# Assessment and Treatment of Water Pollution and Its Impact on Heavy Metals, Pesticides and Diaxions in Some Organs of African Catfish (*Clariasgariepinus*) In Different Aquatic Ecosystems, Nile Delta, Egypt

Ahmed E. Hagras, Eman A. Elhelow and Zeinab S. Abou El Naga
Ecology Division, Zoology Department, Faculty of Sciences,
Mansoura University, Egypt

**Abstract:- River Nile is an essential water resource for both drinking water and irrigation in Egypt. This study assessed water quality at River Nile and three polluted ecosystems namely Omr Beck drain, Sherbeen drain, Manzalalake and investigated the impacts of this water on some organs of African Catfish (*Clariasgariepinus*). The physicochemical parameters of the water were measured seasonally at three ecosystems compared to River Nile in the period fromwinter 2017and autumn 2018. Also, this study evaluates the negative impacts of all measured parameters on the general health of the fish. The data indicated that EC, $HCO_3^-$, $SO_4^{2-}$, $Cl^-$, $Ca_2^+$, $Mg_2^+$, $Na^+$, $K^+$, TH, TA and $NO_2^-$ recorded higher concentration in Omr Beck drain water than those in other polluted ecosystems and River Nile. The data indicated that $NO_3^-$, $NH_4^+$ and DRP recorded higher concentrations in Manzala lake water than those water of RiverNile. The data showed that there were a highly significant variation in the levels of heavy metals, pesticides and diaxions in water and within African cat fish (*Clariasgariepinus)* tissues (liver, kidney and gills) between River Nile and three polluted ecosystems in all seasons per one year($p \leq 0.05$).Also the study solved water pollution problem by reducing pollutants using two different methods (phytoremediation by *Scenedesmusobliqnus*and adsorbent nanotechnology by hydroxyapatite nanorods).each methods achieve 95% of reducing pollutants from polluted fields and so we can reuse waste water.**

***Keywords**:- River Nile, Omr Beck drain, Sherbeen drain, Manzala lake, ClariasgariepinusHeavy metals, Pesticides and diaxions, Scenedesmusobliqnus, hydroxyapatite nano rods.*

## I. INTRODUCTION

Water is the lifeline for the humanity in drinking and agricultural activities, however it receives enormous contaminants every day which resulted from careless interfere of human, others are presented naturally like metals which are useful in low levels but when these metals exceed the allowed limits endanger the water system resulted in degradation of aquatic system (**PEREIRA *et al*., 2013; JÖRUNDSDÓTTIR *et al*., 2014; Bouaroudj*et al*., 2019**).Water bodiescontamination represents the most serious phenomena that faces the worldwide which is produced as a consequence of continuous exposure to agriculture, industrial activities and urbanization(**Olopade*et al*., 2015**). Recently the untreated sewages which were disposed within water threaten the whole aquatic life (Bahnasawy*et al.,* 2009). Even though, River Nile, lakes, canals and seas receive many quantities of industrial, domestic wastewater from drains which disturb the aquatic equilibrium yielding complete alterations within whole constituents of ecosystem (**El-Sheikh et al., 2010;Azzurro*et al*., 2010; Authman*et al*., 2013**)

Heavy metals pollution is an ecological problem in which whole world suffered from it, threaten the aquatic system and difficult be overcome because of its non-biodegradable property and its bioaccumulation through aquatic food chain and finally precipitate within body tissues **(Aiman*et al*., 2016)**. The danger of these metals lied on its destructive influences as it damage and disturb the species biodiversity and habitat constituents including water and sediments(**Monroy*et al*., 2014; Authman*et al*., 2015**). Although some heavy metals are essential for life such as zinc,copper and manganese, butchromium, cadmium and lead (Pb) causing serious hazards on the health ( **Ouyang*etal*., 2002**).

Pesticides have an extremely useful role in improvement of agricultural products by stopping arthropod-borne diseases but the bad effects of that returned to the undeliberate usage of these pesticides which contaminate soil, surface, underground water resources and near the a reservoirwatershed could know water quality problems and disruption in fish (**Moshood, 2009; Akan *et al.*, 2014**). Pesticides are known to be toxic to man if the contamination of food occurred by them is ingested, the chemical stability of these compounds, their high lipid solubility and toxicity to human and animals explained the danger of these compounds ( **Begüm*et al.*, 2005; Teklit, 2016**) which caused irritation, dizziness, tremor, tonic and chronic convulsion (**Akiwumi and Butler, 2008**).

Many ignorant fishermen,farmers and some other users have abused their use for agricultural and fishing purposes. Being persistent and toxic, they pose serious environmental and health hazards, not only in the areas of applications, but up the food chain as the receiving water body contains other edible zooplanktons apart from fish that ingest these toxic chemicals which reside mostly in the fatty parts of their bodies. Consequently, move through the food chain (**Canli and Atli , 2003**).the existence of these compounds in water causes alteration in the natural and physical characters of water including taste odours and colors making it not drinkable even in low levels ( **Chen and Folt , 2000**).

Chlorinated organic pesticides have great threats to environment due to its high stability and resistance to photo degradation so its existence is lasted for long periods in both fresh and marine water (Shokrzadehet al., 2009). These complexes are precipitated in animal bodies where direct absorption or ingestion of polluted nutrientsoccur by fish(Monirithet al.,2000). For monitoring Pesticide residues it should be measured within fish tissues especially gills because it considers the first organ in direct contact with water. Also, pesticides in water were stored in fish liver which gives a complete image about the negative impacts of pesticides over the last decades (Babuet al., 2005; Ntow, 2005)

Dioxins and dioxin-like compounds are a family of organic micropollutants belonging to the group of persistent organic pollutants(**Calkosinski*et al.*, 2014**).

The importance of usage the African catfish namely, *Clariasgariepinus*in investigation returned to its abundance in River Nile and drainage canals in Egyptthroughoutthe year in higher proportion than many other Egyptian fish, and its richness with proteins even though its cheap price (**Hagras*et al.*, 2017; Al-Halani, 2018**). Numerous methods have been proposed for removing toxicants from water sources to produce pure, clean and health water; these methods include chemical precipitation, membrane separation, ion exchange, electrochemicalcoagulation, reverse osmosis, and solvent extraction (**Alqadami*et al.*, 2017**). The oldest physico-chemical treatments for the removal of heavy metals and pesticides from polluted places are labor demanding,costly and also disturbing the environment (**Harvey *et al*., 2002**). So, there is necessary for an efficienteco-friendly and technology for imitigation of water contaminated with such toxic compounds (**Nisha Gaur *etal.*, 2014**). The current study uses thephyto-remediation methods by micro algae especially*ScenedesmusSp.* for the removal of pollutants in Biological treatment**.**

Nano technological treatment by adsorption methodology is considered the optimal due to itsefficiency, easily applicable, don't harm the environment, low totalcost, minimal energy requirement, and rapid performance(**Naushad*et al.*, 2016**). A large number of adsorbent materials havebeen fabricated and used in adsorption/removal of hazardous toxins from water, like chitosan (**Simionato*et al*., 2006; Dai *et al.*,2012**), activated carbon (**Abdien*et al.*, 2016**), hydroxyapatite (**Zhu *et al.*, 2010**), natural clay (**Sdiri*et al.*, 2016**) and other adsorbents. The current study uses Hydroxyapatite (HAP, $Ca_5(PO_4)_3(OH)$), a well-known member of the calcium phosphate family withhigh biocompatibility and can be used as an adsorbent and brought from nature resource ( egg shell) for removal of toxic dyes from aqueous solution (**Peng*et al*., 2018**).

The current investigationaimed to evaluate water physicochemical characteristics, Heavy Metals, pesticides and diaxion in Waterand Some Organs of *Clariasgariepinus*in different drains in Nile Delta, Egypt then solving water pollution problem by reducing the concentration of pollutants (heavy metal, pesticides and diaxions) by phytoremediation treatment using microalgae and by nanotechnological treatment using Hydroxyapatite nanorods.

## II. MATERIALS AND METHODS

### *A. Study Area*

The current investigation was performed in the period from Winter 2017 to Autumn 2018 in four different aquatic ecosystems: three polluted drains, **Omar beck drain** as well as four secondary drains namely Samanoud, El-Mahla El-Kobra, Gohar and El-Naseria drains. It is discriminated by industrial activities and agricultural drainage water.

**sherbeen drain** is located on the Northeast Delta Northern Dakahlia on the western shore of the river Nile, bounded on the north by Damietta governorate and south Talkha. It is considered one of the biggest agricultural draining in Dakahlia.

**Manzala Lake** is located in the northeastern corner of Nile Delta bounded by the Mediterranean Sea to the north and east of the Suez Canal and the West Nile Damietta branch and to the south by easy Husseiniya. It works as a final destination recipient for the main drainage to agricultural, industrial waste and sewage water and fourth source is River Nile (least polluted site) acted as the reference site.

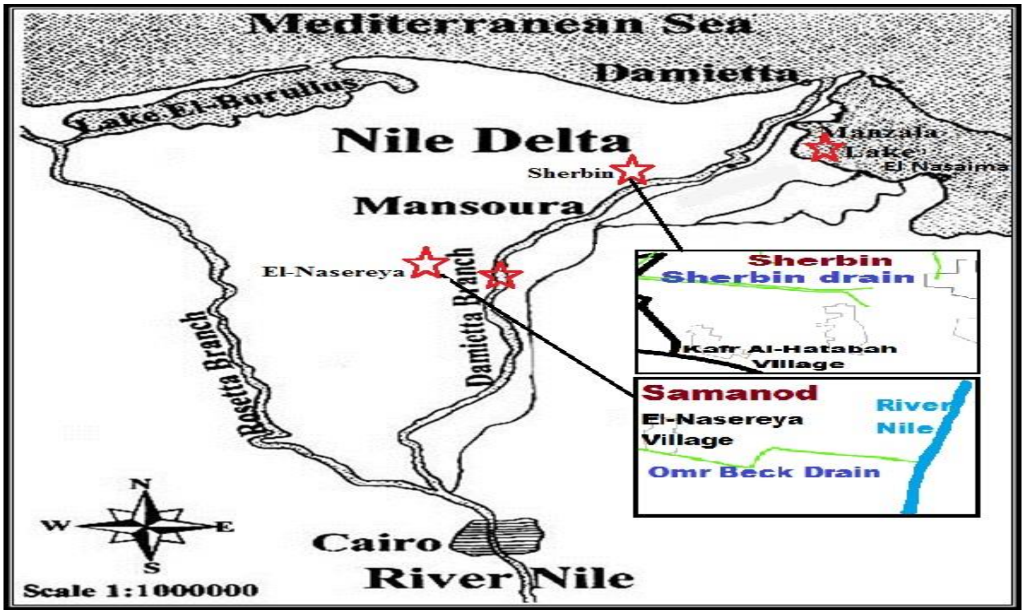


Fig. (1): showing the locality of different study sites at El-Dakahlyia and El-Garbeia Governorate, Egypt represented by ( ☆ ).

*B. Water Sampling*

Subsurface water samples were seasonally collected in 1L polyethylene bottles from each source at 50 cm depth for measuring water temperature (T) by (YSI model 33 S.C.T. meter), electric conductivity (EC) and hydrogen ion concentration (pH) with the aid of a Multi-parameter Analyzer (Model Corning, NY 14831 USA). Dissolved Oxygen (DO), Biological Oxygen Demands ($BOD_5$) methods by (APHA, 1992), Chemical Oxygen Demand (COD) determined by the dichromate reflux method (APHA, 1998), Total Alkalinity (TA) (Welch, 1948), Total Hardness(TH) (Ca and Mg ) (APHA (1992), Extractable Ions (Chloride$Cl^-$)by (APHA, 1998), Sulphate ($SO_4^{2-}$) by ( Jackson ,1967), Carbonates and Bicarbonates (Baruah and Barthakur , 1997), Extractable Cations (Allen *et al.* 1974), Nitrite – N (Barnes and Folkard (1951) and Dewis and Freitas (1970), Nitrate – N(Taras, 1950) , Ammonia− N (APHA, 1989), Dissolved Reactive Phosphorus ( DRP)(APHA, 1985).

The concentrations of heavy metals were preordained by using atomic absorption spectrophotometer (WFXAA spectrophotometer model 130B) (APHA, 1992). Determination of pesticides residues&diaxionsin water samples were analyzed by gas chromatography (GC/Mass) according to Miliadies,1998 and were carried out mainly at Central Agric. Pesticides Laboratory, Pesticide Residues & Environmental Pollution Dept., Agricultural Research Center.

*C. Fish Sampling*

A sum of 240 specimens of the African sharp tooth catfish, *Clariasgariepinus*were collected from each ecosystem seasonally from winter 2017 to autumn 2018.

Liver, kidney and gills tissues were separated and washed by distilled water. Fish samples were then thoroughly dried at 75°C on a hot plate for 24 hr. Each sample was digested according to Dhaneesh *et al.* (2012 a; b) after crushed by a porcelain mortar to estimate heavy metals concentration by atomic absorption spectrophotometer (WFXAA spectrophotometer model 130B) (APHA, 1992). Estimation of pesticides &diaxions residues in fish organs were analyzed by gas chromatography (GC/Mass) according to Miliadies, 1998 and were executed mainly at Central Agric. Pesticides Laboratory, Pesticide Residues & Environmental Pollution Dept., Agricultural Research Center.

