Multipurpose Development of the Eastern Nile, One System Inventory Environmental Report of Egypt

ENTRO

(Eastern Nile Technical Regional Office)

By. Dr.Rifaat Abdel Wahaab
National Research Center
Cairo, Egypt .
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Table of Contents

Table of Contents
(Continued)

Page

Table of Contents
(Continued)

Page

List Acronyms

AHD	Aswan High Dam
BCM	Billion Cubic Meters
BOD	Biochemical Oxygen Demand
CAP	Compliance Action Plan
CAPMAS	Central Agency for Public Mobilization and Statistics
CIDA	Canadian International Development Agency
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
DRI	Drainage Research Institute (NWRC)
EEAA	Egypt's Environmental Affairs Agency
EEIS	Egypt Environmental Information System (a CIDA project at EEAA)
EHD	Environmental Health Department (MOHP)
EIA	Environmental Impact Assessment
EIMP	Environmental Information and Monitoring Program
EMUs	Environmental Management Units
EOHC	Environmental and Occupational Health Center (MOHP)
ERC	Environmental Research Council
FAO	Food and Agriculture Organization of the United Nations
FC	Fecal Coliforms
GOE	Government of Egypt
GOFI	General Organization for Industrialization
HAD	High Aswan Dam
IIP	Irrigation Improvement Project
IPM	Integrated Pest Conrol
LCD	Liters per Capita per Day
MALR	Ministry of Agriculture and Land Reclamation
MSEA	Ministry of State for Environmental Affairs
MOHP	Ministry of Health and Population
MHUNC	Ministry of Housing, Utilities and New Communications
MOI	Ministry of Industry
MWRI	Ministry of Water Resources and Irrigation (previously MPWWR)
NAWQAM	National Water Quality and Availability Management (CIDA project)
NEAP	National Environmental Action Plan
NOPWASD	National Organization for Potable Water and Sanitary Drainage (MHUNC)
NRI	Nile Research Institute, NWRC (previously known as: HADSERI)
NWRC	National Water Research Center, MWRI
NWRP	National Water Resources Plan
PPM	Parts Per Million
PRIDE	Project in Development and the Environment (USAID)

RIGW	Research Institute for Groundwater (NWRC)
TDS	Total Dissolved Solids
TSP	Total Suspended Particles
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
VOC	Volatile Organic Compounds
WHO	World Health Organization
WPAU	Water Policy Advisory Unit (MWRI)
WWTP	Wastewater Treatment Plant

Executive Summary

The purpose of this report is to provide the available information and data on the following environmental aspects: 1) policy and legislative framework; 2) institutional assessment and knowledge, 3) environmental baseline data to cover river Nile system pollution status, sources and describe their environmental impacts; 4) soil, geomorphology and climatically data; 5) comments on data quality and identify gaps for future considerations.

Water Policy and Institutional Responsibilities

The growing populations of Egypt and related industrial and agricultural activities have increased the demand for water to a level that reaches the limits of the available supply. The population of Egypt has been growing in the last 25 years from a mere 38 million in the year 1977 to 66 million in 2002 and is expected to grow to 83 million in the year 2017. The present population of Egypt is strongly concentrated in the Nile Valley and the Delta: 97% of the population lives on 4% of the land of Egypt. To relieve the pressure on the Nile Valley and Delta, the government has embarked on an ambitious programme to increase the inhabited area in Egypt by means of horizontal expansion projects in agriculture and the creation of new industrial areas and cities in the desert. All these developments require water.

The Ministry of Water Resources and Irrigation (MWRI) has prepared a National Water Policy till the year 2017 including three main themes:

- optimal use of available water resources;
- development of water resources; and
- protection of water quality and pollution abatement.

Based on the national policy all ministries have developed their own sector oriented policies and strategies. The goals and objectives for those sectors that are related to water resources management can broadly be described as follows:

- ***MWRI*****:** reach best possible benefits of available water resources in terms of the supply of good drinking water, the support of the development in various economic sectors and the protection of the inland aquatic environment.
- ***MALR*****:** to improve food security and increase national agricultural production through maximizing the net return per unit of water.
- ***(MHUNC),*** **in particular** ***NOPWASD*****:** provide sufficient drinking water of good quality to the population and to treat the municipal wastewater in such a way that the discharge of the effluent does not pose any health and environmental risk.

Several other Ministries have a more indirect role, e.g. with respect to law development and enforcement, and monitoring and inspection. The most important are: ***MoE(EEAA), MoHP, MoI(GOFI), MoT, MoLD, MEE,*** and ***MoP.***

Legislative Aspects

To date, legislative inputs for pollution control have been largely fragmented, cutting across different line ministries and specialized government agencies with no clear responsibilities for enforcement. A notable exception is Law 48/1948. Obviously, none of the applicable laws are enforced, and the factual pollution control is essentially non-existent. There are several apparent reasons for this, the most significant being the government's failure to take environmental action seriously and to insist on implementation of the existing laws. This attitude is now changing; the organization assigned the rule of supervising the enforcers is EEAA. This is a step forward, although EEAA may lack the expertise to carry out this function.

Water Quality & Monitoring Activities

Water quality problems in Egypt vary among various water bodies depending on: flow, pattern of use, population density, extent of industrialization, availability of sanitation systems and the social and economic conditions. Discharge of untreated, or partially treated, industrial and domestic wastewater, leaching of pesticides and residues of fertilizer and navigation are often factors that affect the quality of water. Therefore, preserving the good quality of water is the major environmental challenge in Egypt.

Given what appears to be considerable activity in collecting and analyzing data relevant to water quality monitoring, very few data are available, and organizations essentially do not communicate on data collection program, analytical protocols, or data sharing!.

River Nile from Aswan to Delta Barrage

Available information indicates that the river Nile is subjected to several sources of pollution. Most of the town and many of industries are discharging wastewater into drains which ultimately discharge into the Nile. Aside from the drains, there are also industries discharging effluent directly into the river Nile. Another serious sources of pollution is the uncontrolled use of pesticides and fertilizers, which results in residues seeping from the soil to the irrigation water, into the drains, and finally into the Nile.

Monitoring results have indicated slight increase in organic substances above usual limits at some monitoring points in Aswan during certain months represented by Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), distinctively at the meeting point of Khor Elseil (flood catchments) drain and Kom Umbo Sugar Factory drain with the Nile. However, it was noticed an increase in suspended substances at some points above approved limits which may be due to the existence of cultivation, Kom Umbo Sugar Factory, Edfo Sugar Factory, and sanitary drainage from some villages, towns and floating hotels. As a reference, a monitoring site at Nasser Lake has been chosen.

It is worth mentioning however that , the water quality of the river Nile segment from Aswan to Delta barrage is good, indicating the continued high self-assimilation capacity of the Nile.

Rosetta and Damietta Branches

In the Nile branches the water quality deteriorates in a northward direction due to disposal of municipal and industrial effluents and agricultural drainage as well as decreasing flow. The Rosetta branch receives high oil and grease loadings, nutrients, organic loads, and solids. This is a result of discharging a part of the wastewater of Greater Cairo through the Muheet / Rahawy drain as well as discharges of pesticides and toxic chemicals from other sources. Also, salts, suspended matter and herbicide residues reach the river from agricultural drains.

