ASSESSMENT AND TREATMENT OF HEAVY METALS IN MARIOUTEYA CANAL WATER

By

Aya Atef Taha Shalaby

B.Sc. of Science (Environmental Sciences), Faculty of Science, Mansoura University, 2009

A Thesis Submitted in Partial Fulfillment
Of
The Requirement for the Master Degree
In
Environmental Sciences

Department of Environmental Basic Sciences
Institute of Environmental Studies and Research
Ain Shams University

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This thesis Towards a Master Degree in Environmental Science Has been approved by:

Name
Signature

1-Prof. Dr. Ali Mohamed A. Mashhour
Prof. of Soil Science, Faculty of Agriculture
Al-Azhar University

2-Prof. Dr. Taha Abd El-Azzem Mohamed
Prof. of Environmental Chemistry
Vice Dean of Institute of Environmental Studies & Research for Community Service & Environment Development
Ain Shams University

3-Prof. Dr. Essam Abd El Aziz Kishar
Prof. of Inorganic Chemistry, Faculty of Women
Ain Shams University

4-Dr. Abd El-Hamid El-Ghadban abd El-latif
Assistant Prof. of Soils Science
Environmental Research Department
Soils, Water Environment Research Institute – ARC.

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Under The Supervision of:-

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Faculty of Women
Ain Shams University

2-Dr. Abd El-Hamid El-Ghadban abd El-latif
Assistant Prof. of Soils Science
Environmental Research Department
Soils, Water Environment Research Institute – ARC.

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ABSTRACT

The objective of this study was to evaluate the environmental risks for soils and plants from El-Moheet drain at two seasons (summer and winter). To achieve this aim, were investigate the pH and electrical conductivity (EC) in water and soils, as well as sodium adsorption ratio (SAR) in water; some micro elements and heavy metals were estimated in both water; soils and plants. In addition to calculate of contamination factor (CF), contamination degree (CD), modified contamination degree (mCd); pollution load index (PLI) and bio-accumulation factor of elements in plant.

The obtained data indicated that pH values and sodium adsorption ratio (SAR) of water are varied from winter season to summer. The electrical conductivity values (EC) in summer season was severe and in winter season indicating a slight to moderate degree, but residual sodium carbonate (RSC) was free in both seasons. Regard to soil pH values tend to be neutral, slightly and moderately alkaline and EC was ranged between non-saline to very slightly saline. The highest value was for the Fe and followed by Zn, Mn, B, Pb, Cu, Cr, Ni, Co and Cd, respectively. Heavy metals Cd, Co, Cr, Ni, and Pb displayed very low permissible limits. Elements concentrations in summer season were higher than winter season. However, none of the heavy metals exceeded that the recommended limits in irrigated water according to Food and Agriculture Organization (FAO). Available contents of Fe, Mn and Cu in soils at summer and winter seasons showed very high

concentrations and toxic, but B, Cd, Co, Cr, Ni and Pb were toxic and within the safe limits. Total content of Cd was toxic and exceeded the safe limits at both seasons, but the other elements were toxic and within the safe limits.

The lowest concentration of iron, boron, cobalt and chromium were found in the Wheat plant. Manganese and nickel were found in the fruits of Eggplant, zinc and copper found in Cabbage. While the highest concentrations of iron, manganese, copper, cobalt, nickel and lead were found in Okra fruits. Also zinc, boron and chromium were found in Arugula plant. BCF indicates that most plants have more than 1 and indicate to high concentrations of heavy metals except Cd, Ni and Pb were not hyper-accumulator with all plants under studied at two seasons.

The values of (CF) were low for both zinc, boron and lead and medium for copper and cobalt at all sites and low to medium with both iron, manganese, chromium and nickel indicating that this contamination is related to human activities. Modified contamination degree (mCd) is moderate to high in some sites. The (PLI) is generally high (> 1) in all sites; exception one site. The (PLI) was low (< 1) in some sites in winter.

Key words: El-Mariouteya canal, low quality water, risks assessment, bio-accumulation, soil, plant and pollution.

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1. INTRODUCTION

The reuse of water or low quality water became a part of the extension programme for maximizing the use of water resources. However, the uncontrolled application of such water must have many unfavorable effects on both soils and plants grown especially on the long-term use. The hazardous effects are mainly related to the soil properties and water quality, besides the types of growing crops (**Elgala *et al.*, 2003)**.

The implications associated with heavy metals contamination have considered one of a serious environmental pollutant. It was said that heavy metals in most cases are accumulated in the crop, and could adversely affect consumers feeding on these crops **(FAO. 1992)**. Also vegetables are known to be good absorber of heavy metals from the soil **(Haiyan and Stuanes, 2003)**. The danger lies in its ability to accumulate in the bodies of local residents. Human and animal need a certain percentage of these elements that might happen on the part of the plant through the food chain **(Mohammadi *et al.*, 2014)**. The accumulation of heavy metals and metalloids in agricultural soils is of increasing concern due to the food safety issues and potential health risks as well as its detrimental effects on soil ecosystems. The increase in concentration is a result of vegetables growth in soil contaminated with these elements, owing to geological weathering factors to the soil or as a result of excessive use of fertilizers. Agricultural chemicals, laboratories and factories residues and sewage are often the pollutant source of irrigation water **(Mohammadi *et al.*, 2014)**. Currently, there are more area of agricultural land in the world are using untreated wastewater for

irrigation due to lack of water. Also **FAO (1992)** reported that surveys of wastewater use have shown that more than 85% of the applied heavy metals are likely to accumulate in the soil, most at the surface. Consequently, wastewater treatment plants will pose additional risks to public health. Research and studies conducted on vegetable farms irrigated with wastewater and contaminated water demonstrated that this vegetable contains substantial concentrations of heavy elements that make them unfit for consumption **(Duncan *et al.*, 2007)**.

The occurrence of heavy metals in the environment results primarily from anthropogenic activities. Also, natural processes, such as weathering of rocks and volcanic activities, play a significant role in their enrichment in water bodies **(Forstner and Wittmann, 1983)**. The aquatic environment has been reported as one of the most sensitive environments to the negative effects of heavy metal pollution. This is attributed to direct and prolonged contact between aquatic organisms and soluble metals in these environments **(Ghadimi *et al.*, 2013)**.

Bottom sediments have always contained some level of metals due to the natural pathways of elements in the environment. Therefore, it is not the mere presence of heavy metals in sediments, but their enrichment above natural levels that indicates pollution and a threat to the environment **(Olatunde *et al.*, 2014)**.

Long term wastewater irrigation may lead to accumulation of trace elements in agricultural soils and plants. Food safety issues and potential health risks make this as one of the most serious environmental concerns **(Cui *et al.*, 2004)**.

Contamination of vegetables with heavy metals may be due to irrigation with water contaminated by industrial and domestic wastes, the addition of fertilizer and pesticides, as well as from deposits on different parts of the vegetables exposed to the air from polluted environments. In general, the application of wastewater led to changes in the physicochemical characteristics of soil and consequently heavy metal uptake by vegetables **(Sharma *et al.*, 2007 and Akan *et al.*, 2009)**.

Therefore, the present study has been undertaken to identify the sources of pollution of waterways, environmental assessment for waterways, soil, cultivated plants (fodder crops, cereal crops and vegetables) through mathematical equations in the area west of Cairo and provide recommendations and solutions for protection of the environment from pollution.