*D. Biological Treatment (Phytoremediation Method Using Micro Algae)*

Isolation of the unicellular micro algae, *Scenedesmusobliqnus*was done from different pollutedfields ,Egypt.The isolated unicellular *Scendesmusobliqnus* has get from field to lab, The algae were kept on agar slants at approximately 4°C.Adaptation of *Scendesmusobliqnus* to environmental polluted water with heavy metals and pesticides&diaxions occur by making serial concentration for each sample. To ensure the ability of micro algae to live and grow in this media (water samples polluted with heavy metals, pesticides and diaxions and full with nutrient from the field),Single cells of algae were propagated photoautotrophically in a 250-ml Erlenmeyer flask containing100 ml liquid, kept on a rotator shaker (100 rpm) at 25°C, and illuminated with cool-white fluorescent lights at a continuous light intensity of 5000 lx for each sample. *For cell experiments:* 15-ml aliquots of each sample containing single algal cells (initial spectrophotometric data:

OD680nm=0.050) were distributed to sterile 50-ml Erlenmeyer flasks.

The media for *Scenedesmusobliqnus*for each samples and control were incubated for 96 h on an orbital shaker (100 rpm) at 25°C with a continuous light intensity of 5000 lx (**Wijk*et al.*, 1998; Oliveira-Filho and Paumgartten, 2000**).Cell counts were correlated with absorbance over time for 96 h on a Shimadzu UV-2401PC spectrophotometer. The most favorable wavelength to use for monitoring culture growth was 680nm; **Kasai (1993)** reported that cell numbers and OD680nm were highly correlated. Thus, calculate algal cells growth indirectly using spectrophotometric data in this work. Appropriate control systems containing no heavy metals, pesticides and diaxions were included in each experiment. Control and polluted cultures were grown under the same conditions of temperature, photoperiod, and shaking of the stock cultures.

*E. Nano Technological Treatment From Natural Source (Egg Shell)*

➢ *Preparation of Hydroxyapatitenano rods HAPNRs:*

Eggshells were collected originally from local bakeries (Mansoura-Egypt) were successively washed several times with tap water followed by triplicate wash with distilled water and drayed in clean oven at 80 °C. Obtained brittle material was then ball mailed to obtain fine powder that sintered at 1000 °C for 6 h to ensure removal of all organic residuals and to convert the remained part to purified calcium oxide (CaO).Precipitation method was employed for the preparation of hydroxyapatite nano rods (HAPNRs) by complete dissolution of CaO in concentrated nitric acid ($HNO_3$) followed by dilution process to obtain 1 M $Ca(NO_3)_2$. 0.6 M $(NH_4)_3PO_4$ solution was prepared and slowly added to previously prepared 1 M $Ca(NO_3)_2$ solution and the pH was fixed at about 11–12 through addition of ammonium hydroxide ($NH_4OH$) at 70 °C for 45 min. Obtained mixture was then kept overnight to settle the precipitate.Obtained white precipitate was then washed many times using deionized water to eliminate any excess of $NH_4^+$ and $NO_3^-$ ions. Resultant powdered sintered again at 750 °C for 6 h.A double layer adsorption route was used for the process of purification.52 cm length column of diameter 2 cm containing double layer of synthesized hydroxyapatite (thickness 0.5 cm for each). The flow rate was adjust using a tap in the end of column to be 1ml/s (Adsorption process).

The statistical package for social sciences SPSS/PC computer program (version 20) was used for statistical analysis of the results. Data were analyzed usingone -way analysis of variance (ANOVA). The data were expressed as mean ±S.E. Differences were considered statistically significant at ($P \leq 0.05$) and in significant at ($P > 0.05$)**.** The ordination (CCA: Canonical Correspondence Analysis) was determined using MVSP software program (version 3.2). This analysis helps to explain the relationships between pesticides, diaxions and heavy metals concentrations in water. It also revealed the relationship among the heavy metals present in water and three fish organs.

## III. RESULTS

*A. Physical-Chemical parameters of water*

Annual means in the physicochemical parameters of water samples (temperature, electric conductivity, pH, DO, BOD, COD,TA ,TH, $Cl^-$, $SO_4^{2-}$, $HCO_3^-$, $Na^+$, $K^+$, $Mg^{2+}$,$Ca^{2+}$, $NO_2^{-}$ -, $NO_3^-$, $NH_4^+$ and DRP were given in table 1. The data showed that there was a highly significant difference among the water of River Nile and different three drains in DO, BOD, COD,TA ,TH, $Cl^-$, $SO_4^{2-}$, $HCO_3^-$, $Na^+$, $K^+$, $Ca^{2+}$, $Mg^{2+}$, $NO_2^{-}$ -, $NO_3^-$, $NH_4^+$ and DRP ($p \leq 0.05$), while temperature and pH ($p > 0.05$). The data indicated that electric conductivity in Omr beck drain was the highest value then electric conductivity in Manzala lake was higher than that insherbeen drain and River Nile water , it ranged between 0.410 ds.m$^{1-}$ in the Nile and 2.720 ds.m$^{1-}$ in Omr beck drain.

Dissolved oxygen showed higher values in Nile water amongother drains which ranged between2.720 and 8.150 mgl$^{-1}$in Manzalalake and the Nile respectively. In contrast to BOD and COD which showedhigher values in Manzala lake than that in the control water, the higher BOD readings wasrecorded 2.310 and 8.820 mg $O_2$ l $^{-1}$ in the control and Manzala lake respectively. The higher COD reading was recorded 28.270 **-** 101.200 mg $O_2$ l$^{-1}$ in the control and Manzalalakerespectively. The data indicated that TA and TH recorded higher concentration in Omr beck drain than those water of other polluted drains and Nile River.

The data indicated that $SO_4^{2-}$, $HCO_3^-$, $Na^+$, $K^+$, $Ca^{2+}$, $Mg^{2+}$and $NO_2^-$ recorded higherconcentrations in Omr Beck drain water than polluted water and River Nile (Table1). The data indicated that $NO_3^-$, $NH_4^+$ and DRP recorded higher concentrations in Manzala lake water than polluted water and Nile River (Table1).

*B. Heavy metals, pesticides and diaxions concentrations in water*

The data recorded in Table 2 showed the annual means in the heavy metals, pesticides and diaxionsconcentrations in water samples in the four studying sites ($p \leq 0.05$), the data showed that there were a highly significant variation in the levels of whole heavy metals in water samples between Nile and other polluted sites. The whole heavy metals concentration recorded the highest value in Manzalalake while the lowest value in Nile River. The different types of pesticides ware found in water samples at different concentration at sampling sites. The whole pesticides in Nile River were not detected at all seasons. Dimethoate concentration at Omr Beck drain was 0.024 ppm (the lowest value) while the highest value (0.088 ppm) was recorded in sherbeen drain. Its concentration in Manzalalake was 0.065 ppm. **Chlorpyrifos** concentration at sherbeen drain was 0.042 ppm (the lowest value) while the highest value (0.057

ISSN No:-2456-2165

ppm) was recorded in Manzala lake. Its concentration in Omr Beck drain was 0.055 ppm. **Malathion** concentration at sherbeen drain was 0.021 ppm (the lowest value) while the highest value (0.065 ppm) was recorded in Omr Beck drain. Its concentration in Manzalalake was 0.045 ppm. **Atrazine** concentration at Omr Beck drain was 0.036 ppm (the lowest value) while the highest value (0.074 ppm) was recorded in sherbeen drain. Its concentration in Manzalalake was 0.068 ppm.**Metalaxyl** concentrations at Omr Beck drain and Manzlalake were 0.085 ppm while Its concentration in sherbeen drain was not detected. **Carbendazim** concentration at sherbeen drain was 0.036 ppm (the lowest value) while the highest value (0.070 ppm) was recorded in Manzala lake. Its concentration in Omr Beck drain was 0.057 ppm.**Chloropropham** concentration at sherbeen drain was 0.042 ppm (the lowest value) while the highest value (0.072 ppm) was recorded in Manzala lake. Its concentration in Omr Beck drain was 0.068 ppm.**p-p-DDE*** concentration at sherbeen drain was 0.042 ppm (the lowest value) while the highest value (0.337 ppm) was recorded in Manzala lake. Its concentration in Omr Beck drain was 0.075 ppm.**Diaxoin** concentration at Omr Beck drain was 0.046 ppm (the lowest value) while the highest value (0.066 ppm) was recorded in Manzala lake. Its concentration in sherbeen drain was not detected.

*C. Heavy metals levels in C. gariepinus organs (liver, kidney & gills)*

It is clear from table (3) that **$Zn^{2+}$** in the different organs of cat fish samples in the different habitat types varies 0.805 µg /g dry wet. gills to 6.766 µg /g dry wet. liver. It is shown that high significant of $Zn^{2+}$ content at Manzala lake to that of the Nile River but less significant of $Zn^{2+}$ at Sherbeen drain to that ofNile River.

- **$Fe^{2+}$**in the different organs of cat fish samples in the different habitat types varies from 0.134 µg /g dry wet. gills to3.095 µg /g dry wet. liver. it was evident that $Fe^{2+}$ of the Nile River was the lowest values but the highest ones were for Manzala lake**.**
- **$Cu^{2+}$** in the different organs of cat fish samples in the different habitat types varies from 0.715 µg /g dry wet. gills to 10.765 µg /g dry wet. liver. $Cu^{2+}$ values of fish samples for the four seasons and for Nile River and the other three sampling sites, it was evident that $Cu^{2+}$ of the Nile River was the lowest values but the highest ones were for Manzala lake.
- **$Cd^{2+}$** in the different organs of cat fish samples in the different habitat types varies from 0.168 µg /g dry wet. gills to 4.672 µg /g dry wet. liver. $Cd^{2+}$ values of fish samples for the four seasons and for Nile River and the other three sampling sites, it was evident that $Cd^{2+}$ of the Nile River was the lowest values but the highest ones were for Manzala lake.
- **$pb^{2+}$** in the different organs of cat fish samples in the different habitat types varies from 0.147 µg /g dry wet. gills to5.795 µg /g dry wet. liver. $pb^{2+}$ values of fish samples for the four seasons and for Nile River and the other three sampling sites, it was evident that $pb^{2+}$ of the Nile River was the lowest values but the highest ones were for Manzala lake.
- **$Mn^{2+}$** in the different organs of cat fish samples in the different habitat types varies from 0.108 µg /g dry wet. gillsto 3.820 µg /g dry wet. liver. $Mn^{2+}$ values of fish samples for the four seasons and for Nile River and the other three sampling sites, it was evident that $Mn^{2+}$ of the Nile River was the lowest values but the highest ones were for Manzala lake. Among three organs (Liver, Kidney and Gills) from different sampling sites and seasons , it was evident that the liver organ was the highest value of the concentration of measured heavy metals then kidney and the lowest one was gills organ.

*D. Pesticides and Diaxions concentrations in some organs (liver, kidney and gills) of cat fish*

From table (4) the levels of **Atrazine (herbicides)** in the various organs of cat fish samples in the different habitat types varies from 0.014 µg /g dry wet. Kidney and gills to 0.050 µg /g dry wet. liver. the Atrazine concentration values of fish samples for the four seasons and for Nile River and the other three sampling sites, it was evident that Atrazine concentration of the Nile River was not detected and its lowest value was in Sherbeen drain but the highest ones were for Manzala lake. **Chloropyrofis (Organophosphate pesticides)** concentration in the different organs of cat fish samples in the different habitat types varies from 0.006 µg /g dry wet. gills to 0.049 µg /g dry wet. liver. it was evident that Chloropyrofis concentration of the Nile River was not detected and the lowest was Sherbeen drain but the highest ones were for Manzala lake. **P-P-DDE*(Organochloroinated pesticides)** concentration in the different organs of cat fish samples in the different habitat types varies 0.005 µg /g dry wet. gills to 0.128 µg /g dry wet. liver. it was evident that p-p-DDE* concentration of the Nile River was not detected and the lowest was Sherbeen drain but the highest ones were for Manzala lake. **Chloropropham(Organophosphate pesticides)** concentration in the different organs of cat fish samples in the different habitat types varies from 0.014 µg /g dry wet. gills to 0.056 µg /g dry wet. liver. it was evident that Chloropropham concentration of the Nile River was not detected and the lowest was Sherbeen drain but the highest ones were for Manzala lake. **Diaxions**concentration in the different organs of cat fish samples in the different habitat types varies from 0.024 µg /g dry wet. gills to 0.063 µg /g dry wet. liver. Diaxionsconcentration of the Nile River and Sherbeen drain were not detected but Manzala lake was higher than Omr beck drain. Among three organs (Liver, Kidney and Gills) from different sampling sites and seasons , it was evident that the liver organ was the highest value of Pesticides and Diaxions concentration then kidney and the lowest one was gills organs.

ISSN No:-2456-2165

*E. Correlation between pesticides and water heavy metals*

The Canonical Correspondence Analysis (CCA) detects the degree of correlation between each pesticide variable with water heavy metals concentration values and run on the ordination diagram Fig. (2). It is clear that, all analyzed pesticides showed high significant correlations except diaxion showed moderate significant correlations with heavy metals accumulated in different water samples in the first and second axes of the diagram.

*F. Correlation of heavy metals between water and fish organs*

The Canonical Correspondence Analysis (CCA) detects the degree of correlation between each water heavy metals amounts with fish organ heavy metals accumulation values and run on the ordination diagram Figs. (3, 4&5). It is clear that, all analyzed heavy metals in water samples showed high significant correlations with all analyzed fish organs (liver, kidney and gills) in the first and second axes of the diagram.