The organic load depresses the DO in Rosetta branch to 4 mg/l or less during the winter closure period.

The Damietta Branch receives nutrients and organic loads, as a result of discharges from the Talkha fertilizer industry and drainage of herbicides and pesticides from agricultural drains agricultural drains especially near the Faraskour dam. The drainage at Meet Al-Kholei village also receives sewage water that population residing in this area disposes. This sewage water finally discharges in the Damietta branch. TDS increases in the branches up to approximately 500 mg/l.
Fecal coliforms counts exceeded the WHO Guidelines in both Damietta and Rosetta branch which strongly proves the discharge of untreated or partially treated human wastes, directly or indirectly. Special attention must be strictly directed to El-Serw drain in Delta to avoid future contamination to Al-Salam canal. For both Dammitta and Rosetta branches, water enters the branches from the Nile with good quality and then it deteriorates downstream the branch till it become in the medium condition. The extremely low flow condition, which occurs during low demand wintertime, in addition to discharging wastes from different pollution source along the branch can explain changes in water quality along the branches.

Northern Lakes
Two of the Northern lakes, Maryut and Manzala, are polluted by inflow from sanitary and industrial wastes carried in the agriculture drains and by discharge of these wastes directly into the lakes. Lake Maryut is reported to be more saline than lake Manzala and to have some concentrations of heavy metals, an appreciable organic loading, and a very high coliform level

1.0. Introduction

1.1. Overview
Governments all over the world pay more and more attention to fresh water resources because these either become increasingly scarce or they are a threat due to flooding. At the same time there is a growing awareness that the quality of water resources should be protected. Water of good quality and without risks for public health is nowadays considered to be a major asset.

In this field, Egypt has its own particular position. It covers a very arid region situated between the Sahara and Arabian deserts. Egypt is extremely dependent on the River Nile, being the most downstream country in the Nile basin. This makes co-operation with other Nile basin countries indispensable. The country hardly has any other fresh water resources. Rainfall is very rare, except for a very small strip along the coast of the Mediterranean. Fossil groundwater is available in parts of the Western and Eastern Deserts and the Sinai.

Egypt, being the most downstream country of the river Nile, will be influenced by developments upstream, in particular in *Sudan and Ethiopia*. Co-operation with Nile Basin countries is needed to ensure an equitable development of the Nile Basin as a whole. Egypt has a major interest in this co-operation. Many opportunities exist for the further development of the Nile water resources system, among others resulting in more water available for the riparian countries.

To undertake the necessary actions and to identify and prepare a major initial project, the Eastern Nile Council of Ministers (ENCOM) at their meeting in Alexandria, on Feb., 2005 instructed the Eastern Nile Technical Office (ENTRO) to prepare inventories containing information on the *Water Resources, Environmental, Socio-economic* and related issues for the Eastern Nile. These inventories will be compiled into 'one system inventory' to provide the 1st 'no borders' overview of the Eastern Nile.

1.2. Purpose of the Report
The purpose of this report is to compile essential baseline information on environment and highlight major related issues in Egypt namely: environmental regulatory and institutional setting, environmental baseline, soils, climatically data and maps indicating land use & land cover.
It is also aimed to include data/information gathered and comments on data quality and annotated list of references.

1.3. Composition and the Contents of this Report
This report presents information on the Environment of the Country in the following arrangement:
-Water Policy
-Environmental Legislation and Institutional Framework
-Water Quality & Monitoring
-Northern Lakes

2.0. Water Policy

The Ministry of Water Resources and Irrigation (MWRI) has prepared a National Water Policy till the year 2017 including three main themes:

- optimal use of available water resources;
- development of water resources; and
- protection of water quality and pollution abatement.

At present, Egypt is addressing the issue of limited water quantity by managing the demand side. MWRI formulated a water master plan in 1981. This plan is currently updated. The process of updating the water master plan aims to allocate available water resources according to various needs and demands that are feasible from the economic perspective. It also aims to gain social acceptance and political support. The Water Master Plan is updated through the National Water Resources Plan (NWRP) project.

The NWRP has been operated since 1998 and jointly funded between MWRI and the Netherlands Government. This project is directed towards developing a National Water Resources Plan that describes how Egypt will safeguard its water resources both quantity and quality and how it will optimize the use these resources in response to the socio-economic and environmental conditions.

2.1. Optimal use of available water resources

In the mean time, the government of Egypt intends to reclaim an area of 3.4 million acre to increase the current 8.0 million acre of agriculture land. To implement these ambitious policy themes, MWRI has embarked on several programs including the improvement of the irrigation systems on the level of branch and field canal in an area of around 400,000 acre in the old land. It is expected that this outcome of this program will help saving the irrigation water by 5-10 percent. Also, Installation of the Nile drainage systems in an area of five million acre and rehabilitation of old drainage network in another 1.5 million acre. This would leach salt from the soil profile and improve the soil fertility. Other programs are the rehabilitation of irrigation and drainage pumping stations Introducing new crop varieties as early mature and salt tolerant; and replacing and rehabiliting the existing grand barrages and structure on the Nile and main canals. The following is the set of proposed strategies to achieve optimum use of all the available water resources.

2.1.1. Minimize water loses

The main proposed actions to minimize water losses are as follows:

- Use of pipelines to transfer water in the new land especially at the locations of high porosity soils.
- Gradual expansion of groundwater wells for use as a secondary source of water on the farm level to decrease conveyance losses in third order canals.
- Replacement of the level-based water distribution system to the flow-based water distribution system through calibration of control structures.
- Introduction of new technologies for canal maintenance and weed resistance.
- Improvement of the River Nile navigation path and facilities to reduce and eliminate the additional amount of water that is released for that purpose during the winter season.

2.1.2. Irrigation improvement project

The main objective of the irrigation improvement project in the old land is to improve the efficiency of water use at the *mesqa* and farm levels. It also initiates the user participation in the operation and maintenance of the irrigation system.

The framework of the irrigation improvement project in Egypt includes rehabilitation and renewal of water structures, use of pipeline and raised *mesqas*, use of one point collective pumping from branch canal into *mesqas*, and land leveling using modern techniques. Other actions include redesign of the field irrigation systems. It is crucial in that regard to consider the formulation of water user associations that reflects the new vision for the water distribution management process.

2.1.3. Cropping pattern shifts

The following policies are proposed to reduce agriculture water consumption:

- Gradual Replacement of sugar factories with sugar beat factories, as they were designed to process sugarcane.
- Reduce rice cultivated area to about 900,000 or one million feddans which should be sufficient to satisfy national demand, provide some potential for export, and prevent soil salinization and seawater intrusion.
- Replace currently used varieties of rice with the new shorter-life rice varieties, which have higher productivity, and require less water due to their shorter growing season.
- Develop new crop varieties using genetic engineering that have higher productivity and less water consumption and salt tolerant.
- Design an indicative cropping pattern for each region in the country based on climatologically conditions, soil characteristics, and water resources availability in terms of quantity and quality. Farmers could be advised to follow the indicative cropping pattern or pay for excess water if they deviate.

