A STUDY ON THE IMPACT OF AGRICULTURAL DRAINAGE ON THE PHYSICAL, CHEMICAL AND BACTERIOLOGICAL PROPERTIES OF LAKE QARUN

Submitted By

Mohamed Ahmed Mahmoud Ibrahim

B.Sc. of Science (Geology/Chemistry), Faculty of Science,

Cairo University (Fayoum Branch), 2001

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

Department of Environmental Basic Sciences
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APPROVAL SHEET

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Abstract

The presence of pollutants in the lakes are considered the most common problem facing users. So, the aim of this study was to monitor the physiochemical and bacteriological properties of Qarun lake. It is a closed saline lake in the northern part of El-Fayoum Depression (Middle Egypt) at the margin of the Great Western Desert. During the 20th century, lake water salinity has increased strongly as a result of high evaporation rate, also fish productivity decreased strongly. It receives agricultural and domestic non-treated drainage waters, which are also used for aquaculture in Qarun area. The study aimed to establish the status of the lake and monitored the effect of agricultural drainages and domestic on the concentration of pollutants. The Physiochemical, bacteriological and some heavy metals monitored during the summer of 2017 and winter of 2018 to compare it with the previous results of the lake. The study proved that the lake suffering pollution by heavy metals as Cd^{2+} (0.0034mg/l), Zn^{2+} (1.091mg/l) at Al-Bats drain, NH_3 (0.58 mg/l), $PO4^{3-}$(1.38mg/l), COD (292mg/l) and BOD (71mg/l) at Al-Wadi drain. Therefore, it is necessary to put an environmental policy to control this pollution.

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List of Abbreviation

Acronym	Definition
AAS	Atomic Absorption Spectrophotometer
APHA	American Public Health Authority
AWWA	American Water Works Authority
BOD	Biological oxygen demand
COD	Chemical oxygen demand
Cf	Contamination factor
DO	Dissolved Oxygen
EC	Electrical Conductivity
EEAA	Egyptian Environmental Affairs Agency
EMISAL	The Egyptian Company for Salts and Mineral
ERL	Effects Range Low
ERM	Effects Range Median
FAO	Food and Agriculture Organization
GC	Gas Chromatography
HI	Hazard Index
HPLC	High Performance Liquid Chromatography
ICPES	Inductively Coupled Plasma-Emission Spectrometry
Igeo	geoaccumulation Index
IFR	Inflow River mouth
MI	Metal Index
MPI	Metal Pollution Index
MPN/100 ml	Multi perhaps number per 100 ml
NOAA	National Oceanic and Atmospheric Administration
OFR	Outflow River mouth
OWA	Open Water Area

PEL	Probable Effect Level
PER	Potential Ecological Risk
PER	Potential Ecological Risk
PI	Pollution Index
PLI	Pollution Load Index
SpC	Specific Conductivity
SQGs	Sediment Quality Guidelines
TCF	Total coliform fecal
TDS	Total Dissolved Solids
TEL	Threshold Effect Levels
TOC	Total Organic Carbon
TSS	Total Suspended Solids
WEF	Water Environment Federation
WEPA	Wadi El-Rayan Protected Area
WHO	World health organization
WQI	Water Quality Index
XRF	X-Ray Fluorescence

Chapter 1

Introduction & Research Objectives

Chapter 1
1. Introduction & Research Objectives

1.1. Introduction:

The aquatic environment with its water quality is considered the main factor controlling the state of health and disease in both cultured and wild fishes. On the other hand, water quality state of a water body depends on a large number of physical, chemical, and biological indicators (Plumb & Hanson 2011). Pollution of the aquatic environment is a serious and growing problem Aquatic organisms, such as fish, accumulate pollutants directly from contaminated water and indirectly via the food chain (Sasaki *et al*., 1997).

Increasing number and amount of industrial, agricultural and commercial chemicals discharged into the aquatic environment having led to various deleterious effects on the aquatic organisms (Ali *et al*., 2008). The aquatic ecosystem has been contaminated with different types of pollutants and the major reasons of this situation are industrial, agricultural and domestic effluents produced by human activities (Paul & Meyer, 2001). The problems of environmental pollution and its deleterious effects on aquatic biota, including fish received focused interest during the last decades. Lake Qarun is one of the oldest lakes in Egypt and was known to the ancient Egyptians by the Sea of Morris (the Great Lake). The third largest lake in Egypt, located in Fayoum on the edge of the Western Desert about 90 km south of Cairo. Fayoum is not far from the Nile Valley, it is one of the most important natural monuments in Egypt and a resource has helped to support human culture for 8000 years. The lake receives sewage and agricultural water through a system of twelve drains. Most of the wastewater reach the lake through

two main drains, Al-Batts and Al-Wadi, while there are small drains pouring sewage in the lake by hydraulic pumps but small amounts (Fathi & Flower, 2005).Lake Qarun is a closed saline basin lying in the lowest north west part of El-Fayoum depression, between longitudes 30^{o} $24^{'}$ and 30^{o} $50^{'}$ E and latitudes 29^{o} $24^{'}$ and 29^{o} 33' N. It has an elongated rectangular shape with average dimensions 45 km length, 5.7 km width and 4.2 m depth in average. The main water sources in the lake are also from agricultural drainage and domestic wastewater (Abdel-Satar *et al*., 2010). Therefore, increases salinity gradually which greatly affects living organisms in the lake, in addition to aggravation enrich the lake water caused by it load of nutrients from agricultural wastewater (Ibrahim & Ramzy, 2013). Lake Qarun works as a store for agricultural water and sewage in Fayoum governorate. It receives agricultural drainage water constantly, controlling the area and volume (Mahmoud, 2015). Lake Qarun receiving about 450 million cubic meters annually of agricultural drainage water, which is almost reserves of lost lake water per year evaporation, leading to a gradual increase in salinity and adverse effects on the lake environment, for example, it animals and plants (Fadel, 2014). The lake received about 226.3 and 100.84 million cubic meters of sewage from Al-Wadi and Al-Batts drainages, respectively (El-Sherif *et al.*, 2016). Lake Qarun is under severe environmental pressure and as a result of extensive evaporation of water from such closed ecosystem, the accumulation of chemical pollutants (heavy metals, pesticides and other pollutants) is expected to increase annually in all its components (e.g. water, sediment and fish) and to change their quality and affect their aquatic life (Mansour & Sidky, 2002).

Previous studies reported that Lake Qarun components are polluted with heavy metals (Ali & Fishar, 2005). Investigation of heavy metals in sediments of aquatic ecosystems is an essential requirement in order to