*G. Treatment of polluted water:*

- *phytoremediation by micro algae of heavy metals*

The biological treatment by micro algae (*Scendesmussp.*) clarifies the maximum growth of algae after 21 days of retention time in polluted water media with heavy metals, pesticides and diaxions in **summer season** (the highest amount of pollutants). Data showed the reduction of heavy metals concentration by micro algae (Scendesmus sp.)phytoremediation method in Table (5)

**For Zinc metal, Nile River( Reference site),** the concentration of zinc metal was 0.018 mg/l. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.720 mg/l. and become 0.029 mg/l.the treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment. **In Sherbeen drain,** Its concentration before treatment was 0.480 mg/l. and become 0.011 mg/l.the treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.970 mg/l. and become 0.045 mg/l. The treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.

**Iron ($Fe^{+2}$), In Nile River( Reference site),**the concentration of iron metal was 0.021 mg/l. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.760 mg/l. and become 0.028 mg/l.the treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment.**In Sherbeen drain,** Its concentration before treatment was 0.530 mg/l. and become 0.015 mg/l.the treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.890 mg/l. and become 0.041 mg/l. The treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.

**Cupper ($Cu^{+2}$), In Nile River ( Reference site),** the concentration of cupper was 0.011 mg/l. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 2.210 mg/l. and become 0.077 mg/l.the treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment.**In Sherbeen drain,** Its concentration before treatment was 0.620 mg/l. and become 0.034 mg/l. the treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.**In Manzala lake**, Its concentration before treatment was 3.090 mg/l. and become 0.173 mg/l. The treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.**Cadmium ($Cd^{+2}$)** , **In Nile River ( Reference site),** the concentration of cadmium was 0.013 mg/l. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.550 mg/l. and become 0.031 mg/l.the treatment occurred aroundly 92% as its concentration was decreased to 8 % of its concentration before treatment.**In Sherbeen drain,** Its concentration before treatment was 0.440 mg/l. and become 0.034 mg/l. the treatment occurred a roundly 92% as its concentration was decreased to 8 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 1.240 mg/l. and become 0.075 mg/l. The treatment occurred aroundly 94% as its concentration was decreased to 6 % of its concentration before treatment.

**Lead ($pb^{+2}$)** ,**In Nile River ( Reference site),** the concentration of lead was 0.009 mg/l.After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.850 mg/l. and become 0.027 mg/l.the treatment occurred aroundly 97 % as its concentration was decreased to 3 % of its concentration before treatment.**In Sherbeen drain,** Its concentration before treatment was 0.386 mg/l. and become 0.027 mg/l. the treatment occurred aroundly 93% as its concentration was decreased to 7 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.952 mg/l. and become 0.059 mg/l. The treatment occurred aroundly 94% as its concentration was decreased to 6 % of its concentration before treatment.**Manganese ($Mn^{+2}$), In Nile River ( Referance site),** the concentration of magnesium was 0.012 mg/l. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.850 mg/l and become 0.034 mg/l.the treatment occurred aroundly 96 % as its concentration was decreased to 4 % of its concentration before treatment.**In Sherbeen drain,** Its concentration before treatment was 0.580 mg/l. and become 0.013 mg/l. the treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment.**In Manzala lake**, Its concentration before treatment was 0.908 mg/l. and become 0.058 mg/l. The treatment occurred aroundly 94% as its concentration was decreased to 6 % of its concentration before treatment.

➢ *Phytoremediation of pesticide residue and diaxions*

Data showed the reduction of pesticide residue and diaxionsconcentration by micro algae (*Scendesmus sp.*) phytoremediation method in Table (6)

- *Dimethoate (organo phosphate pesticides),*

**In Nile River** (Reference site), the concentration of Dimethoate was not detected. After using *scendesmus* micro algae to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.042 mg/l. and become 0.004 mg/l.the treatment occurred aroundly 90% as its concentration was decreased to 10% of its concentration before treatment. **In Sherbeen drain,** Its concentration before treatment was 0.098 mg/l. and become 0.007 mg/l.the treatment occurred aroundly 92% as its concentration was decreased to 8 % of its concentration before treatment.**In Manzala lake**, Its concentration before treatment was 0.042 mg/l. and become 0.001 mg/l. The treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment.

- *Chloropyrofis (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Chloropyrofis was not detected. After using *scendesmus* micro algae to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.067 mg/l. and become 0.002 mg/l. The treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment. **In Sherbeen drain,** Its concentration before treatment was 0.052 mg/l. and become 0.002 mg/l.the treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment. **In Manzalalake**, Its concentration before treatment was 0.068 mg/l. and become 0.004 mg/l. The treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.

- *Malathion (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Malathion was un detected. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.074 mg/l. and became nil or un detectable. The treatment occurred aroundly 100% .**In Sherbeen drain,** Its concentration before treatment was 0.041 mg/l andbecame nil or un detectable. The treatment occurred aroundly 100% .**In Manzala lake**, Its concentration before treatment was 0.057 mg/l. and became not detected. The treatment occurred aroundly 100%.

- *Atrazine (Herbicides)*

**In Nile River**( Reference site), the concentration of Atrazine was un detected. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.042 mg/l and became not detected. The treatment occurred aroundly 100% .**In Sherbeen drain,** Its concentration before treatment was 0.088 mg/l. and becamenot detected. The treatment occurred aroundly 100%.**In Manzala lake**, Its concentration before treatment was 0.083 mg/land became not detected. The treatment occurred aroundly 100%.

- *Metalaxyl (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Metalaxyl was not detected. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.089 mg/land becamenot detected. The treatment occurred aroundly 100% . **In Sherbeen drain,** the concentration of Metalaxyl was not detected.**In Manzala lake**, Its concentration before treatment was 0.095 mg/land becamenot detected. The treatment occurred aroundly 100%.

- *Carbendazim (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Carbendazim was not detected. After using *scendesmus* micro algae to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.067 mg/l and become 0.012 mg/l. The treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.**In Sherbeen drain,** Its concentration before treatment was 0.044 mg/l and become 0.003 mg/l.the treatment occurred aroundly 91% as its concentration was decreased to 9 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.083 mg/l and become 0.003 mg/l. The treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment.

- *Chloropropham (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Chloropropham was not detected. After using *scendesmus* micro algae to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.074 mg/land becamenot detected. The treatment occurred aroundly 100%. **In Sherbeen drain,**Its concentration before treatment was 0.051 mg/l and became not detected. The treatment occurred aroundly 100%. **In Manzala lake**, Its concentration before treatment was 0.087 mg/land become 0.007 mg/l. The treatment occurred aroundly 91% as its concentration was decreased to 9% of its concentration before treatment.

ISSN No:-2456-2165

- *p-p-DDE* (Organo chlorinated pesticides)*

**In Nile River**( Reference site), the concentration of p-p-DDE*was not detected. After using *scendesmus* micro algae to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.079mg/l and became not detected. The treatment occurred aroundly 100%. **In Sherbeen drain,**Its concentration before treatment was 0.055 mg/land become 0.005 mg/l. The treatment occurred aroundly 90 % as its concentration was decreased to 10 % of its concentration before treatment.**In Manzala lake**, Its concentration before treatment was 1.099 mg/land become 0.091 mg/l. The treatment occurred aroundly 91% as its concentration was decreased to 9% of its concentration before treatment.

- *Diaxions*

**In Nile River**( Referance site), the concentration of Diaxions was not detected. After using *scendesmus* micro algae to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.307 mg/land become 0.011 mg/l. The treatment occurred aroundly 95 % as its concentration was decreased to 5 % of its concentration before treatment. **In Sherbeen drain**, the concentration of Diaxions was not detected. **In Manzala lake**, Its concentration before treatment was 0.081 mg/land become 0.003 mg/l. The treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment.

- *2-Nano technological treatment from natural source (Adsorption process) :-*

The nano technological treatment by natural source (egg shell) to obtained HydroxyApatite Nano Rods (HAPNRs) to purify polluted water media with heavy metals, pesticides and diaxions in summer season (the highest amount of pollutants).

The polluted water pass from double layer of synthesized hydroxyapatite (thickness 0.5 cm for each) to occur the process of purification. Then,The purified water was measured .the concentration of pollutants in purified water was decreased to 95% from the polluted water in all study sited compared to Nile River (reference site). Data showed the reduction of heavy metals concentration by hydroxyapatite nanorods Adsorption method in Table (7)

- *For Zinc ($Zn^{+2}$) ,*

**In Nile River( Reference site),** the concentration of zinc metal was 0.018 mg/l.After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.720 mg/l and become 0.027 mg/l.the treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment.**In Sherbeen drain,** Its concentration before treatment was 0.480 mg/l and become 0.015 mg/l.the treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.970 mg/l and 0.065 mg/l. The treatment occurred aroundly 93% as its concentration was decreased to 7 % of its concentration before treatment.

- *Iron ($Fe^{+2}$) ,*

**In Nile River( Reference site),** the concentration of iron metal was 0.021 mg/l.After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.760 mg/l and become 0.037 mg/l.the treatment occurred aroundly 95 % as its concentration was decreased to 5 % of its concentration before treatment.**In Sherbeen drain,**Its concentration before treatment was 0.530 mg/l and become 0.017 mg/l.the treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.890 mg/l and become 0.041 mg/l. The treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.

- *Cupper ($Cu^{+2}$),*

**In Nile River ( Reference site),** the concentration of cupper was 0.011 mg/l. After using hydroxyapatite nano rods to purify the pollutants.**In Omr Beck drain**, Its concentration before treatment was 2.210 mg/l and become 0.067 mg/l.the treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment. **In Sherbeen drain,**Its concentration before treatment was 0.620 mg/l and become 0.037 mg/l. the treatment occurred aroundly 94% as its concentration was decreased to 6 % of its concentration before treatment. **In Manzalalake**, Its concentration before treatment was 3.090 mg/l and become 0.127 mg/l. The treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment.**Cadmium ($Cd^{+2}$), In Nile River (Reference site),** the concentration of cadmium was 0.013 mg/l. After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.550 mg/l and become 0.041 mg/l.the treatment occurred aroundly 92% as its concentration was decreased to 8 % of its concentration before treatment. **In Sherbeen drain,**Its concentration before treatment was 0.440 mg/l and become 0.026 mg/l. the treatment occurred aroundly 94% as its concentration was decreased to 6 % of its concentration before treatment. **In Manzalalake**, Its concentration before treatment was 1.240 mg/l and become 0.099 mg/l. The treatment occurred aroundly 92 % as its concentration was decreased to 8 % of its concentration before treatment.

- *Lead ($pb^{+2}$),*

**In Nile River ( Reference site),** the concentration of lead was 0.009 mg/l. After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.850 mg/l and become 0.034 mg/l.the

ISSN No:-2456-2165

treatment occurred aroundly 96 % as its concentration was decreased to 4 % of its concentration before treatment. **In Sherbeen drain,**Its concentration before treatment was 0.386 mg/l and become 0.029 mg/l. the treatment occurred aroundly 93% as its concentration was decreased to 7 % of its concentration before treatment. **In Manzalalake**, Its concentration before treatment was 0.952 mg/l and become 0.056 mg/l. The treatment occurred aroundly 94% as its concentration was decreased to 6 % of its concentration before treatment. **Manganese ($Mn^{+2}$)** ,**In Nile River( Reference site),** the concentration of magnesium was 0.012 mg/l. After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.850 mg/l and become 0.026 mg/l.the treatment occurred aroundly 97 % as its concentration was decreased to 3 % of its concentration before treatment. **In Sherbeen drain,**Its concentration before treatment was 0.580 mg/l and become 0.015 mg/l. the treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.908 mg/l and become 0.051 mg/l. The treatment occurred aroundly 94% as its concentration was decreased to 6 % of its concentration before treatment.

Data showed the reduction of pesticide residue and diaxionsconcentration by hydroxyapatite nanorods Adsorption method in Table (8)

- *Dimethoate (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Dimethoate was not detected. After using hydroxyapatite nano rods to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.042 mg/l and become 0.002 mg/l.the treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.**In Sherbeen drain,**Its concentration before treatment was 0.098 mg/l and become 0.005 mg/l.the treatment occurred aroundly 95 % as its concentration was decreased to5 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.042 mg/l and become 0.002 mg/l. The treatment occurred aroundly 95 % as its concentration was decreased to 5 % of its concentration before treatment.

- *Chloropyrofis (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Chloropyrofis was not detected. After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.067 mg/l and become not detected. The treatment occurred aroundly100% .**In Sherbeen drain,**Its concentration before treatment was 0.052 mg/l and become 0.001 mg/l.the treatment occurred aroundly 97% as its concentration was decreased to 3 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.068 mg/l and become 0.003 mg/l. The treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.

- *Malathion (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Malathion was not detected. After using hydroxyapatite nano rods to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.074 mg/l and become 0.004 mg/l. The treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.**In Sherbeen drain,**Its concentration before treatment was 0.041 mg/l and become 0.006 mg/l. The treatment occurred aroundly 90% as its concentration was decreased to 10 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.057 mg/l and become 0.004 mg/l. The treatment occurred aroundly 93% as its concentration was decreased to 7 % of its concentration before treatment.

- *Atrazine (Herbicides)*

**In Nile River**( Reference site), the concentration of Atrazine was not detected. After using hydroxyapatite nano rods to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.042 mg/land becamenot detected. The treatment occurred aroundly 100% .**In Sherbeen drain,** Its concentration before treatment was 0.088 mg/l andbecame not detected. The treatment occurred aroundly 100% .**In Manzala lake**, Its concentration before treatment was 0.083 mg/l and became not detected. The treatment occurred aroundly 100%.