2.1.4. Groundwater development strategies

The groundwater policy aims to encourage agricultural development of desert areas. These areas will be the basis for initiating new communities that can absorb part of the highly concentrated population in the Nile valley and Delta. The expected increase in the future demands for groundwater requires continuous monitoring and evaluation of the groundwater aquifers to avoid any possible deterioration in these aquifers due to miss or over use.

The groundwater in the Nile valley and Delta region cannot be considered an independent resource as it gets recharged only from seepage losses, the River Nile canal and drainage networks; and from deep percolation losses of irrigated land. The strategy of groundwater depends on the conjunctive use of Nile surface and groundwater through:

- Utilization of the aquifer as a storage reservoir used to supplement surface water supply during peak periods and recharged during the minimum demand periods.
- Use the vertical wells drainage system in Upper Egypt to prevent the groundwater table from reaching the root zone avoiding water logging and increasing productivity.
- Groundwater could be used as a source of water for fish farms as it has consistent and steady temperature and good quality.

- Augment the canal water supply by pumping groundwater from low capacity private wells at tail ends of long *mesqas* where water shortage is experienced.

Groundwater in parts of the Western Desert and Sinai is very deep and this needs huge investments to be utilized. Therefore, future strategies for best utilizing groundwater in the Western desert and Sinai include:

- Use of the modern technologies for determining the main characteristics of each aquifer, its maximum capacity and safe yield. This data should be the basic criteria for selecting the most suitable projects that could use such aquifers as a sustainable source of water.
- Use of non-conventional sources of energy, such as solar and wind energy to minimize the costs of pumping.
- Use of new technologies for farm irrigation in desert areas to minimize field losses especially deep percolation due, in part, to the high porosity of such soils.

2.1.5.Reuse of agricultural drainage water

MWRI is considering drainage water reuse as a main source to meet part of the irrigation water demands. The reuse of drainage water increases the overall efficiency of the water system; but it must be regulated to prevent future environmental impacts. Future strategies for drainage water reuse are as follows:

- Increase the amount of drainage water reuse from about 5.0 BCM/ year in the year 2000 to around 9.0 BCM/year by year 2017 with average salinity about 1170 ppm. This could be achieved through implementing several projects to expand the reuse capacity at different areas. Main future projects include El-Salam canal project, El-Umoum Drain project, and El-Batts Drain project.
- Establish an integrated information system for water quality monitoring in drains using the existing data collection network.
- Continuous monitoring and evaluation of the environmental impacts due to the implementation of drainage water reuse policy especially on soil characteristics, cultivated crops, and health conditions.

2.1.6. Reuse of sewage water

The MWRI future policy for utilization of such source could be summarized as follows:

- Increase the amount of secondarily treated wastewater use from 0.26 to 2.8 BCM/year by year 2002 and to 4.5 BCM/year by year 2017.
- Limit the use of treated wastewater to cultivate non-eatable crops, such as cotton and flax.
- Separate industrial wastewater from domestic sewage, so that it would be easier to treat domestic sewage with minimum costs and avoid the intensive chemical treatment needed for industrial wastewater.

2.2. Water resources development

MWRI is investigating the possibilities of developing new water resources or increasing the availability of existing resources to meet future increasing demands. In that regard, the future water policy for Egypt will include the following strategies:

2.2.1. Increase Egypt's share of the Nile water

Almost 85 percent of the Nile water originates from the Ethiopian highland through the Sobat River, the Blue River Nile, and the Attbara River. The rest originates from the Equatorial Lakes

Plateau through Bahr El-Ghabal. A very small portion comes from Western Sudan through Bahr El-Ghazal. According to the Nile water treaty with Sudan, Egypt's share of the water was fixed at 55.5 BCM/year by the 1959.

Bilateral cooperation with the River riparian started through joint agreements to develop the River-shared resources. Studies clarified that large amounts of Nile water is lost before it reaches Aswan. Accordingly, there is a modest potential to decrease these losses through implementing joint projects with other countries in the Nile basin. Three projects had been identified, namely, Jongli Canal, Bahr El-Ghazal, and Mashar Marshes projects, which will add about 9 BCM/year to Egypt's share of Nile water. However, the MWRI does not entirely depend on these projects, as they will be implemented outside the borders of the country and require great efforts in the sphere of political negotiation and cooperation among the countries of the River Nile.

Since the cooperative development holds the greatest prospect of bringing mutual benefits to the region, the Nile riparian, including Egypt, has taken a historic step in the establishment of the Nile Basin Initiative (NBI). The Council of Ministers of Water Affairs of the Nile Basin States formally launched the Initiative in February 1999. The initiative includes all Nile countries; and provides an agreed basin-wide framework to fight poverty and promote socio-economic development in the region. The Nile countries seek to realize their shared vision through a Strategic Action Program, comprising basin-wide projects, as well as sub-basin joint investment projects. The basin-wide Shared Vision Program, a broad based program of collaborative action aims at exchanging experience and promoting capacity building activities. At the same time, group of other countries, one in the Eastern Nile and another in the Nile Equatorial Lakes region, have identified joint, mutually beneficial investment opportunities at the sub-basin level.

2.2.2. Desalination of Brackish water

The MWRI is looking for the utilization of the low salinity brackish groundwater in irrigating certain seasonal crops. This amount of water is available at shallow depths in the Western and Eastern Deserts and at the borders of the Nile valley. The average salinity of such water varies from 3000 to 12000 ppm. The future strategy of the MWRI in that regard takes the following into consideration:

- This source of water can be considered an independent resource that can be used as a supplementary water supply source to meet part of the water demands in desert areas, specially near to the northern shoreline. The level of treatment of this water will depend on the type of use whether it will be for municipal or agriculture needs. This amount of water could be used with minimum treatment to irrigate certain perennial or seasonal crops.
- Non-conventional sources of energy, such as solar and wind energies could be used in the treatment process to minimize the cost and increase its economic value.
- This source will be used as a supplementary source to rainfall water to increase land productivity by cultivating two crops per year instead of one.

2.2.3. Harvesting of rainfall and flash floods water

Studies indicate the possibility to conserve about 2.0 BCM/year from flash floods. MWRI considers the flash flood on the top priorities of the national agenda, because of its economic benefits and negative social impacts. The future strategies of the MWRI for flash flood risk assessment and utilization considers the following:

- Use of modern technology in remote sensing areas and GIS to examine the basic characteristics of the stream network that contribute to flash floods.

- Adjust High Aswan Dam daily release during the occurrence of flash floods over a certain area that drains its water to the River Nile.
- Avoid hazards from flash floods by designing risk zone maps for major bottlenecks on the basin streamlines. Furthermore, identify areas that lie in risk zones to take proper precautions to avoid any possible hazards.

2.3. Water quality protection and pollution abatement

2.3.1. Policy theme

The policy theme is realized through preventive measures and long-term policies. The preventive measures are carried out through the regular assessment of the water quality status and suitability for various uses. Moreover preventive measures include enforcement of laws to protect water resources from pollution. The Ministry of Water Resources and Irrigation formulated a National Program for Water Quality Monitoring in the Nile, canals and drains and Lake Nasser. The Central Laboratory carries out the substantial lab work for Environmental Quality Management affiliated to National Water Research Center. The monitoring program includes 300 locations for surface water and 230 locations for groundwater. The long term policies to control pollution include covering open conveyance system passing through urban system to closed conduits; coordinating with other concerned ministries to set priorities for wastewater treatment plants due to budget limitation; introducing environmentally safe weed control methods either mechanical, biological or manual and banning the use of chemical herbicides. Subsidies on fertilizers and pesticides were removed and some long lasting effect agricultural chemicals were also banned. Public awareness programs are introduced to promote the issue of conserving Egypt's water resources in terms of quality and quantity.

