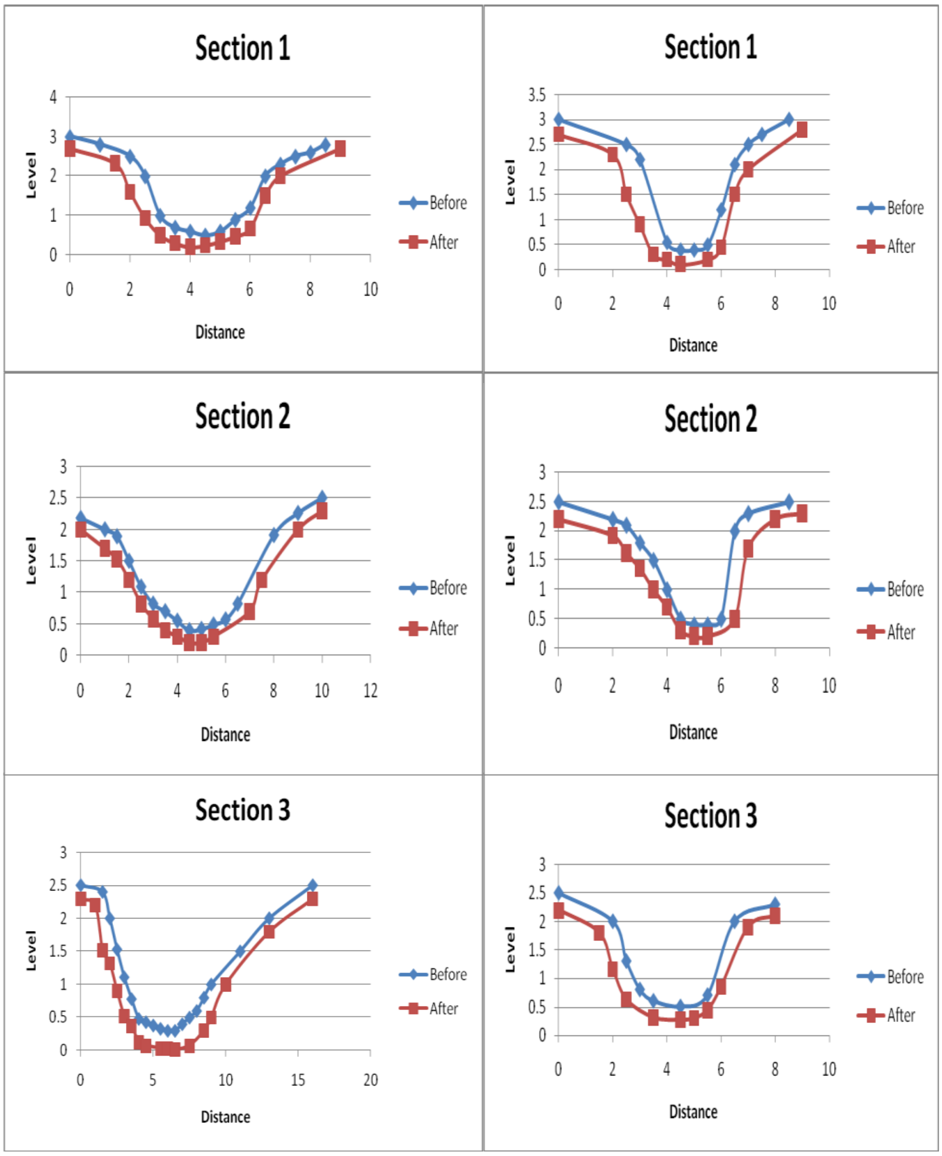


Fig.11Cross section (m) of Masraf been Hudeen drain"before and after cleaning in Kf.

Fig.12Cross section (m) of El-Safouna canal "before and after cleaning"El-Beheira governorate.

Fig.13 Cross section (m) of El- Kushk drain"before and after cleaning" El-Beheira governorate.


Section 1
Level
Distance
Before
After
Section 1
Level
Distance
Before
After
Section 2
Level
Distance
Before
After
Section 2
Level
Distance
Before
After
Section 3
Level
Distance
Before
After
Section 3
Level
Distance
Before
After

CONCLUSION

The results indicated an increase in discharges after cleaning process than before in irrigation and drain canals. There were some restrictions to do the activities of cleaning process by the farmers themselves.