- *Metalaxyl (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Metalaxyl was not detected. After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.089 mg/l and become 0.003 mg/l. The treatment occurred aroundly 97 % as its concentration was decreased to 3 % of its concentration before treatment. **In Sherbeen drain**, the concentration of Metalaxyl was not detected.**In Manzalalake**, Its concentration before treatment was 0.095 mg/l and become 0.001 mg/l. The treatment occurred aroundly 98% as its concentration was decreased to 2 % of its concentration before treatment.

- *Carbendazim (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Carbendazimwas not detected. After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.067 mg/l and become 0.002 mg/l. The treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment.**In Sherbeen drain,**Its concentration before treatment was 0.044 mg/l and become 0.002 mg/l.the treatment occurred aroundly 95% as its concentration was decreased to 5 % of its concentration before treatment.**In**

**Manzalalake**, Its concentration before treatment was 0.083 mg/l and become 0.005 mg/l. The treatment occurred aroundly 94% as its concentration was decreased to 6 % of its concentration before treatment.

- *Chloropropham (organo phosphate pesticides)*

**In Nile River**( Reference site), the concentration of Chloropropham was not detected. After using hydroxyapatite nano rods to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.074 mg/l and become 0.001 mg/l. The treatment occurred aroundly 98 % as its concentration was decreased to 2 % of its concentration before treatment.**In Sherbeen drain,**Its concentration before treatment was 0.051 mg/l and become 0.003 mg/l. The treatment occurred aroundly 94 % as its concentration was decreased to 6 % of its concentration before treatment.**In Manzalalake**, Its concentration before treatment was 0.087 mg/l and become 0.003 mg/l. The treatment occurred aroundly 96 % as its concentration was decreased to 4 % of its concentration before treatment.

- *p-p-DDE* (Organochloroinated pesticides)*

**In Nile River** (Reference site), the concentration of p-p-DDE*wasnot detected. After using hydroxyapatite nano rods to remove the pollutants.**In Omr Beck drain**, Its concentration before treatment was 0.079mg/l and became not detected. The treatment occurred aroundly 100%. **In Sherbeen drain,**Its concentration before treatment was 0.055 mg/land became not detected. The treatment occurred aroundly 100%. **In Manzala lake**, Its concentration before treatment was 1.099 mg/and become 0.081 mg/l. The treatment occurred aroundly 92 % as its concentration was decreased to 8 % of its concentration before treatment.

- *Diaxions*

**In Nile River**( Reference site), the concentration of Diaxions was not detected. After using hydroxyapatite nano rods to remove the pollutants. **In Omr Beck drain**, Its concentration before treatment was 0.307 mg/land become 0.019 mg/l. The treatment occurred aroundly 94 % as its concentration was decreased to 6 % of its concentration before treatment. **In Sherbeen drain**, the concentration of Diaxions was not detected. **In Manzalalake**, Its concentration before treatment was 0.081 mg/l and become 0.003 mg/l. The treatment occurred aroundly 96% as its concentration was decreased to 4 % of its concentration before treatment. After recording the results of treatment, the two methods of treatment of polluting water (Biological and Nano technological treatment ) were achieved a roundly 95 % of purified water pollution. They have advantage that they are friendly to the environment.

| Water variables | Different study sites through out the study period | | | |
|---|---|---|---|---|
| | River Nile | Omr Beck drain | Sherbeen Drain | Manzala Lake |
| Temp. (C °) | 25.600 ± 0.270 | 26.060 ± 0.320 | 26.350 ± 0.130 | 25.940 ± 0.060 |
| E.C. (d.s $m^{-1}$) | 0.410 ± 0.040 | 2.710 ± 0.050 | 1.460 ± 0.050 | 2.120 ± 0.050 |
| Ph | 7.190 ± 0.016 | 7.950 ± 0.018 | 7.330 ± 0.018 | 7.640 ± 0.013 |
| DO | 8.150 ± 0.070 | 2.820 ± 0.070 | 4.230 ± 0.060 | 2.720 ± 0.060 |
| BOD | 2.310 ± 0.060 | 8.450 ± 0.070 | 7.400 ± 0.060 | 8.820 ± 0.070 |
| COD | 28.270 ± 1.380 | 91.750 ± 1.180 | 51.970 ± 1.110 | 101.200 ± 1.700 |
| TA | 140.000 ± 2.600 | 323.000 ± 2.600 | 253.750 ± 2.870 | 290.500 ± 2.700 |
| TH | 57.200 ± 1.410 | 102.600 ± 1.600 | 70.370 ± 1.070 | 83.850 ± 1.520 |
| $Cl^-$ | 2.340 ± 0.050 | 15.600 ± 0.260 | 8.250 ± 0.060 | 12.640 ± 0.050 |
| $SO_4^{2-}$ | 0.850 ± 0.020 | 6.300 ± 0.050 | 3.330 ± 0.040 | 4.160 ± 0.060 |
| $HCO_3^-$ | 0.950 ± 0.040 | 5.370 ± 0.050 | 3.080 ± 0.060 | 4.360 ± 0.060 |
| $Na^+$ | 2.560 ± 0.120 | 16.970 ± 0.150 | 8.950 ± 0.170 | 13.540 ± 0.180 |
| $K^+$ | 0.195 ± 0.0120 | 1.250 ± 0.017 | 0.670 ±0.0120 | 0.980 ± 0.010 |
| $Ca^{2+}$ | 0.830 ± 0.042 | 5.210 ± 0.047 | 2.880 ± 0.040 | 4.160 ± 0.037 |
| $Mg^{2+}$ | 0.560 ± 0.030 | 3.830 ± 0.042 | 2.160 ± 0.040 | 2.560 ± 0.045 |
| $NO_2^{--}$ | 0.030 ± 0.001 | 0.056 ± 0.001 | 0.040 ± 0.001 | 0.069 ± 0.002 |
| $NO_3^-$ | 6.780 ± 0.200 | 24.720 ± 0.280 | 32.210 ± 0.230 | 28.330 ± 0.290 |
| $NH_4^+$ | 1.580 ± 0.130 | 15.730 ± 0.230 | 11.800 ± 0.140 | 17.040 ± 0.160 |
| DRP | 0.045 ± 0.005 | 2.580 ± 0.025 | 0.590 ± 0.025 | 2.950 ± 0.037 |

Table (1):-Annual means of physicochemical parameters (mean ± SE) of water samples at various sampling sites.

| Water variables | Different study sites through out the study period | | | |
|---|---|---|---|---|
| | River Nile | Omr Beck drain | Sherbeen Drain | Manzala Lake |
| $Zn^{2+}$ | 0.041 ± 0.005 | 0.480 ± 0.007 | 0.260 ± 0.007 | 0.665 ± 0.007 |
| $Fe^{2+}$ | 0.058 ± 0.005 | 0.560 ± 0.006 | 0.360 ± 0.008 | 0.667 ± 0.007 |
| $Cu^{2+}$ | 0.022 ± 0.002 | 1.140 ± 0.030 | 0.470 ± 0.027 | 1.750 ± 0.037 |
| $Cd^{2+}$ | 0.030 ± 0.003 | 0.370 ± 0.003 | 0.270 ± 0.002 | 0.617 ± 0.005 |
| $Pb^{2+}$ | 0.040 ± 0.003 | 0.544 ± 0.003 | 0.226 ± 0.003 | 0.686 ± 0.003 |
| $Mn^{2+}$ | 0.028 ± 0.003 | 0.457 ± 0.003 | 0.310 ± 0.003 | 0.640 ± 0.003 |
| Dimethoate | ND | 0.024 ± 0.003 | 0.088 ± 0.003 | 0.065 ± 0.003 |
| Chlorpyrifos | ND | 0.055 ± 0.003 | 0.042 ± 0.003 | 0.057 ± 0.003 |
| Malathion | ND | 0.065 ± 0.002 | 0.021 ± 0.002 | 0.045 ± 0.001 |
| Atrazine | ND | 0.036 ± 0.001 | 0.074 ± 0.003 | 0.068 ± 0.001 |
| Metalaxyl | ND | 0.085 ± 0.003 | ND | 0.085 ± 0.002 |
| Carbendazim | ND | 0.057 ± 0.002 | 0.036 ± 0.002 | 0.070 ± 0.002 |
| Chloropropham | ND | 0.068 ± 0.002 | 0.042 ± 0.002 | 0.072 ± 0.003 |
| p-p-DDE* | ND | 0.075 ± 0.001 | 0.042 ± 0.002 | 0.337 ± 0.003 |
| Diaxoin | ND | 0.046 ± 0.003 | ND | 0.066 ± 0.002 |

Table (2): Annual mean of Heavy metals, Pesticides and diaxions of water samples(mean ± SE) at various sampling sites
ND: Not Detected

| variables | Different study sites through out the study period | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nile River | | | Omr Beck drain | | | Sherbeen drain | | | Manzala lake | | |
| | Liver | Kidney | Gills | Liver | Kidney | Gills | Liver | Kidney | Gills | Liver | Kidney | Gills |
| $Zn^{2+}$ | 1.380 ± 0.080 | 1.114 ± 0.080 | 0.805 ±0.046 | 3.874± 0.088 | 3.200 ± 0.078 | 2.848 ± 0.050 | 2.166 ± 0.076 | 1.833 ± 0.075 | 1.590 ± 0.075 | 6.766 ± 0.083 | 5.772 ± 0.079 | 4.691 ± 0.056 |
| $Fe^{2+}$ | 0.343 ± 0.036 | 0.233 ± 0.029 | 0.134 ± 0.017 | 1.805± 0.034 | 1.212 ± 0.027 | 0.905 ± 0.031 | 0.630 ± 0.036 | 0.503 ± 0.031 | 0.450 ± 0.025 | 3.095 ± 0.030 | 2.557 ± 0.027 | 2.070 ± 0.023 |
| $Cu^{2+}$ | 1.677 ± 0.074 | 1.100 ± 0.088 | 0.715 ± 0.071 | 8.972± 0.093 | 7.597 ± 0.088 | 5.967 ± 0.065 | 4.282 ± 0.098 | 3.487 ± 0.088 | 2.350 ± 0.060 | 10.765 ± 0.119 | 8.512 ± 0.073 | 6.903 ± 0.069 |
| $Cd^{2+}$ | 0.787 ± 0.055 | 0.425 ± 0.045 | 0.168 ± 0.035 | 3.900± 0.064 | 3.647 ± 0.049 | 3.347 ± 0.042 | 2.592 ± 0.066 | 1.617 ± 0.049 | 1.077 ± 0.039 | 4.672 ± 0.060 | 4.392 ± 0.057 | 3.812 ± 0.040 |
| $Pb^{2+}$ | 0.277 ± 0.041 | 0.191 ± 0.051 | 0.147 ± 0.031 | 2.912 ±0.060 | 2.635 ± 0.064 | 2.262 ± 0.043 | 1.415 ± 0.054 | 0.805 ± 0.055 | 0.517 ± 0.028 | 5.795 ± 0.053 | 4.765 ± 0.058 | 3.830 ± 0.051 |
| $Mn^{2+}$ | 0.234 ±0.033 | 0.150 ± 0.032 | 0.108 ±0.012 | 2.677 ±0.051 | 1.657 ± 0.046 | 1.015 ±0.040 | 0.834 ± 0.039 | 0.637 ± 0.037 | 0.410 ± 0.035 | 3.820 ± 0.046 | 3.447 ± 0.042 | 3.062 ± 0.041 |

Table (3): Annual mean of Heavy metals concentration of cat fish organs (liver, kidney, gills) (mean ± SE) at various sampling sites

| variables | Different study sites through out the study period | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nile River | | | Omr Beck drain | | | Sherbeen drain | | | Manzala lake | | |
| | Liver | Kidney | Gills | Liver | Kidney | Gills | Liver | Kidney | Gills | Liver | Kidney | Gills |
| Atrazine | ND | ND | ND | 0.044± 0.003 | 0.036± 0.002 | 0.018± 0.001 | 0.026± 0.002 | 0.014± 0.001 | 0.014± 0.001 | 0.050± 0.003 | 0.038± 0.002 | 0.023± 0.002 |
| Chloropyrofis | ND | ND | ND | 0.031± 0.002 | 0.028± 0.001 | 0.014± 0.001 | 0.020± 0.001 | 0.012± 0.001 | 0.006± 0.003 | 0.049± 0.003 | 0.039± 0.003 | 0.014± 0.001 |
| P-P-DDE* | ND | ND | ND | 0.063± 0.003 | 0.046± 0.003 | 0.026± 0.003 | 0.021± 0.001 | 0.016± 0.001 | 0.005± 0.004 | 0.128± 0.008 | 0.079± 0.004 | 0.038± 0.002 |
| ChloroPropham | ND | ND | ND | 0.056± 0.001 | 0.046± 0.002 | 0.026± 0.003 | 0.029± 0.002 | 0.021± 0.001 | 0.014± 0.002 | 0.056± 0.003 | 0.041± 0.003 | 0.026± 0.002 |
| Diaxion | ND | ND | ND | 0.056± 0.003 | 0.043± 0.003 | 0.024± 0.002 | ND | ND | ND | 0.063± 0.003 | 0.045± 0.003 | 0.026± 0.001 |

Table (4): Annual mean of Pesticides and Diaxions concentration of cat fish organs (liver, kidney, gills) (mean ± SE) at various sampling sites ND: Not Detected

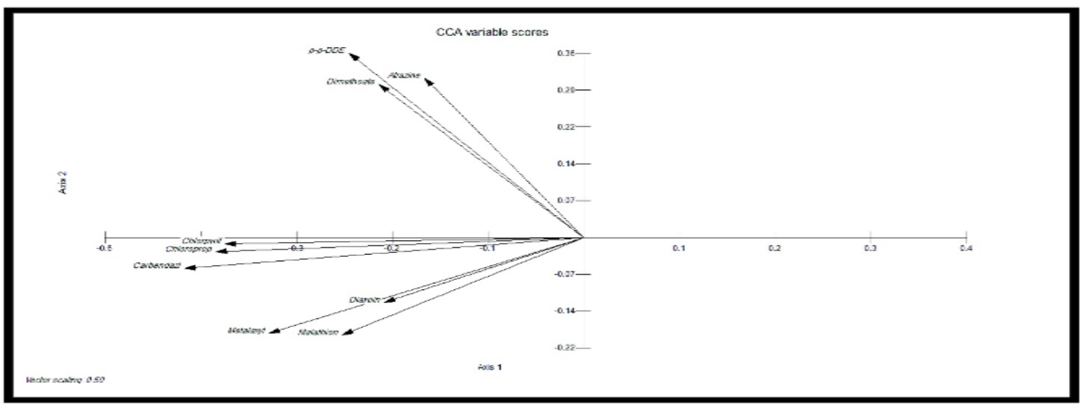


Fig. (2): Canonical Corresponding Analysis (CCA) ordination diagram of the heavy metals accumulated in water according to the gradient of pesticides (arrows) in the study sites.