2.3.2. Water quality management

As the quality of water gets worse, its scope of use narrows, reducing supplies and intensifying shortages. The MWRI in coordination with the other concerned ministries and authorities are implementing a long-term strategy for preventing pollutants from discharging to the Nile and other water bodies. The implementation of this strategy requires a comprehensive database that includes maps, and also an electronic database, a design for landfill sites based on sound hydro geologic information and impact assessment. The MWRI will establish a Water Quality Management Unit in co-operation with the Netherlands Government. The objectives of this unit are as follows:

- to co-ordinate between all related activities within the Ministry and its research institutes and the executive departments and authorities;
- to develop and execute training packages;
- to develop public awareness campaigns directed to other governmental sectors, stakeholders and the public;
- to develop strategic water quality plans on the regional and national level in cooperation with other ministries and stakeholders;
- to develop water quality database.

Other major project implemented by the MWRI is the National Water Quality and Availability Management (NAWQAM) project. This project is directed towards developing a coordinated national system for sustainable water resources management in Egypt. The Egyptian institutions, in particular the MWRI have the capacity to manage water resources from a national perspective through the participation of other stakeholders and the usage of collaborative techniques. This includes the following activities:

- Building the MWRI capacity to prepare sustainable and comprehensive environmental analysis with regard to water quality and availability.
- Developing the management and professional capacity of organizations working in the issue of water quality and availability to effectively prepare policy options, make operational decisions based on improved "national level" data, and incorporate environmental analysis.
- Rationalizing water quality monitoring activities in a sustainable manner.
- Utilizing applied research and pilot projects to prepare guidelines towards implementing national strategies and action plans.

Groundwater quality management and protection in general is a complex task. Its complexity is rising from its multi-disciplinary institutional and regulatory requirements, socio-economic impacts, as well as its technical requirements. In Egypt, the protection efforts were ignored for many reasons; nevertheless, the issue has attracted the attention since the beginning of the 1990's. Since then efforts of protecting groundwater have been gaining momentum. During this period many actions were taken under the broad umbrella of groundwater protection. Among these actions two steps were achieved by the end of the 1990s, which are major milestones in the direction of protecting the groundwater. Those are the establishment of the Groundwater Sector (GWS) with the mandate of protecting groundwater resources; and the preparation of the conceptual and technical frameworks for protecting groundwater by the Research Institute for Groundwater (RIGW) in cooperation with the UNDP and UNESCO.

2.3.3. Economic instruments

Some implemented and suggested economic instruments include:

- Encouraging private sector participation of in the environmental management through financial packages for industrial compliance.
- Adopting the polluter pay principle.
- Introducing incentives and tax exemption for promoting the adoption of clean technologies.
- Removing of subsidies for agrochemicals.
- Encouraging recycling efforts through the deposit recycling schemes, tax incentives for recycled material, grants and loans for recycling industries and reduction of custom tariffs on recycled raw material.
- Reducing fresh water pollution resulting from industrial effluents through effluent charges, soft loans, and grants to finance the purchase of wastewater treatment equipment and tradable emission permits.

2.3.4. Coastal Lakes Management

Degradation of the water quality of Egyptian lakes is due, in part, to the uncontrolled discharge of human, industrial and agricultural wastewater. Fish production from the lakes along the Mediterranean coastal plain is estimated to be about 38 percent of the total fish production. The primary water concern is to prevent the water quality from deteriorating to the point of threatening fisheries production. Most vulnerable are the brackish Northern Coastal Lakes, where they are located at the end of the Nile system and have been exposed to changes in salinity. In

addition, these lakes are losing their attraction as recreational resorts. These circumstances negatively affect the livelihoods of the population who depend on these lakes.
The Ministry of Water Resources and Irrigation and the EEAA have developed a program listed in National Strategy for Lakes rehabilitation and conservation with the full support of the communities living around these lakes. The activities of this program are to design and implement a monitoring program and to identify and control sources of pollution.

2.3.5. Coastal Water Management Scheme

The MWRI developed a sustainable management scheme for coastal waters in Egypt. An integrated plan for managing and protecting coastal water quality is the output of this program.
The expected results of implementing this plan are improved water quality that will have positive economic and financial returns on the cost of the program formulation and implementation. The activities of this scheme include:

- Update and extend existing contingency plans.
- In collaboration with relevant authorities, develop a system to control sources of pollution.
- Set criteria for brine disposal to the marine environment.
- Support wider ratification and implementation of relevant shipping conventions and protocol.

2.3.6. Drinking Water

Water losses

One of the major problems in potable water supply is the estimated 50 percent loss of water in the distribution networks. This problem costs the Government a huge amount of money every year. The annual amount of lost water in networks is estimated at 2.95 BCM. If the estimated cost of operation and maintenance for one cubic meter is L.E. 0.45, the annual wasted fund is almost L.E. 1.3 billion. This amount is equivalent to the total annual investment of the National Organization for Potable Water, And Sanitation Drainage (NOPWASD).

Poor quality of drinking water

Poor quality of drinking water is a concern in many parts of Egypt. This is due, in part, to the fact that sources of raw water for many areas have become increasingly polluted, and therefore require more sophisticated treatment to produce drinking water of adequate quality. Furthermore, water treatment units are not always functioning properly as a result of lacking maintenance and proper operation. Even when water treatment is satisfactory, drinking water is sometimes contaminated in leaking distribution network, which are infiltrated for example by sewage. Rooftop water storage tanks have also been identified as another source of bacterial contamination of drinking water.

High domestic water consumption

Water has traditionally been viewed as a free commodity in Egypt. Government subsidies encourage wasteful practices. The price of water does not reflect the actual cost for providing it. Therefore, there has been no strong incentive for consumers to use water rationally and consequently the per capita water consumption is high, especially in areas where the water supply systems are well functioning.

The general policy of the government of Egypt with regard to the water supply sub-sector is to increase the efficiency of water utilities and shift from service beneficiaries to utility income. In order to achieve this target we need to establish a database for the uncovered areas. This will help planning for the full coverage with safe drinking water to all rural and urban formal and informal settlements.

2.3.7. Water Quality Management Program

The Ministry of Water Resources and Irrigation has developed a program that aims to improve the quality of drinking water in Egypt. This program will minimize the potential health hazards resulting from water borne diseases. The program can generate financial returns plus its economic impact on the Egyptian society. The activities of this program will be as follows:

- To provide uncovered areas with safe drinking water.
- To develop an alternative system for production and distribution of drinking water employing user pay principle.
- To evaluate the use of compact systems.
- To develop appropriate systems for iron and manganese removal.
- To develop appropriate systems for micro-pollutants removal.
- To provide technical support for institutional structure.
- To develop training programs on operation, maintenance, analysis and record keeping, etc.