Recommendations:

- A further a Study on area with closed irrigation and drainage system is needed.
- It is necessary to clean open field drain in the same time with main drain in the drainage network in large scale.
- Extension public awareness to clean out the importance of field canal or drain cleaning to explain this process increase the discharge of canal and drainage water which is lead to increase the crop production and farmers income.
- Public awareness to protect human health from weed infestation is the shelter and good breeding conditions they offer for vectors (mosquitoes, snails, etc.) of debilitating diseases.
- Punishment farmers who for beden discharges sanitation home wastes to irrigation canals or drains.

ACKNOWLEDGEMENT

This study was financially supported by GIZ as a part of a study on agriculture water productivity for adaptation to climate change project in Egypt.

This research was technically supported by Prof. Dr. Nabil Kandil, who provided insight and expertise that greatly assisted the research.

REFFRENCES

Abd El- Haleem, A.S; Abd El-Sabour A.S. and Zaghloul , R.A. (1992). The use of water hyacinth as biological indicators of environmental contamination by heavy metals. Proc. Conf. In Environmental Contamination, C.E.P. Consultant Ltd., Edinburgh, UR. 236-265.

American Public Health Association, APHA (1992). Standard Methods for the Examination of Water and Wastewater . 18th, Washington , D.C., USA.

AOAC Method 990.06 (2012). Organic Pesticides in water. Ed. Latimer GW, 19th edition Chapter 10 p 17-26.

Ayers, R.S. and D.W. Westcot (1985). Water Quality for Agriculture FAO, Irrigation and Drainage Paper, 29.

Cooper, R.C. and Olivieri A.W. (1998). Infectious disease concerns in Wastewater reuse. In: Asano T (ed.) pp. 489-520.

Decree 16 of law 93/1962 (1995): Regarding wastewater reuse in irrigation of the executive regulation for law 93/1962 recommended by the high water committee of the experts.

Egyptian Code 501/2005 for Safety Use of treated sewage water in agriculture, Ministry of Housing, Egypt (2005). Egyptian Code No.

329/2001. Using of treated waste water in agriculture. 2nd volume. Analysis Method to Evaluate Pollutant in Breeding, plant & soil.
FAO (1992). Wastewater Treatment and Use in Agriculture. Pescod M.B. Irrigation and Drainage Paper 47. Food and Agricultural Organization (FAO), Rome.
Jackson , M.L. (1973). Soil Chemical Analysis. Prentice – Hall , Inc., Englewood Cliffs, N.J.
Joseph, L.D (1997). Pesticides in surface and ground water of the Tulare Basins, California : Analysis of Available data, 1966 -1992. Water-supply paper 2468, U. S. Department of the Interior, U. S. G. S.
Mahmoud, S.A. (1988). Practical Applied Microbiology . Egyptian Anglo, Cairo , No. 8272187 (in Arabic).
Muller, G. (1979). Schwermetalle in den sedimenten des Rheins-Veranderungen Seit 1971, Unschau 79 (24):778-783.
Pionke, H. B. and D.E. Glotfelty (1989). "Nature and extent of groundwater contamination by pesticides in an agricultural watershed," Water Research, vol. 23(8), pp. 1031-1037.
Singh, M.; G. Muller and Singh, I.B. (2002). Heavy metals in freshly deposited stream sediments of rivers associated with urbanization of the Ganga Plain, India. Water, Air and Soil Pollution 141: 35-54.
Soltanpour, P.N.; Workman, S.M.; and Schwab, A.P. (1979). Use of inductively Coupled Plasma Spectrophotometry for the simultaneous determination of macro – and micro nutrients in NH4 HCO3 – DTPA extracts of soils. Soil Sci. Soc. Am. J. 43 : 75-78.
Strickland, J. D. and Parsons, T. R. (1972). A practical Hand Book of Sea Water Analysis. Fisheriers Research Board of Canada Bulletin 167, 2nd . P. 310.
Turekian, K.K. and Wedepohl, K.H. (1961). “Distribution of elements in some major units of the earth’s crust”, Bull. Geol. Soc. Am. 72:175-192.
Vymazal, J. (1995). Algae and Element Cycling in Wetlands. CRC Press/Lewis Publisher, Boca Raton, Florida.
Wesseling,C.; R. McConnell; T. Partanen; Hogstedt, C. (1997). "Agricultural pesticide use in developing countries: Health effects and research needs," International Journal of Health Services, 2, 273-308.
WHO (1989). “Health guidelines for the use of wastewater in agriculture and aquaculture”. Technical Report No. 778. WHO, Geneva 74p.
Wolverton, B.C. (1989). Aquatic plant/ microbial filters for treating septic tank effluent. In : Hammer, D.A. (ed.), constructed wetlands for Wastewater Treatment. Municipal, Industrial and Agricultural. pp. 173-178. Lewis Publishers, Chelsea, Michigan.
Ximenez, E.P.; A.Y. Madrid; C. Camara; C. Cuadrado, C.Burbano and Muzquiz, M . (2001). Evaluation of Lupines species to accumulate heavy metals from wastewaters. International. Journal of Phyto-remediation. 3 (4): 369-379.