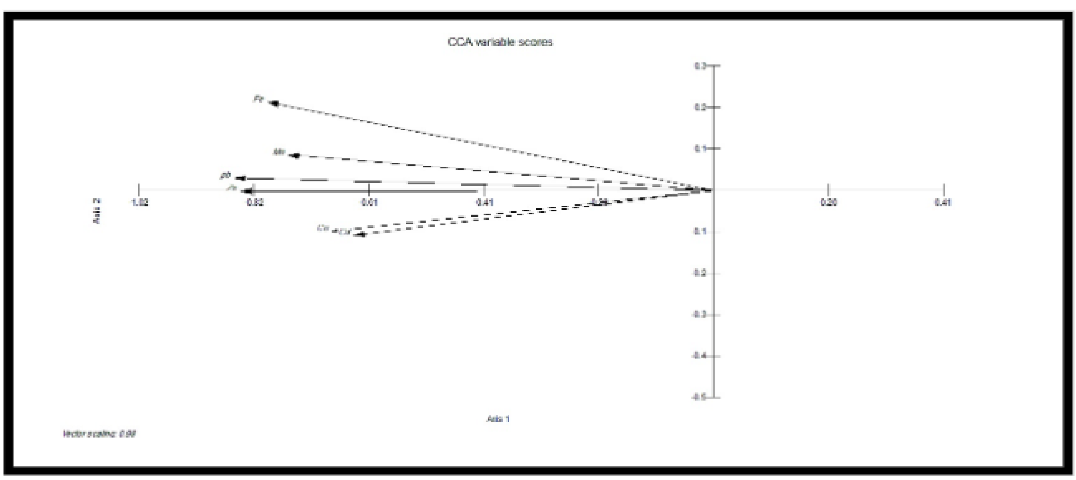


Fig. (3): Canonical Corresponding Analysis (CCA) ordination diagram of the heavy metals accumulated in liver of collected fish samples according to the gradient of heavy metals in water (arrows) in the study sites.

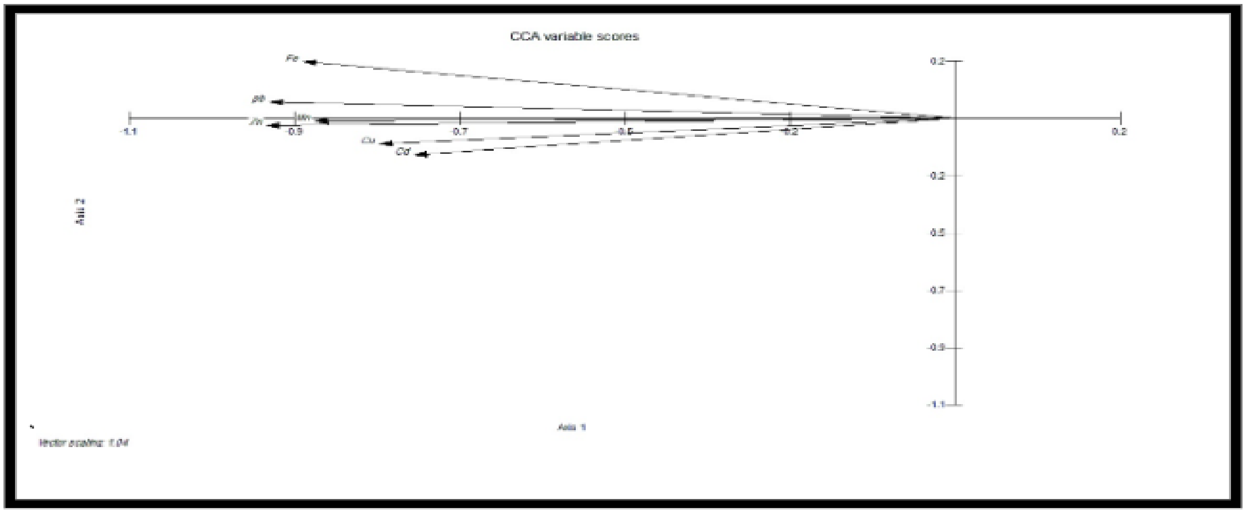


Fig. (4): Canonical Corresponding Analysis (CCA) ordination diagram of the heavy metals accumulated in kidney of collected fish samples according to the gradient of heavy metals in water (arrows) in the study sites.

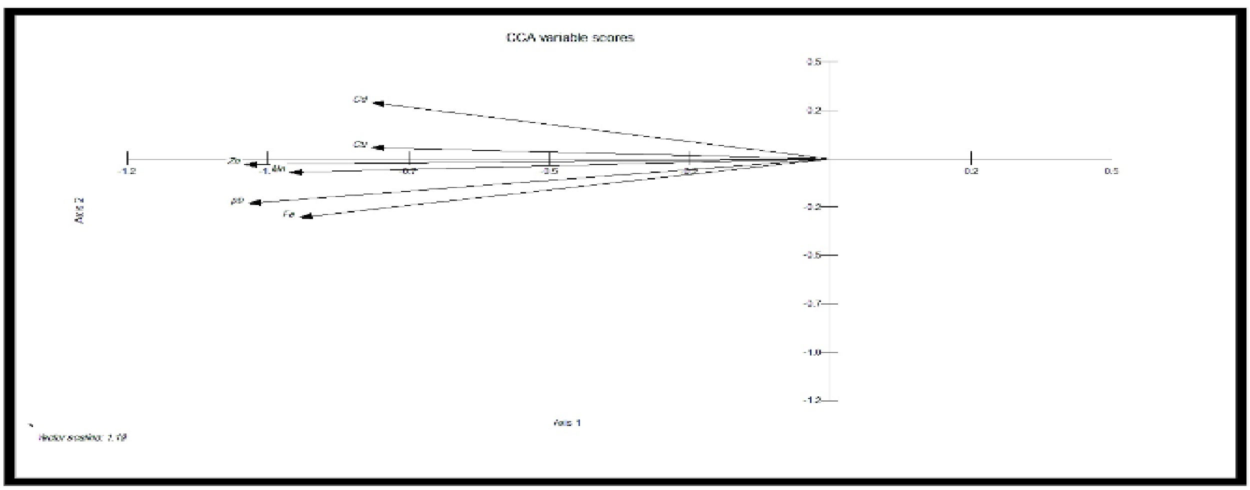


Fig. (5): Canonical Corresponding Analysis (CCA) ordination diagram of the heavy metals accumulated in gills of collected fish samples according to the gradient of heavy metals in water (arrows) in the study sites.

| Water variable | Nile River | Omr Beck drain | | Sherbeen drain | | Manzala lake | |
|---|---|---|---|---|---|---|---|
| | Reference site | Before treatment | After treatment | Before treatment | After treatment | Before treatment | After treatment |
| $Zn^{2+}$ | 0.018 | 0.720 | 0.029 | 0.480 | 0.011 | 0.970 | 0.045 |
| $Fe^{2+}$ | 0.021 | 0.760 | 0.028 | 0.530 | 0.015 | 0.890 | 0.041 |
| $Cu^{2+}$ | 0.011 | 2.210 | 0.077 | 0.620 | 0.034 | 3.090 | 0.173 |
| $Cd^{2+}$ | 0.013 | 0.550 | 0.031 | 0.440 | 0.034 | 1.240 | 0.075 |
| $pb^{2+}$ | 0.009 | 0.850 | 0.027 | 0.386 | 0.027 | 0.952 | 0.059 |
| $Mn^{2+}$ | 0.012 | 0.850 | 0.034 | 0.580 | 0.013 | 0.908 | 0.058 |

Table (5): The concentration of heavy metals of water samples (ppm) in summer season after algae treatment (phytoremediation)

| Types of pesticides and diaxions | Equ. | Nile River | Omr Beck drain | | Sherbeen drain | | Manzala lake | |
|---|---|---|---|---|---|---|---|---|
| | | Reference site | Before treatment | After treatment | Before treatment | After treatment | Before treatment | After treatment |
| Dimethoate | GC/FPD | ND | **0.042** | **0.004** | **0.098** | **0.007** | **0.042** | **0.001** |
| Chlorpyrifos | GC/FPD | ND | **0.067** | **0.002** | **0.052** | 0.002 | **0.068** | **0.004** |
| Malathion | GC/FPD | ND | **0.074** | ND | **0.041** | ND | **0.057** | ND |
| Atrazine | GC/FPD | ND | **0.042** | **ND** | **0.088** | **ND** | **0.083** | **ND** |
| Metalaxyl | GC/FPD | ND | **0.089** | **ND** | ND | ND | **0.095** | **ND** |
| Carbendazim | GC/FPD | ND | **0.067** | **0.012** | **0.044** | **0.003** | **0.083** | **0.003** |
| Chloropropham | GC/FPD | ND | **0.074** | **ND** | **0.051** | **ND** | **0.087** | **0.007** |
| p-p-DDE* | GC/FPD | ND | **0.079** | **ND** | **0.055** | **0.005** | **1.099** | **0.091** |
| Diaxoin | GC/FPD | ND | **0.307** | **0.011** | ND | ND | **0.081** | **0.003** |

Table (6): The concentration of pesticides &Diaxions of water samples (ppm) in summer season after algae treatment (phytoremediation) ND: Not Detected

| Water variable | Nile River | Omr Beck drain | | Sherbeen drain | | Manzala lake | |
|---|---|---|---|---|---|---|---|
| | Referance site | Before treatment | After treatment | Before treatment | After treatment | Before treatment | After treatment |
| $Zn^{2+}$ | 0.018 | 0.720 | 0.027 | 0.480 | 0.015 | 0.970 | 0.065 |
| $Fe^{2+}$ | 0.021 | 0.760 | 0.037 | 0.530 | 0.017 | 0.890 | 0.041 |
| $Cu^{2+}$ | 0.011 | 2.210 | 0.067 | 0.620 | 0.037 | 3.090 | 0.127 |
| $Cd^{2+}$ | 0.013 | 0.550 | 0.041 | 0.440 | 0.026 | 1.240 | 0.099 |
| $pb^{2+}$ | 0.009 | 0.850 | 0.034 | 0.386 | 0.029 | 0.952 | 0.056 |
| $Mn^{2+}$ | 0.012 | 0.850 | 0.026 | 0.580 | 0.015 | 0.908 | 0.051 |

Table (7): The concentration of heavy metals of water samples (ppm) in summer season after Nano technological treatment

| Types of pesticides and diaxion | Equ. | Nile River | Omr Beck drain | | Sherbeen drain | | Manzala lake | |
|---|---|---|---|---|---|---|---|---|
| | | Referance site | Before treatment | After treatment | Before treatment | After treatment | Before treatment | After treatment |
| Dimethoate | GC/FPD | ND | **0.042** | **0.002** | **0.098** | **0.005** | **0.042** | **0.002** |
| Chlorpyrifos | GC/FPD | ND | **0.067** | **ND** | **0.052** | **0.001** | **0.068** | **0.003** |
| Malathion | GC/FPD | ND | **0.074** | **0.004** | **0.041** | **0.006** | **0.057** | **0.004** |
| Atrazine | GC/FPD | ND | **0.042** | **ND** | **0.088** | **ND** | **0.083** | **ND** |
| Metalaxyl | GC/FPD | ND | **0.089** | **0.003** | ND | ND | **0.095** | **0.001** |
| Carbendazim | GC/FPD | ND | **0.067** | **0.002** | **0.044** | **0.002** | **0.083** | **0.005** |
| Chloropropham | GC/FPD | ND | **0.074** | **0.001** | **0.051** | **0.003** | **0.087** | **0.003** |
| p-p-DDE* | GC/FPD | ND | **0.079** | **ND** | **0.055** | **ND** | **1.099** | **0.081** |
| Diaxoin | GC/FPD | ND | **0.307** | **0.019** | ND | ND | **0.081** | **0.003** |

Table (8): The concentration of pesticides &Diaxions of water samples (ppm) in summer season after Nano technological treatment (ND: Not Detected)

## IV. DISCUSSION

Water temperature is critical parameter as it has a great effect on the aquatic system due to its impacts on the organism's existence, evolution, reproductive performance and endurance to the infected diseases (**Moustafa *et al.*, 2010; Gaber *et al.*, 2013; El-Naggar *et al.*, 2016**).The mean value of water temperature was found within the permissible limits set by (**WHO, 2004**), which was between 25 and 30◦C but The relative increase in temperature of Sherbeen&Omr beck drains and Manzala Lake was observed. The elevation in the water temperature have adverse impacts which mainly represented in a decrease in the dissolved oxygen in water (**UNEP, 2006; Adeogun, 2012**).