Enhancing the performance of treatment and distribution systems is an expected outcome of this program. Full coverage with safe drinking water will be achieved according to GOE plans.

2.3.8.Wastewater Management

2.3.8.1. Domestic wastewater

The total amount of domestic wastewater has been estimated at 3.6 BCM for the year 1995/96. Approximately 24 percent of the population of Egypt is connected to sewerage services, however this value is expected to grow rapidly, due to works under construction. The population without connection to sewerage systems relies on individual means of treatment and disposal, mainly on-site treatment such as septic tanks. Often on-site solutions are ill designed and poorly maintained. There is, however, little information available to support this argument.

An assessment of water quality in Egypt indicated that the major water quality problems are pathogenic bacteria/parasites; heavy metals and pesticides. Major sources of these pollutants are the uncontrolled discharge of human, industrial and agricultural wastes.

2.3.8.2. Agriculture Wastewater

Agriculture is also a major water polluter. Wastewater seeping from agriculture fields is considered non-point sources of pollution. These non-point sources are, however, concentrated through collecting agricultural drains from point sources of pollution for the River Nile, the Northern Lakes or irrigation canals in case of mixing water for reuse.

Moreover, these non-point sources of pollution may also influence the groundwater quality. Major pollutants in agricultural drains are salts; nutrients (phosphorus and nitrogen); pesticide residues (from irrigated fields), pathogens (from wastewater), and toxic organic and inorganic pollutants (from domestic and industrial sources).

2.3.8.4.Industrial Wastewater

Industrial use of water in Egypt is estimated at 7.5 BCM/year in 1999. The industrial use of water is expected to increase. Consequently, an increase in the volume of effluents is expected. Industrial wastewater contains a variety of toxic organic and inorganic chemicals, which are potential health and environmental hazard.

2.3.9. Sanitation Management Program

The Ministry of Health and Population in collaboration with the Ministry of Housing, Utilities and Urban communities and other local agencies have developed a program to protect the environment and public health through a comprehensive, integrated scheme for wastewater collection and treatment. This program aims mainly to induce institutional reforms that promote the implementation of non-conventional low-cost technology, simplification of procedures, changes in both attitudes and behavior, and participation of major population groups, particularly women. Other objectives include evaluating the environmental health and socio-economic impacts; and determining the socio-economic benefits of sewerage treatment.

The activities of this program include:

- Develop and implement low cost technologies for domestic wastewater treatment taking into account some traditional and indigenous practices.
- Development and implementation of decentralized systems to increase the potentiality for reuse taking into account some traditional and indigenous practices.
- Prepare training packages for engineers, chemists, technical operators, and workers associated with the developed wastewater management activities.
- Devise an equitable system to finance the cost of extending sanitation services to non-served areas, to close the gap between rural and urban areas.
- Strengthen the institutional structure.

The output of this program is serving areas that lack sanitation, thus improving the quality of life. This will have its own economic and financial gains, once a system that deals with sanitation as a revenue generating activity is in gear. The supportive measures for this program include addressing the existing institutional and financial constraints to enhance the inspection authority of the EEAA to ensure the effective implementation of the law.

3.0. Environmental Legislation and Institutional Framework

There is a wide variety of legislation in Egypt for the control of the impact of human activity to minimise its harmful and nuisance impacts on the environment. Thus this environment legislation is concerned with surface water contamination, soil pollution and degradation, air contamination, noise, energy consumption and effects on human beings and other living organisms.
Other legislation is concerned with the impact of the human exploitation of natural resources; the visual effects of building developments and redevelopments; that may harm sites of historic/ architectural / archaeological importance.

A legal basis for controlling water pollution exists through a number of laws and decrees. Law 48/1992 regarding the protection of the river Nile and other waterways from pollution, and Law 4/1994 on Environmental protection are the most important ones and are discussed below.

3.1. Law 48/1982 and Decree 8/1983
Law 48 of 1982 specifically deals with discharges to water bodies. This law prohibits discharge to the river Nile, irrigation canals, drains, lakes and groundwater without a license issued by the MWRI. Licenses can be issued as long as the effluents meet the standards of the laws. The license includes both the quantity and quality that is permitted to be discharged. Discharging without a license can result in a fine. Licenses may be withdrawn in case of failure to immediately reduce discharge, in case of pollution danger, or failure to install appropriate treatment within a period of three months.
Under the law, the Ministry of Interior has police power while the Ministry of Health and Population is the organization responsible to give binding advice on water quality standards and to monitor effluents/discharges. Law 48 does not cover ambient quality monitoring of receiving water bodies although some standards are given.
Law 48 recognizes three categories of water body functions:

- Fresh water bodies for the Nile river and irrigation canals;
- Non-fresh or brackish water bodies for drains, lakes and ponds;
- Groundwater aquifers.

Ambient quality standards are given for potable resources which are intended as raw water supplies for drinking water. The implementing Decree 8 of 1983 specifies the water quality standards for the following categories:
- The Nile river and canals into which discharges are licensed (article 60);
- Treated industrial discharges to the Nile river, canals and groundwater;
  - Upstream the Delta barrages discharging more than 100 m^3/day (article 61);
  - Downstream the Delta barrages discharging more than 100 m^3/day (article 61);
  - Upstream the Delta barrages discharging less than 100 m^3/day (article 62);
  - Downstream the Delta barrages discharging less than 100 m^3/day (article 62);
- Drain waters to be mixed with the Nile river or canal waters (article 65);
- Treated industrial and sanitary waste discharges to drains, lakes and ponds (article 66);
- The drains, lakes and ponds into which discharges are licensed (article 68);

Discharge of treated sanitary effluents to the Nile River and canals is not allowed at all (article 63) and any discharge of sanitary waste into other water bodies should be chlorinated (article 67). The water quality standards are generally based on the drinking water standards and are not linked to all other functions a water body may have. The use of agrochemicals for weed control is also regulated in the law.

3.2. Law 4/1994

Through Law 4 of 1994 the EEAA is the authority responsible for preparing legislation and decrees to protect the environment in Egypt. The agency also has the responsibility for setting standards and for carrying out compliance monitoring. It should participate in the preparation and implementation of the national programme for environmental monitoring and utilization of data (including water quality). The agency is also charged with establishing an "environmental Protection Fund" which would include water quality monitoring.

With respect to the pollution of the water environment, the law states that all provisions of Law 48/1982 are not affected and further, Law 4 only covers coastal and seawater aspects. Nevertheless a number of issues are unclear**:**

- The MWRI remains the responsible authority for water quality and water pollution issues, although the definition of "discharge" in Law 4 specifically includes discharges to the Nile River the waterways. EEAA is responsible for coordinating the pollution monitoring networks.

- In Law 4 it is stated that all facilities discharging to surface water are required to obtain a license and maintain a register indicating the impact of the establishment's activity on the environment. The register should include data on emissions, efficiency and outflow from treatment units and periodic measurements. EEAA will inspect the facilities yearly and follow-up any non-compliance. This provision is confusing or creating duplication because Law 48/1982 also includes certain standards for effluents with MOHP as compliance monitoring organization and only MOHP laboratory results are considered to be official.
- Both laws create funds where fines are collected and which are used to fund monitoring and other activities.