تقييم الأثر البيئي لتطهير قنوات الرى والمصارف المكشوفة

محمد محسن الخولى، سيد أحمد التهامى و صابر محمود أحمد
معهد بحوث الاراضى والمياه والبيئة –مركز البحوث الزراعية –الجيزة -مصر

تعد أهم مشاكل المزارعين هى تطهير الترع والمصارف المكشوفة وربما تكون ملوثة بالصرف الصناعي أو الزراعي أوالنفايات المنزلية بما تحتويه من الأسمدة والمبيدات. وهناك ارتباط إيجابي بين تركيز المبيدات و ممارسات استخدام الأراضي والنباتات المائية (الأوراق العائمة والمغمورة والطحالب) التى يمكن أن تعرقل كثيرا من تدفق المياه بالإضافة مصدر اخر للتلوث وهو الحشائش حيث تكون المأوى المناسب للتكاثر حيث يوجد بها(البعوض والقواقع وغيرها) التى تنقل الامراض وتؤثر على الصحة العامة.

وتقوم الحكومة المصرية بتطهير المصارف الرئيسية والفرعية بانتظام وكذا الترع العمومية وترع التوزيع. وتقع على عائق المزارعون تطهير وصيانة المساقى ومصارف الحوض او الحوشة.

والهدف من هذه الدراسة هو مشاركة المزارعين فى تطهير وصيانة المساقى ومصارف الدرجة الثالثة والتوعية البيئية .

ولقد نفذت هذه الدراسة في بعض قرى محافظات كفر الشيخ والبحيرة بمشاركة المزارعون بحيث تعود الفائدة على المزارعين في المشاركة في أعمال الصيانة والتطهير.

وقد تم اختيار قريتين الأولى عزبة النصرة بمحافظة كفر الشيخ ، والثانية هي عزبة البحيرة ويتم جمع عينات المياه من المسقة والمصرف فى ثلاثة نقاط رصد (أول ووسط ونهاية) على مرحلتين (قبل وبعد التطهير) واخذت عينات من الرواسب والنباتات المائية الطافية وقد تم قياس التصرفات والمقاطع العرضية من نقاط الرص المختارة.

وأظهرت النتائج أن تركيز بعض العناصر الكبرى والصغرى والثقيلة قبل وبعد التطهير والصيانة هي أقل من الحدود الحرجة في جميع نقاط الرصد وفقا للمعايير القياسية (FAO1992) ومن ناحية اخرى قد تم تجاوز تركيز الأمونيا في المساقى الحدود الحرجة لأغراض الري التي أشارت إلى أن الظروف اللاهوائية.

وتقل قيم مجموع بكتريا القولون البرازية فى عينات المياه التي تم جمعها بعد عملية التطهير في محافظة كفر الشيخ حيث وجدت بكتريا السالمونيلا والشيجلا بقيم مرتفعة تزيد عن الحدود الحرجة وبتتبع قيم الاكسجين الكيميائي والبيولوجي فقد اظهرت مستوى مرتفع تجاوز الحدود القصوى من الكود المصرى ٥٠١ لسنة ٢٠٠٥.

اظهرت النتائج ان جميع عينات المياه التى تم جمعها من المساقى والمصارف فى كل من كفر الشيخ والبحيرة تحتوى على الانتميبا واالكولاى القولونية قبل وبعد التطهير وايضا جميع العينات ملوثة بالمبيدات فى المساقى والمصارف قبل وبعد التطهير.

اظهرت النتائج ان هناك علاقة بين الكلوروفيل(B & A) الموجودة في المياه وتركيز الطحالب فى عينات المياه التي تم جمعها من المساقى والمصارف.

وقيم المبيدات في عينات المياه التي تم جمعها من كل من المساقى والمصارف فى كل من كفر الشيخ والبحيرة أقل من الحد المسموح به (< ٣ ملجم / لتر) قبل و بعد التطهير.