Electric conductivity is defined as the ability of water to transfer the electrical current, which isn't only influenced by

ISSN No:-2456-2165

presence of dissolved salts in water including Na, Ca, Mg, Ca, Fe, Al, Cl, $SO_4^{-2}$ and P but also by variation in total dissolved solids and water temperature (**Bhatnagar and Devi, 2013**). The high conductivity values observed in Omr Beck drain &Manzala lake water indicated strongly implicates industrial, agricultural and sewage sources. These results agree with reports of electrical conductivity being a direct measure of anthropogenic impact **(UNESCO-WHO-UNEP, 1996**).

pH values used to measure the degree of acidity and alkalinity of water so it is beneficial parameter in evaluating chemical and biological state of water. There are several factors which have significant influences on pH such as water temperature, quantities of organic compounds and photosynthesis process occurred by aquatic flora **(Osman *et al*., 2010)**. The values of pH in the investigated localities lie within the alkaline scale; It is within Egyptian standard regularities (6- 9.5) and the permissible limits of **WHO (1993)**. The pH is important for aquatic life which most organisms have adapted to live in pH ranging from 6.5 up to 8.5 and the runoff from agricultural, domestic and industrial areas may contain iron, aluminum, ammonia, mercury or other species **(El Bouraie*et al*., 2010)** that elevated pH values. The relatively highest pH of Omr Beck drain &Manzala lake water can be attributed to the large amounts of different pollution sources discharged into this drain.

Dissolved oxygen can be defined as the quantity of free oxygen in water which is essential for the life of organisms inhabiting the aquatic ecosystem. The atmospheric air and photosynthetic organisms are the main sources of oxygen (**Bhatnagar and Devi, 2013**). DO has a vital role in the aquatic life because it influences the survival, growth, distribution, behavior and fish physiology and other organisms inhabited aquatic ecosystem (**Mayer, 2012).**

The highly DO level (more than 5.0 mg/L) support good fish production (**Bhatnagar *et al*., 2004**). However, Catfish and other air breathing fish can adapt with low DO as 1.0 mg/L (**Santhosh and Singh, 2007; Bhatnagar and Singh, 2010; RFP, 2010; InfonetBiodivision, 2016; Swan, 2017**). The level of DO increase with decreased water temperature. As was expected the highest value of DO was recorded during winter season might be due to temperature in this season was low. The lowest value of DO was observed during summer that could be due to the decreased quantity or completely absence of rain accompanied by elevation in the water temperature which resulted in lowering in dissolved oxygen, increasing in organic matter decomposition which occurred by aquatic organisms which also consume more oxygen (**Veado *et al*., 2000)**. The reduction in DO content maybe due to decomposition of suspended organic matter of sewage in drains (**Tayel *et al*., 2007**). Lower DO values were recorded in Omr Beck drain &Manzala Lake indicated that the oxygen is depleted in water, and this could be attributed to the pollution of the water by bitumen and other pollutants.

BOD refers to the quantity of dissolved oxygen which is consumed by microorganisms to convert the most complicated organic compounds to simple ones under specific temperature (**Elewa*et al*., 2007**). Increase in BOD values monitored in Omr Beck drain &Manzala Lake environments being affected by quantity and quality of discharges, as well as seasonal and spatial effects (**Abdel-Hamid *et al*., 1992**). BOD is an indirect measurement of the biodegradable organic matter content in water sample while the COD measures the total organic matter content in it. The high BOD and COD values in Omr Beck drain &Manzala Lake areas are indication of high organic and inorganic pollutant loads in the sites. The mean BOD values of the samples exceeded the permissible limit (3.0–6.0 mg / L) of the European Union (EU) for good quality water that will adequately support fishes and other aquatic life forms since the BOD value for unpolluted waters is usually ≤2 mg/L while values for polluted ones can be as high as ≥10 mg/L. The significantly high mean COD values in sites Omr Beck drain &Manzala lake also exceeded the permissible limit (≤20 mg/L) for unpolluted surface water thus falling within the category of polluted waters (20–200 mg/L) (**Chapman, 1996**).

Alkalinity that considered all basic compounds must be at least 20 mg/L for good catfish productivity (**Steven, 2009; PHILMINAQ, 2017**). In particular, the alkalinity was above the value of 20 mg/L as recommended for African catfish that surely affected on its production.

Hardness refers to quantities of Ca, Mn, Mg, Fe, Al, Zn, etc. in water, but in waste water hardness is mainly returned to amounts of Ca and Mg. The generally acceptable value of hardness for fish culture is at least 20 mg/L (Swann, 1997) with an optimum range of 30 to 180 mg/L as CaCO3 (**Santhosh and Singh, 2007; Swan, 2017**). The current study with high total hardness may occur due to the presence of excess pollutants in the water.

The elevated levels of $HCO_3^-$, $SO_4^{-2}$, $Cl^-$, $Ca^{2+}$, $Mg^{2+}$, $Na^+$, $K^+$, in Omr Beck drain &Manzala Lake were reported in the present investigation. These results in harmony with those obtained by **El-Naggar *et al.* (2016), Soltan and Awadallah (1995)** and **Hagras *et al.* (2017)** showed elevations occurred due to huge amounts of domestic and industrial wastes which discharged in water.

Dissolved inorganic nitrogen refers to total amounts nitrite, nitrate and ammonia (**Tayel *et al*., 2007; Osman *et al*., 2010)**. The high amount found in Omr Beck drain &Manzala Lake water which may be enormous organic matters discharged within water as recorded by **Tayel *et al*., 2007**. The higher contents of nitrite in Sherbeen drain water are indication of the microbial activity. The recorded increase in NO comparing to in River Nile water might be attributed to the increased bacterial activity in conversion of NO -NO -

ions through nitrifying process (**Osman *et al.*, 2010**). The increase in ammonia level in water samples collected from Manzala Lake water is indicator of the presence of pollutants with high microbial activity viz.: sewage discharge, industrial effluents and agriculture-runoff and could be attributed to the increase in the oxygen consumption of the decomposing organic matter and oxidation of chemical constituents (**Elghobashy *et al.*, 2001**). High levels of nitrate and nitrite causing increased growth of algae, and after its death caused oxygen depletion problems which harm or may kill fishes and other aquatic organisms (**Osman *et al.*, 2010**). Although mean ammonia value in investigated areas water exceeded acceptable limits by the Egyptian governmental law No. 48, (1982), its value in River Nile water was considerably elevated.

Heavy metals found its way to water system naturally or due to human activities such as shipping and harbor activities, leaching from landfills, storm runoff, industrial or domestic sewage and atmospheric deposits (**Rajeshkumar&Munuswamy, 2011**). Present results showed that, most of the heavy metals concentrations in surface water of Omr Beck &Sherbeen drains, Manzala lake are very high and above the WHO and NIS permissible limits for surface waters and statistically different from the control value which in most cases falls within the standard limits. The high metal values could easily be attributed to pesticides and heavy metals.

The un deliberate usage of pesticides in the third world countries has serious consequences on the general health as it accumulated within fish bodies then moved through the food chain reaching human and resulting in serious problems including mutations and cancers **(Porte and Albaiges, 1994; Jacobs, *et al.*, 2002).**

Elevated amounts of pollutants including pesticidesheavy metals and making fishes undergo stress conditions which disturb its homeostasis and decrease its tolerance for adaptation for these severe conditions **(Olufayo and Alade, 2012 ).** However there are limitation in the investigations which studied the toxic influences of these pesticides on the health of fish or other organisms inhabiting aquatic ecosystem **(Ahmed and Moustafa, 2010; Abd-algadir*et al.*, 2011 and El-Sharkawy*et al.*, 2011).** Fishes exposed to toxicants undergo stress, which is a state of re-established homeostasis, a complex suite of mal-adaptive responses **(Chrouses, 1998 ;Olufayo and Alade, 2012 ).** It is a systemic toxicant rated as moderately to extremely toxic to fish and aquatic organisms, and which can give rise to long-lasting metabolites. So the current study measured the concentration of toxicants (heavy metals and pesticides) found in fish organs (liver, kidney and gills).**El-Shehawi *et al.* (2007)** and **Lee *et al.* (2011**) stated that heavy metals pollution is an ecological problem that threaten the aquatic system and difficult be overcome due to its non-biodegradable property and its bioaccumulation through aquatic food chain and finally precipitate within body tissues. The danger of these metals lied on its destructive influences as it damage and disturb the species biodiversity and habitat constituents.

The present investigation indicated that Cu, Pb, Cd, Zn, Fe and Co concentrations in fish liver, kidney and gills were greater in fish living in three polluted sites than those in River Nile. The accumulation of heavy metals in tilapia species was studied in the investigation of **Saad *et al.* (1981)** reported elevated concentrations of heavy metals in both liver and stomach than in fish muscles sampled from polluted sites. Also, the mean metals concentrations in the lake water were extremely lower than those in various organs of the fishes. These results illustrate the fish ability to accumulate heavy metals. This agrees with the present findings that heavy metals levels were higher in fish liver and kidney than that in gills, and agrees with the present study on the remarkable dissimilarity in the metals levels among water and fish organs.

The Findings of **Teklit (2016)** study showed high levels of pesticides residue in various organs of fishes (*Labeobarbusspp, Clariasgariepinus and Oreochromisniloticus*) than that in the water where sampled from. This agrees with the present results that pesticide residues levels were higher in fish organs than water. Also, The Study of **SCIUTO*et al.*,(2018)** ensured that diaxions levels were highly precipitated within fish organs than in the polluted water. This agrees with the current findings that diaxions amounts were greater in fish organs than water.Reusing this drainage water without suitable treatment may cause adverse effects on soil, crop, animal, and human health (**Abu, 2011**). Among various removal strategies such as coagulation, photocatalytic degradation, membrane separation, biological treatment,nanotechnologicl treatment by adsorption is a promising method that may utilize mass-produced low-cost materials (**Li *et al.*, 2016**).

Biological treatment by bioremediation of heavy metal and pesticides in contaminated soil and water environments has become one of the most sensational issues due to their deleterious effect on public health and environment. In natural habitat, certain microbes are capable of metabolizing those persistent compounds or detoxify them which could be employed for bioremediation. Hence the direct use of such microorganisms capable of degrading xenobiotics is also becoming a popular approach to safeguard the environment. Planktonic green algae, such as *Scenedesmus* sp. are useful globally test organisms in ecotoxicological studies. So, the present study using it in the treatment process due to its ability to adopt in polluted media and more tolerant to organic pollutant. Microalgae (*Scendesmus*) have a certain ability to bi bioindicator disturbed in various aquatic ecosystems (**Gurbuz*et al.*, 2008; Rodriguez-Garcia &Guil-Guerrero, 2008**). In the present study, phytoremediation treatment of water polluted water with heavy metals and pesticides residue by *Scendesmus sp.* was excellent treatment and achieved the highestefficiency as this micro alga had the ability of removal pollutants in all study sites comparison to control.

Nano technologicl treatment by adsorption using Hydroxyapatite (HAP, $Ca_5(PO4)_3$ (OH)), a member of the calcium phosphate family with high biocompatibility, can be used as an adsorbent for getting red of toxic colors from aqueous solutions (**Peng *et al.*, 2018**). The cleaning of wastewater from the non-biodegradable dyes still requires techniques with tremendous costs and environmental impacts. Feng, 2010 reported that Magnetic hydroxyapatite adsorbed $Cd^{2+}$ and $Zn^{2+}$ ions from aqueous solutions and **Lu &Astruc, 2018** said that The application of nanomaterials (NMs) for the removal of pollutants from water has attracted significant attention. The application of NMs for the removal of toxic elements in water and focuses on inorganic NMs, organic polymer NMs and organic polymer-supported nano composites. this agree with the present study which finding the high ability of Hydroxyapatite nano rods to adsorb heavy metals, pesticides and diaxions in polluted water from different polluted localities compared with control.

## V. CONCLUSION AND RECOMMENDATION

The current study illustrated the variation in the water quality between River Nile and three polluted ecosystems, Omr beck drain, Sherbeen drain and Manzalalake and its impacts on *C. gariepinus* dwelling all ecosystems. The correlation between pesticides and heavy metals values that produced by Canonical Correspondence Analysis (CCA), all analyzed pesticides showed high significant correlations except diaxion showed moderate significant correlations with heavy metals accumulated in different water samples and The correlation between heavy metal in water samples with heavy metals of fish showed that high significant correlations with all analyzed fish organs (liver, kidney and gills). Accordingly great efforts must be exerted to reduce the amounts of pollutants thrown in the water and making strict laws which restricted dumping of wastes within water and rationalization the use pesticides which discharged in drains which reduce water quality. Also, treatment of sewage, domestic and agricultural wastes must be continuously performed and controlled by laws phytoremediation treatment using microorganisms and nano technological treatment by adsorption method have proven to be more energy, environmentally efficient ,inexpensive and ecofriendly to the environment.The importance of reducingthe use of pesticides is necessarybecause oftheir impact onsediment, water and aquatic ecosystem inthis environmentand returntothe natural resources thatexistin nature.