3.3. Responsibilities of Institutions Affecting Water Quality

The institutions involved with water quality management in Egypt are generally line-management ministries with responsibilities in areas that are related to, but not necessarily coincident with, environmental protection. The Ministry of Health and the Ministry of Industry have many other functions, many of which conflict with water quality management. Egypt lacks such a relatively strong central coordinating or managing body, although the Egyptian Environmental Affairs Agency (EEAA) has some of the appropriate rules(coordination, studies and evaluation). Following are discussions of the institutions with major roles in water quality management.

3.3.1. Minister of Water Resources and Irrigation (MWRI)

The MWRI is formulating the national water policy to face the problem of water scarcity and water quality deterioration. The overall policy's objective is to utilize the available conventional and non-conventional water resources to meet the socio-economic and environmental needs of the country. Under law No. 12 of 1984, MWRI retains the overall responsibility for the management of all water resources, including available surface water resources of the Nile system, irrigation water, drainage water and groundwater.

The MWRI is the central institution for water quality management. The main instrument for water quality management is Law 48. The MWRI is responsible to provide suitable water to all users but emphasis is put on irrigation. It has been given authority to issue licenses for domestic and industrial discharges. The responsibility to monitor compliance to these licenses through the analyses of discharges has been delegated to MOHP.

The National Water Research Centre (NWRC) supports the MWRI in its management. Within the NWRC, three institutes are focusing on the Nile, the irrigation and drainage canals and groundwater (NRI, DRI, RIGW). NWRC maintains a national water quality monitoring network and contracts portions of the monitoring activity to these institutes. NWRC also operates a database where all MWRI water quality data is consolidated. NWRC also operates a modern, well equipped water quality laboratory.

3.3.2. Egyptian Environmental Affairs Agency (EEAA)

The central organization for environmental protection is the EEAA. This agency has an advisory task to the Prime Minister and has prepared the National Environmental Action Plan of Egypt 2002/17 (2002). The Minister of State for Environment heads the agency. According to Law 4, it has the enforcing authority with respect to environmental pollution except for fresh water resources. Through Law 48, the MWRI remains the enforcing authority for inland waterways.

The EEAA is establishing an Egyptian environmental information system (EEIS) to give shape to its role as coordinator of environmental monitoring. Moreover, staff is being prepared to enforce environmental impact assessment (EIA). Major industries have been visited in view of their non-compliance with respect to wastewater treatment. Compliance Action Plans (CAP's) are being agreed upon to obtain a grace period for compliance. Additionally EEAA is monitoring waste from Nile ships and is responsible for coastal water monitoring. In cooperation with the MWRI, an action plan was implemented to reduce industrial pollution of the Nile.

3.3.3. Ministry of Health and Population (MOHP)

The MOHP is the main organization charged with safeguarding drinking water quality and is responsible for public health in general. Within the framework of Law 48/1982, this Ministry is involved in standard setting and compliance monitoring of wastewater discharges. The Environmental Health Department (EHD) is responsible for monitoring with respect to potable water resources (Nile River and canals). The MOHP samples and analyses all intakes and treated outflows of drinking water treatment plants. Also water from drinking water production wells is monitored. In case of non-compliance of drinking water quality, especially with respect to bacterial contamination, MOHP takes action.

Within the framework of Law 48 MOHP samples and analyses drain waters to be mixed with irrigation waters, industrial and domestic wastewater treatment plant effluents and wastes discharged from river vessels. In case of non-compliance of discharges, the MWRI generally takes action upon notification from the MOHP.

3.3.4. Ministry of Housing, Utilities and New Communities (MHUNC)

Within the Ministry of Housing, Utilities and New Communities, the National Organization for Potable Water and Sanitary Drainage (NOPWASD) has the responsibility for planning, design and construction of municipal drinking water purification plants, distribution systems, sewage collection systems, and municipal wastewater treatment plants. Once the facilities have been installed, NOPWASD organizes training and then transfers the responsibilities for operation and maintenance to the regional or local authorities.

3.3.5. Ministry of Agriculture and Land Reclamation (MALR)

MALR develops policies related to cropping patterns and farm production. Moreover they are in charge of water distribution at field level and reclamation of new agricultural land. With respect to water quality management issues, their policies on the use and subsidy reduction of fertilizers and pesticides is important. In addition, MALR is responsible for fisheries and fish farms (aquaculture).

The Soil, Water and Environment Research Institute is part of the MALR and is responsible for research on many subjects such as water and soil quality studies on pollution, bioconversion of agricultural wastes, reuse of sewage wastewater for irrigation, saline and saline-alkaline soils, fertilizer and pesticide use and effects.

3.3.6. Ministry of Industry (MOI)

The government has owned the majority of industries in Egypt for many decades. Within the MOI, the General Organization for Industrialization (GOFI) manages the publicly owned facilities. The present government is in the process of privatization of industries. At this moment GOFI still manages approximately 300 industrial facilities. MOI maintains a register of all industries in Egypt including design data related to processes used and quantities of water taken in and discharged by each facility.

3.3.7. Ministry of Higher Education and Scientific Research (MHESR)

Two of the research institutes of the Ministry of Higher Education and Scientific Research (MHESR), namely the National Research Center (NRC) and the National Institute for Oceanography and Fisheries (NIOF), collect samples for specific research projects. Both institutes have modern well-equipped water quality laboratories.

3.3.8. Ministry of Interior

The Ministry of Interior, Egypt's national police force, has for some time maintained the Inland Water Police, a special police force for enforcement of Law 48 and protection of the environment in general. The Inland Water Police provides guidance to citizens and takes enforcement actions for violations of environmental laws. Law 4/1994 provides additional authority for this environmental police force, specifying that the MOW shall form a police force specialized in environmental protection within the Ministry and in its Security Departments in the governorates. (Article 65 of the Executive Regulations).