## ACKNOWLEDGEMENTS

I wish to express my deep thanks and gratitude to Dr. Mohamed I. Mashaly, lecture of invertebrates and parasitology for his great efforts in statistical analysis. and Dr. Amr Abdel Ghani, Assistant professor in National Research Centerfor his cooperation for nano technological treatment by Hydroxy Apatite nano rods of this work.

## REFERENCES

[1]. **Abd-algadir, M. I., Idris O. F. and Elkhier M. K. S. (2011):** Effect of pendimethalin herbicide on fish (Tilapia nilotica) skeletal muscles, gills and its influence on human. *World J Life Sci Med Res*, *1*, 5-10.

[2]. **Abdel-Hamid, M.I., Shaaban-Dessouki, S.A. and Skulberg, O.M. 1992.** Water quality of the River Nile in Egypt. 1. Physical and chemical characteristics. ArchivfürHydrobiologie, Supplement, 90(3): 283-310.

[3]. **Abdien, H.G., Cheira, M.F.M., Abd-Elraheem, M.A., Saef El-Naser, T.A., Zidan, I.H., 2016.** Extraction and pre-concentration of uranium usingactivated carbon impregnated trioctyl phosphine oxide. Elixir Appl. Chem. 100, 43462- 43469.

[4]. **Abu, Z.M. (2011):** Egyptian policies for using low quality water for irrigation. Wat.Res. Center- Cairo – Egypt. http://www.docstoc .com/docs/68231841/Egyptian-policies-for-using-low-quality-water-fo-irrigation.

[5]. **Adeogun, A.O., 2012.**Impact of industrial effluent onwater quality and gill pathology of *Clariasgariepinus*from Alaro stream, Ibadan, Southwest, Nigeria. European Journal of Scientific Research, 76(1): 83-94.

[6]. **Ahmed, E. N. G. and Moustafa, G. G. (2010**)**:** Evaluation the Toxic Effects of Herbicide Stomp 50% EC (Pendimethalin) On Health of Oreochromisniloticus. *Zag. Vet. J. (ISSN. 1110-1458), 38(3), 8-17***.**

[7]. **Aiman, U., A. Mahmood, S. Waheed and R.N. Malik, 2016.** Enrichment,geoaccumulation and risk surveillance of toxic metals for different environmental compartments from MehmoodBootidumping site, Lahorecity, Pakistan. Chemosphere, 144: 2229–2237.

[8]. **Akan, J.C., Chellube, M.T., Chellube Z.M. andAbdulrahman, F.I. (2012).** Assessment of Pollutants in Water and Sediment Samples in Lake Chad, Baga, North Eastern Nigeria. Journal ofEnvironmental Protection, 3: 1428-1441.

[9]. **Akiwumi, F.A. and Butler, D.R. (2008).** Mining and environmental change in Sierra Leone, West Africa: a remote sensing and hydrogeomorphological study. Environ Monit Assess 142: 309-318.

[10]. **Al-Halani, A.A., Hagras, A.E., Abdeen S.H., Abdrabbuh A. E., and Mashaly, M.I. (2018):** WaterSodicity and Organic Pollution in Sediments and Organ Tissues of *Clariasgariepinus*and*Oreochromisniloticus*from

Ammar Drain and Damietta Branch of the River Nile, Nile Delta –Egypt. International Journal of Environment and Bioenergy, 13(2): 68-88.

[11]. **Allen, S.E.; Grimshaw, H.M.; Parkinson, J.A.; Quarmby, C. & Roberts, J.D.(1974).** Chemical Analysis of Ecological Materials. Blackwell Scientific Publ. Osney, Oxford, London.

[12]. **Alqadami, A.A., Naushad, M., Abdalla, M.A., Ahamad, T., ALOthman, Z.A.,**

[13]. **Alshehri, S.M., Ghfar, A.A., 2017.** Efficient removal of toxic metal ions from wastewater using a recyclable nanocomposite: a study of adsorption parameters and interaction mechanism. J. Clean. Prod. 156, 426-436.

[14]. **APHA (American Public Health Association) (1998).**Standard Methods for the Examination of Water and Waste Water, 19th Edition.American Public Health Association, American Water Work Association, Water Pollution Control Federation, Washington, D.C.

[15]. **APHA. (1989):** Standard methods for the examination of water and wastewater, sewage and industrial wastes. 16th Ed.New York, 1193.

[16]. **APHA (1992):** In official methods for the examination water and wastewater. Nineteenth ed.

[17]. **APHA, AWWA, and WPCE (1985):** Standard methods for the examination of water and wastewater. 16th Ed. New York, American Public Health Association.

[18]. **Authman, M.M.N., Abbas, H.H. and Abbas, W.T. (2013):** Assessment of metal status in drainage canal water and their bioaccumulation in *Oreochromisniloticus*fish in relation to human health Environmental Monitoring and Assessment, Environmental Monitoring and Assessment, 185(1), 891-907.

[19]. **Authman, M.M.N., Zaki, M.S., Khallaf, E.A. and Abbas, H.H. ( 2015)**: Use of fish as bio-indicator of the effects of heavy metals pollution, Aquaculture Research & Development, 6(4), 1-13.

[20]. **Azzurro, E., Matiddi, M., Fanelli, E., Guidetti, P. La Mesa, G., Scarpato, A. and Axiak, V. 2010.**Sewage pollution impact on Mediterranean rocky-reef fish assemblages. Marine Environmental Research, 69: 390-397.

[21]. **Babu, R., Imagawaa, T., Tao, H. and Ramesh, R.2005**: Distribution of PCBs, HCHs and DDTs, andtheirecotoxicological implications in Bay of Bengal, India,‖*Environment International*, vol. 31, no. 4, pp. 503- 512.

[22]. **Bahnasawy, M.H., Khidr, A.A.A. andDheina, N.A. 2009.** Seasonal variations of heavy metals concentrations in mullet, *Mugilcephalus*and *Liza ramada*(Mugilidae) from Lake Manzala, Egypt. Egyptian Journal of Aquatic Biology and Fisheries, 13(2): 81-100.

[23]. **Barnes, H. &Folkard, A.R. (1951):** The determination of nitrites. Analyst, 76:599.

[24]. **Barsanti, L. &Gualtieri, P. (2006):** Algae: anatomy, biochemistry and biotechnology, CRC Press, New York: 97-126.

[25]. **Baruah, T.C. &Barthakur, H.P. (1997):** A text book of Soil Analysis, Vika Publishing House Pvt Ltd., New Delhi, 334.

[26]. **Begüm A, Amin M, Kaneco S, Ohta K (2005).** Selected elemental composition of the muscle tissue of three species of fish, Tilapia nilotica, Cirrhinamrigala and Clariusbatrachus, from the fresh water Dhanmondi Lake in Bangladesh. Food Chemistry 93: 439-443.

[27]. **Bhatnagar A, Devi P (2013).** Water quality guidelines for the management of pond fish culture. Int. J. Environ. Sci. 3(6): 1980- 2009.

[28]. **Bhatnagar A, Jana SN, Garg SK, Patra BC, Singh G, Barman UK (2004).** Water quality management in aquaculture, In: Course Manual of Summer School on the Development of Sustainable Aquaculture Technology in Fresh and Saline Waters, CCS Haryana Agricultural, Hisar (India) pp. 203-210.

[29]. **Bhatnagar A, Singh G (2010).** Culture fisheries in village ponds: a multi-location study in Haryana, India. Agric. Biol. J. N. Am. 1(5):961-968.

[30]. **Calkosinski, I., Rosinczuk-Tonderys, J., Bazan, J., Dobrzynski, M., Bronowicka-Szydelko, A.andDzierrzba, K. 2014.** Influence of dioxinintoxication on the human system and possibilities of limiting its negative effects on the environment and living organisms. Ann. Agric. Environ. Med. 21:518–524.

[31]. **Canli M, Atli G (2003).**The relationships between heavy metal (Cd, Cr, Cu, Fe, Pb, Zn) levels and the size of six Mediterranean fish species. Environ Pollut 121: 129-136.

[32]. **Chapman D (1996).** Water Quality Assessments: A Guide to the Use of Biota, Sediments and Water in Environmental Modelling. Chapman & Hall, London.http://apps.who.int/iris/bitstream/10665/41850/1/0419216006_eng.pdf

[33]. **Chen CY, Folt CL (2000)** Bioaccumulation of arsenic and lead in a freshwater food web. Environ SciTechnol 34: 3878-3884.

[34]. **Chrouses, G.P. (1998):** Stressors, stress and neuroendocrine integration of the adaptative response. Ann. NY. Acad. Sci. 851:311-335.

[35]. **Dai, J., Ren, F., Tao, C., 2012.** Adsorption behavior of Fe(II) and Fe(III) ions on thio urea cross-linked chitosan with Fe(III) as template. Molecules 17, 4388-4399.

[36]. **Dewis, J. &Freitas, F. (1970):** Physical and chemical methods of soil and water analysis. FAO Soils Bulletin,10.

[37]. **Dhaneesh, K.V., Gopi, M., Ganeshamurthy, R., Ajith Kumar, T.T., and Balasubramanian, T. 2012a.** Bio-accumulation of metals on reef associated

organisms of Lakshadweep Archipelago. Foo Chemistry, 131: 985-991.

[38]. **Dhaneesh, K.V., Gopi, M., Noushad, K.M. ,Ganeshamurthy, R., Ajith Kumar, T.T. andBalasubramanian, T. 2012b**. Determination of metal levels in thirteen fish species from Lakshadweep Sea. Bulletin of Environmental Contamination and Toxicology, 88: 69-73.

[39]. **Egyptian Governmental Law No. 48, 1982.**The implementer regulations for law 48/1982 regarding the protection of the River Nile and water ways from pollution.Map. Periodical Bull., 3-4: 12-35.

[40]. **El-Bouraie, M.M., El-Barbary, A.A. ,Yehia, M.M. andMotawea, E.A. 2010.** Heavy metal concentrations in surface river water and bed sediments at Nile Delta in Egypt. Suoseura-Finnish Peatland Society, 61(1): 1-12.

[41]. **Elewa, A.A., Saad, E.A., Shehata, M.B. andGhallab, M.H. 2007.** Studies on the effect of drain effluents on the water quality of Lake Manzala, Egypt. Egyptian Journal of Aquatic Biology and Fisheries, 11(2): 65-78.

[42]. **Elghobashy, H.A., Zaghloul, K.H. and Metwally, M.A.A. 2001.** Effect of some water pollutants on the Nile tilapia, *Oreochromisniloticus*collected from the River Nile and some Egyptian lakes. Egyptian Journal of Aquatic Biology and Fisheries, 5(4): 251-279.

[43]. **El-Naggar, A.M., Abdeen S.H., Hagras, A.E. ,Abdrabbuh, A.E., Mashaly, M.I. and Al-Halani, A.A. 2016.**Impacts of Fluctuations of Physicochemical Environmental Parameters of Aquatic Ecosystems on Somatic Indices and Sex Hormones of the Teleosts*Clariasgariepinus*and *Oreochromisniloticusniloticus*. Journal of Bioscience and Applied Research, 2(10): 670-685.

[44]. **El-Sharkawy, N. I., Reda, R. M., and El-Araby, I. E. (2011):** Assessment of Stomp (Pendimethalin) toxicity on Oreochromisniloticus. *Journal of American Science*, *7*(10).

[45]. **El-Shehawi, A.M.; Ali, F. K.** and**Seehy, M.A. (2007).**Estimation of water pollution by genetic biomarkers in tilapia and cat fish species shows species site interaction. Afr. J. Biotech., 6: 840- 846.

[46]. **El-Sheikh, M.A., Saleh, H.I., El-Quosy, D.E.and Mahmoud, A.A. 2010.** Improving water quality in polluted drains with free water surface constructed Wetlands. Ecological Engineering, 36: 1478-1484. from wastewater assisted with kaolin clay by magnesium hydroxide

[47]. **Gaber, H.S., El-Kasheif, M.A., Ibrahim, S.A. and Authman, M.M.N. 2013.**Effect of Water Pollution in El-Rahawy Drainage Canal on Hematology and Organs of Freshwater Fish *Clariasgariepinus*. World Applied Sciences Journal, 21 (3): 329-341.

[48]. **Gurbuz, F.; Ciftci, H.; Akcil, A. (2008):** Biodegradation of cyanide-containing effluents by Scenedesmusobliquus, Journal of Hazardous Materials, doi:10.1016/j. jhazmat. 2008.05.008.

[49]. **Hagras, E. Ahmed., El-Gammal, I. Maie, Abdrabouh, E., Abeer and El-Bahnasy, T. Hanaa, 2017**.Environmental Impact Assessment of Heavy Metals on African Catfish (*Clariasgariepinus*) ofsome Drains in Dakahlia Governorate, Egypt. Journal of Environmental Science, Toxicologyand Food Technology, PP 39-51.

[50]. **Harvey, P.; Campanella, B.; Castro, P.; Harms, H. ; Lichtfouse, E.; Schffner, A. ; Smrcek, S.; Werck-Reichhart, D. (2002):** Phytoremediation of polyaromatic hydrocarbons, anilines and phenols, Environ. Sci. Pollut. Res. 9: 29-47.

[51]. **InfonetBiodivision (2016).** Fish farming (new, with animal welfare information) http://www.infonet-biovision.org/AnimalHealth/Fish-farming-new-animal-welfare-information

[52]. **Jackson, M.L. (1967).** In soil Chemical Analysis. Prentica-Hall.Inc., Inglewood Cliffs, London 498 pp.