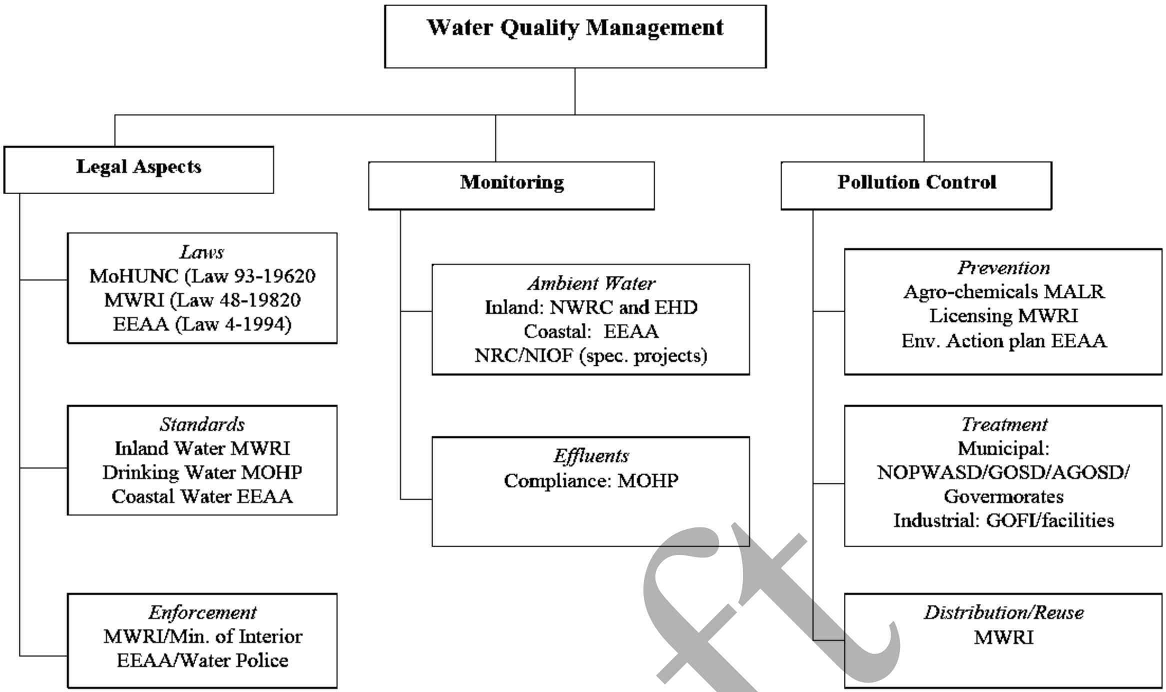
It is worth mentioning that the Egyptian legislation has been concerned with the environmental resources since long time; and has organized the human activities that affect the environment. However, for political and economic reasons it became difficult for the Egyptian legislator to apply these laws and for the citizens to abide with these regulations.

The institutional framework of water quality management in Egypt is summarized in *Figure* (1).

3.3.9. Non-Governmental Organizations

Non-Governmental Organizations (NGOs) in Egypt have an important role to play in contributing to the country's social, economic, and democratic development. In this respect, the Egyptian government has been encouraging and supporting the establishment of various NGOs, especially those working in the fields of environmental awareness and protection. Currently, there are more than 2,000 environmental NGOs in Egypt, some of them are more active than others, but collectively they play an indispensable role in raising public awareness towards environmental issues, and in conducting environmental protection and conservation activities *(Annex 1).*

FIGURE 1: INSTITUTIONAL FRAMEWORK OF WATER MANAGEMENT IN EGYPT



SOURCE: National Water Resources Plan for Egypt, Technical Report No. 5

3.4. Gaps and Overlaps in the Legislative Framework

Various aspects of environmental protection were addressed before Law 4/94. These were traditional regulatory measures that focused on end-of-pipe controls implemented through command-and-control regulations. Not surprisingly the result is piecemeal, leaving gaps and causing overlaps. Law 4/94 was a step towards introducing more flexible and more effective tools for dealing with environmental problems. The source of institutional overlap between ministries and agencies involved with environmental issues lies with the originating legislation.

3.5. Compliance with Environmental Laws and Regulations

The environmental laws that are regulating the environment in Egypt include penalties to those who do not abide with the law. These penalties may tackle the form of restricting the freedom of the citizens who break the law or charge financial fines. Enforcing environmental law is done through specified responsible agencies. Enforcing the law is achieved through various means such as regular administrative inspection, sudden inspection and complaints from individuals or NGOs.

Egyptian environmental laws have not been enforced adequately for a variety of reasons, including:

- lack of adequate authorities with necessary resources to carry out inspection and enforcement;
- lack of public awareness regarding the magnitude of the environmental problems and their negative effects;
- the regulatory approach is not effective because standards generally do not allow the flexibility necessary for the polluter and the regulatory agency to negotiate quick agreement on a compliance schedule;
- Instead, Egyptian regulators concentrate on informing the polluter of a violation

– but there are no provisions for phasing in compliance measures after the violation has been announced and;

- there is no sufficient coordination and cooperation among the ministries and governmental institutions regarding the issue of environmental protection.

3.6. Environmental Education/ knowledge

Education and awareness are essential tools in highlighting the importance of environmental protection. In this respect, there have been recent initiatives aimed at enhancing and developing environmentally literate citizens who share a concern for environmental protection issues. This could be realized through introducing environmental education and training programs on both formal and informal levels of education. Formal education is that directed at schools and universities, while informal education is directed to all strata of society, at all ages and cultural levels.

Federal education has been carried out at each educational stage such as primary schools, preparatory schools, and universal.

Non-formal education is all-important to environmental awareness, since it targets a wide range of groups and includes all strata of society. Mass media and newspapers play a very important role in effective environmental education programs of this type.

EEAA, realizing the importance of raising the public's environmental awareness, is providing continuous support to environmental training and awareness activities and initiatives. This is reflected in the protocol between the Ministries of Education and Environment signed in 1999. The protocol addresses the integration of environmental dimensions in the formal curricula, the development of teacher-training materials, and the design of informal environmental training programs. A collaborative partnership between EEAA and the various channels of mass media has been developed. Within this framework, EEAA has sponsored several daily and weekly environmental radio and TV programs in addition to the environmental sections in major newspapers.

3.6.1. Relevant Organizations

- Environmental Information and Public Awareness Department, EEAA
- Ministry of Education, Environmental Education Department
- Ministry of Scientific Research and Higher Education

3.7. Conclusion

From this brief description, it can be assumed that the laws are sufficiently stringent and the institutions appropriate for effective implementation of those laws. It was consistently stated, however, that none of the applicable laws are enforced, and pollution control is essentially non-existent.

There are several apparent reasons for this, the most significant being the government's failure to take environmental action seriously and to insist on implementation of the existing laws. This attitude is now changing; the organization assigned the rule of supervising the enforcers is EEAA. This is a step forward, although EEAA may lack the expertise to carry out this function.

4.0. Water Quality Assessment and Monitoring Programs

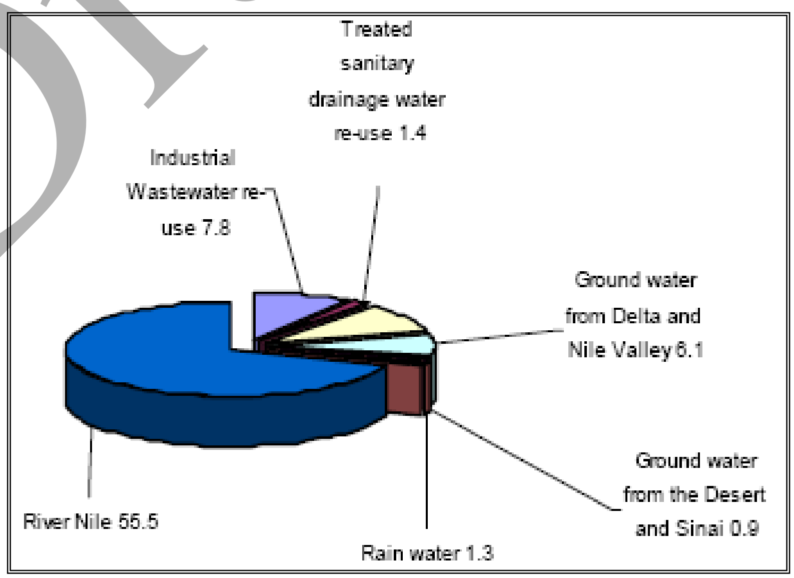
This section describes the current monitoring programs, types and sources of water quality problems of the River Nile system. It will evaluate the water quality monitoring programs and data quality assessment and evaluation.