[53]. **Jacobs, M. N., Covaci, A. and Schepens, P. (2002):** Investigation of selected persistent organic pollutants in farmed Atlantic salmon (*Salmosalar*), salmon aquaculture feed, and fish oil components of the feed. *Environmental science & technology*, *36*(13), 2797-2805.

[54]. JÖRUNDSDÓTTIR H. Ó., S. JENSEN, K. HYLLAND, T. F HOLTH, H. GUNNLAUGSDÓTTIR, J. SVAVARSSON, Á. ÓLAFSDÓTTIR, H. EL-TALIAWY, F. RIGÉT, J. STRAND, E. NYBERG, A. BIGNERT, K. S. HOYDAL, H. P. HALLDÓRSSON. 2014. Pristine Arctic: Background mapping of PAHs, PAH metabolites and inorganic trace elements in the North-Atlantic Arctic and sub-Arctic coastal environment. - *Science of the Total Environment*, 493: 719-728.

[55]. **Kasai, F.; Takamura, N.; Hatakeyama, S. (1993):** Effects of smetryne on growth of various freshwater algal taxa. Environ Pollut 79: 77-83.

[56]. **Lee, K.; Kweon, H.; Yeo, J.; Woo, S.; Han, S.** and **Kim, J. H. (2011).** Characterization of tyrosine-rich *AntheraeaPernyi* silk fibroin hydrolysate.Int.J. Biol. Macromol., 48, 223–226.

[57]. **Li, H.Y. , Liu, S.Y. , Zhao, J.H., Feng, N.(2016):** Removal of reactive dyes from wastewater assisted with kaolin clay by magnesium hydroxide coagulation process, Colloids Surf. A: Physicochem. Eng. Aspects 494 :222–227.

[58]. **Lu, Feng ,Astru , (2018):**Nanomaterials for removal of toxic elements from water Coordination Chemistry Reviews 356: 147–164.

[59]. **Mayer E (2012).** Monitoring Pond Water Quality to Improve Production https://thefishsite.com/articles/monitoring-pond-water-quality-to-improve-production Accessed on 31/10/2017

[60]. **Miliadies, G.E. (1998):** Analysis of pesticide residues in water samples by gas capillary chromatography, Bull. Environ. Contam.Toxicol. 61: 255–260.

[61]. **Monirith, H. Nakata, M., Watanabe, S., Takahashi, S., Tanabe, F. and Tana**, **TS. 2000** .Organochlorine Contamination in Fish and Mussels fromCambodia and Other Asian Countries, *Water Science andTechnology*, vol. 42, no. 7-8, pp. 241-252.

[62]. **Monroy, M., Maceda-Veiga, A. and de Sostoa, A. 2014.** Metal concentration in water, sediment and four fish species from Lake Titicaca reveals a large-scale environmental concern. Science of the Total Environment, 487: 233–244. doi:10.1016/j.scitotenv.2014.03.134.

[63]. **Moshood**, **K. M**.( 2009): *Influence of watershed Activities on the Water Quality and Fish*.

[64]. **Moustafa, M.M., M.H.H. Ali, A.M. Abdel-Satar, T.Y. Mohamed, and S.M. Madbouly, 2010**.Water quality assessment of Rosetta and Damietta branch, River Nile, Egypt. African Journal of Pharmacy Biology and Medical Sciences, 6(2): 127-142.

[65]. Naushad, Mu, Khan, M.R., ALOthman, Z.A., Al-Muhtaseb, A.H., Awual, MdR.,Alqadami, A.A., 2016. Water purification using cost effective material preparedfrom agricultural waste: kinetics, isotherms, and thermodynamic studies. Clean(Weinh) 44, 1036-1045.

[66]. **Nisha Gaur; Gagan Flora; MahavirYadav; ArchanTiwari (2014):**Areview with recent advancements on bioremediation- based abolition of heavymetals. Environ. Sci. Processes Impacts, 16: 180-193.

[67]. **Ntow,J. W. 2005**. Pesticide Residues in Volta Lake, Ghana,‖*Lakes andReservoirs: Research and Management*, vol. 10, no. 4, pp. 243-248.

[68]. **Oliveira-Filho, E. C., and Paumgartten, F. J. R. (2000).**Toxicity of Euphorbia milil latex and niclosamide to snails and nontarget aquatic species.Ecotoxicol. Environ. Saf. 46: 342–350.

[69]. **OLOPADE OlaniyiAlaba, TAIWO Iyabode Olusola, OLUWOLEAND Comfort Opeoluwaand AKANKALI Justin Ayaegbunem(2015):** WATER QUALITY AND HAEMATOLOGICAL INDICES OFCLARIAS GARIEPINUS FROM OGUN RIVER (NIGERIA) , Transylv. Rev. Syst. Ecol. Res. 17.2 ,"The Wetlands Diversity"

[70]. **Olufayo, M. O. and Alade, O. H. (2012):** Acute toxicity and histological changes in gills, liver and kidney of catfish, *Heterobranchusbidorsalis e*xposed to *c*ypermethrinconcentration *.African Journal of Agricultural Research Vol. 7(31), pp. 4453-4459.*

[71]. **Osman, A.G.M., Al-Awadhi, R.M., Harabawy, A.S.A.and Mahmoud, U.M. 2010.** Evaluation of the use of protein electrophoresis of the African Catfish*Clariasgariepinus*(Burchell, 1822) for biomonitoring aquatic pollution. Environmental Research Journal, 4(3): 235-243.

[72]. **Ouyang, Y.; Higman, J.; Thompson, J.;'Toole, T. O.; Campbell, D.(2002):** "Characterization and spatial distribution of heavy metalsin sediment from Cedar and Ortega rivers subbasin," *Journal of Contaminant Hydrology*, vol. 54, no. 1-2: 19–35.

[73]. **Peng, B.L. , Tang, J.T., Luo, J.H., Wang, P.M. , Ding, B., Kam**, **C.T. (2018)** . Applications of nanotechnology in oil and gas industry: progress and perspective, Can. J. Chem. Eng. 96 : 91–100.

[74]. **PEREIRA S., A. L. PINTO, R. CORTES, A. FONTAÍNHAS-FERNANDES, A. M. COIMBRA, S. M. MONTEIRO. 2013.** Gill histopathological and oxidative stress evaluation in native fish captured in Portuguese northwestern rivers. - *Ecotoxicology and Environmental Safety*, 90: 157–166.

[75]. **PHILMINAQ (2017).** Water Quality Criteria and Standards for Freshwater and MarineAquaculturehttp://aquaculture.asia/files/PMNQ%20WQ%20standard%202.pdf Retrieved on 8/10/2017.

[76]. **Porte, C. and Albaigés, J. (1994**)**:** Bioaccumulation patterns of hydrocarbons and polychlorinated biphenyls in bivalves, crustaceans, and fishes. *Archives ofEnvironmental Contamination and Toxicology*, *26*(3), 273-281.

[77]. **Rajeshkumar, S.** and**Munuswamy, N. (2011).**Impact of metals on histopathology and expression of HSP 70 in different tissues of Milk fish (*Chanoschanos*) of Kaattuppalli Island, South East Coast, India. - Chemosphere 83(4): 415-421.

[78]. **Request for Proposal (RFP) (2010).**A manual for rural freshwater aquaculture.Rural Fisheries Programme, WRC Report No.TT 463/P/10.Department of Ichthyology and Fisheries Science, Rhodes University, S. Africa.http://nda.agric.za/doaDev/sideMenu/fisheries/03_areasofwork/Aquaculture/AquaDocumentation/ManualRuralFreshwaterAquaculture.pdf

[79]. **Rodriguez-Garcia, I. &Guil-Guerrero, J.L., (2008):** Evaluation of the antioxidant activity of three microalgal species for use as dietary supplements and in the preservation of foods, Food Chemistry, 108: 1023-1026.

[80]. **Saad, M.A.H.; Ezzat, A.; El-Rayis, O.A.** and **Hafez, H.A. (1981).**Occurrence and distribution of chemical pollutants in Lake Mariut, Egypt. II. Heavy metals. Wat.Air Soil Pollut.16, 401-407.

[81]. **Santhosh B, Singh NP (2007).** Guidelines for Water Quality Management for Fish Culture in Tripura, ICAR Research Complex for NEH Region, Tripura Center, Publication no. 29

[82]. **Sara Bouaroud, Ahmed Menad, AzeddineBounamous, Hocine Ali-Khodja,AbdelfettahGherib, Dana E. Weigel,**

**HarounChenchouni 2019.**Assessment of water quality at the largest dam in Algeria (BeniHaroun Dam) and effects of irrigation on soil characteristics of agricultural lands.Chemosphere, 219: 76 -88.

[83]. **SCIUTO S., PREARO M., DESIATO R., BULFON C., BURIOLI E. A. V., ESPOSITO G., GUGLIELMETTI C., DELL'ATTI L., RU G., VOLPATTI D., ACUTIS P. L., AND MARTUCCI F. (2018):** Dioxin-like Compounds in Lake Fish Species: Evaluation by DR-CALUX Bioassay Journal of Food Protection, Vol. 81, No. 5, Pages 842–847

[84]. **Sdiri, A., Khairy, M., Bouaziz, S., El-Safty, S., 2016.**A natural clayey adsorbent for selective removal of lead from aqueous solutions.Appl. Clay Sci.126, 89-97.

[85]. **Shokrzadeh, M., Saeedi, S. S., Saravi, Y. and Zehtab, Y. (2009)**: Lindanemanufactured thereby, JP2007-2229, 17.

[86]. **Simionato, J.I., Paulino, A.T., Garcia, J.C., Nozaki, J., 2006.** Adsorption of luminium from wastewater by chitin and chitosan produced from silkworm chrysalides. Polym.Int. 55.

[87]. **Soltan, M.E., Awadallah, R.M. (1995).**"Chemical Survey on the River Nile Water from Aswan into the Outlet", Journal of Environmental Science and Health. Part A: 30(8):1647–1658.

[88]. **Steven R (2009).** Fish Pond Water Quality: As Simple as Chemistry 101 https://www.noble.org/news/publications/ag-news-and-views/2009/july/fish-pond-water-quality-as-simple-as-chemistry-101/ Accessed on November 2, 2017.

[89]. **Swann L (2017).**A Fish Farmer's Guide to Understanding Water Quality.https://extension.purdue.edu/extmedia/AS/AS-503.html

[90]. **Swann LD (1997).**A Fish Farmer's Guide to Understanding Water Quality.AquacultureExtension Illinois, Purdue University, Indiana Sea Grant Program Fact Sheet AS-503.

[91]. **Taras, J. M. (1950):** Phenoldisulphonic acid method of determining nitrate in water. J. Anal. Chem- 22 (8): *1020 – 1022*.

[92]. **Tayel, S.I., Ibrahim, S.A., Authman, M.M.N. and El-Kashef, M.A. 2007.**Assessment of Sabal drainage canal water quality and its effect on blood and spleen histology of *Oreochromisniloticus*. African Journal of Biological Sciences, 3(1): 97-107.

[93]. **Teklit GA (2016).** Residues Analysis of Organochlorine Pesticides in Fish, Sediment and Water Samples from Tekeze Dam, Tigray, Ethiopia. J Environ Anal Toxicol 6: 342. doi:10.4172/2161-0525.1000342

[94]. **UNEP (United Nations Environment Program), 2006.**Water Quality for Ecosystem and Human Health. Prepared and published by the United Nations Environment Program Global Environment Monitoring System (GEMS)/Water Program. ISBN 92- 95039-10-6, pp: 132.

[95]. **UNESCO-WHO-UNEP, 1996.**Water Quality Assessments -A Guide to Use of Biota, Sediments and Water in Environmental Monitoring - Second Edition. Deborah Chapman Eds., pp: 609.

[96]. **Veado, M.A.R.V., De Oliveria, A.H., Revel, G., Pinte, G., Ayrault, S. and Toulhoat, P. 2000.** Study of water and sediment interactions in the Das Velhas River, Brazil - Major and trace elements. Water SA, 26(2): 255-262.

[97]. **Welch, P. S. (1948):**Limnological Methods. McGraw-Hill, New York. 381 pp.

[98]. **WHO (World Health Organization) (1993**).IPCS Environmental Health Criteria Series No. 155. Biomarkers and risk assessment: concepts and principles. Geneva: World Health Organization.

[99]. **WHO, 2004** Drinking Water Guidelines available at http://103.whosea.org.tehifor/water.litm/ 130.

[100]. **Wijk, D. J.; Kroon, S. G. M.; Garttener-Arends, C. M. (1998):** Toxicity of chlorate and chlorinated to selected species of algae, bacteria, and fungi. Ecotoxicol. Environ. Saf. 40: 206-211.

[101]. **Yano, H., Seki, N., Ishida, T.(2008):** Manufacture of nanofibers and nanofibers manufactured thereby, JP2007-2229, 17.

[102]. **Zhang, E.; Wang, B.; Wang, Q.; Zhang, S.; Zhao, B. (2008):** Ammonia-nitrogen and orthophosphate removal by immobilized *Scenedesmus sp.* isolated from municipal wastewater for potential use in tertiary treatment, Bioresource Technology, 99: 3787-3793.

[103]. **Zhu, Z., Li, L., Zhang, H., Qiu, Y., Zhao, J., 2010.** Adsorption of lead and cadmium on Ca-deficient hydroxyapatite. Sep. Sci. Technol 45, 262-268.