4.1. Water Resources

The main water resource in Egypt is the River Nile. It constitutes 96% of the renewable water resources in accordance with the Agreement on Full Utilization of the Waters of the Nile concluded between Egypt and Sudan in 1959. Under this Agreement Egypt's annual quota of the Nile water is 55.5 billion cubic meters, while Sudan's is 18.5 billion cubic meters. Moreover, the volume of seasonal rains on coasts and Sinai is 1.3 billion cubic meters annually. Other water resources are the renewable and non-renewable groundwater in deserts. Current water uses are a mix of direct utilization of main resources, and indirect one; namely reuse of agricultural drainage and treated wastewater.

As the following chart shows, the direct use of renewable water resources is represented in 55.5 billion cubic meters of Nile water, 1.3 billion cubic meters of rains, and 0.9 billion cubic meters of non-renewable groundwater in Eastern and Western Deserts and Sinai. Indirect use is represented in 6.1 billion cubic meters of renewable groundwater in Nile Valley and Delta, 7.5 billion cubic meters of agricultural drainage reuse, 7.8 billion cubic meters of industrial effluents reuse, and 1.4 billion cubic meters of treated wastewater. The use of water resources in different sectors includes agriculture (58.65 billion cubic meters), industry (7.5 billion cubic meters) and drinking or household (4.75 billion cubic meters) in addition to Nile navigation and power generation.

Increasing water needs are due to population growth, standards of living improvement, and the State policy aiming at reclamation of new lands, encouragement of industry and maximization of clean water accessibility. Closing the gab between the available water resources and the increasing water demand by the various economic sectors is a major challenge facing Egypt currently.



Source: State of Environment (2005)

However, Egypt endeavors to make the optimum use of potable water and non-conventional water resources such as desalination of seawater, reuse of agricultural drainage, and treated wastewater.

The Government aims to improve water resources management and increase the efficiency of their use through further utilizing modern irrigation methods to decrease the waste. Raising grassroots awareness with respect to the importance of rationalizing the consumption of water in irrigation, industry and household, and protecting water resources against pollution, as well as involving people in water policies formulations.

The agricultural sector is the largest water consumer in Egypt. Its quota is almost 85% of the total water demand. During 1980- 2000, cultivated area has increased from 5.8 million acres to 7.95 million acres. Yield productivity jumped by nearly 180%. Rice and sugarcane are the largest water consuming crops in Egypt. Agricultural expansion has contributed effectively to reducing poverty and hunger, and providing food security.

With population growth, however, any attempt of agricultural expansion would require more irrigation water provision. This necessitates improving irrigation water use, agricultural drainage water reuse, and groundwater utilization. National programs have been adopted to improve irrigation systems, reuse of agricultural drainage and treated wastewater, and make the optimum use of groundwater.

Water quality differs according to locations, flows, water uses, population density, type of pesticide and fertilizers used in cultivation, sanitary drainage and industrial effluents systems, in addition to social and economic conditions. Therefore, preserving the good quality of water is the major environmental challenge in Egypt.

4.2. Monitoring Programs

A number of government ministries have responsibility for water quality issues in Egypt. ***NO ORGANIZATION*** has clear responsibility for managing River Nile water quality. Although currently proposed legislation would give the Egyptian Environmental Affairs Agency (EEAA) overall responsibility for coordinating environmental program, his exact rule is not clear. The following section presents a brief summary description of the various agencies that were identified as being a potential source of relevant & reliable data.

Ministry of Water Resources and Irrigation (MWRI):

MWRI has, through the National Monitoring Program for assessing and monitoring Surface and Underground Water. 320 surface water sites, along canals, main canals, the Nile, Lake Nasser, and drains located in strategic locations, in addition to 250 sites along groundwater aquifers network. MWRI monitors the general indicators of water quality including natural, chemical and biological parameters (such as salts, cations, anions, bacteriological and organic pollutants, dissolved oxygen, BOD, COD, heavy elements, and…other).

Ministry of Health and Population (MoHP)

The MoHP undertakes four programs related to water quality monitoring. One of these is related to the adequacy of potable water treatment with the objective of ensuring that all such treatment plants in Egypt meet drinking water standards.

Ministry of Health (MoH) regularly monitors the quality of the Nile water in 10 governorates; *Aswan, Sohag, Asiout, Menia, Beni Suef, Gharbeya, Daqahleya, Damietta, Alexandria, and Port Said.* The MOHP conducts an industrial discharge monitoring program jointly with MWRI. Also,the MOHP monitors the discharge from major wastewater treatment plants on a quarterly basis. The program includes 86 of the 104 operating plants throughout Egypt

Egyptian Environmental Affairs Agency (EEAA)
EEAA runs annual monitoring program for Nile water quality. The EEAA has two units that monitor water quality of the Nile River.
The Environmental Quality Section is responsible to monitor ambient water quality of the Nile River. Their program commenced in 1999 and consists of sampling on an annual basis. The first years program included 18 sampling points and the network has expanded to 31 points in the 2001 program.
The Environmental Inspection Unit (EIU) is charged with monitoring industries that discharge wastewater to waterways. They monitor approximately 550 industries that discharge wastewater into the Nile River and agricultural drains. They verify compliance with Law 48 and the terms of their discharge license. Violators are given 90 days to rectify the problem and letters are delivered to MWRI and the Governor of the area where the violation takes place. The EIU returns to the violator after 90 days to check to see if the violation has been rectified. For non-violators, they are rechecked on a random basis. A comprehensive database of the 550 industries is maintained by the EIU.

Ministry of Housing, Utilities and New Communities (MHUNC)
The National Organization of Potable Water and Sanitary Drainage (NOPWASD) within MHUNC have the responsibility for planning, design and construction of municipal wastewater treatment plants and sewage collection systems.

4.3. Sources of Pollution

The protection of water resources is one of the most critical environmental issues in Egypt. Egypt is facing an increasing demand for water due to the rapidly growing population, as well as the growth in urbanization, agriculture and industry. In the meantime, Egypt faces a rapidly increasing deterioration of its surface and groundwater due to increasing discharges of heavily polluted domestic and industrial effluents into its waterways. Excessive use of pesticides and fertilizers in agriculture also causes water pollution problems.

An assessment of water quality in Egypt indicated that the major water quality problems are pathogenic bacteria/parasites; heavy metals and pesticides. Major sources of these pollutants are the uncontrolled discharge of human, industrial and agricultural wastes.

The sources of pollution on the river Nile system, starting from Aswan till Delta Barrage, Nile branches, main canals & drains will be carefully identified in this section. Figure (1) shows the industrial & domestic wastewater outfall points schematically while Figures (2 &3) depicts the agricultural drain outfalls and monitoring network along the Nile, Canals & Drains.

"It is worth mentioning that this section includes the analysis & assessment of water quality ***"AVAILABLE"*** *data that have been recorded during the February 2001-Monitoring Campaign by MWRI". However, MoHP 2003- Water quality monitoring Campaign is also included in a separate annex.*

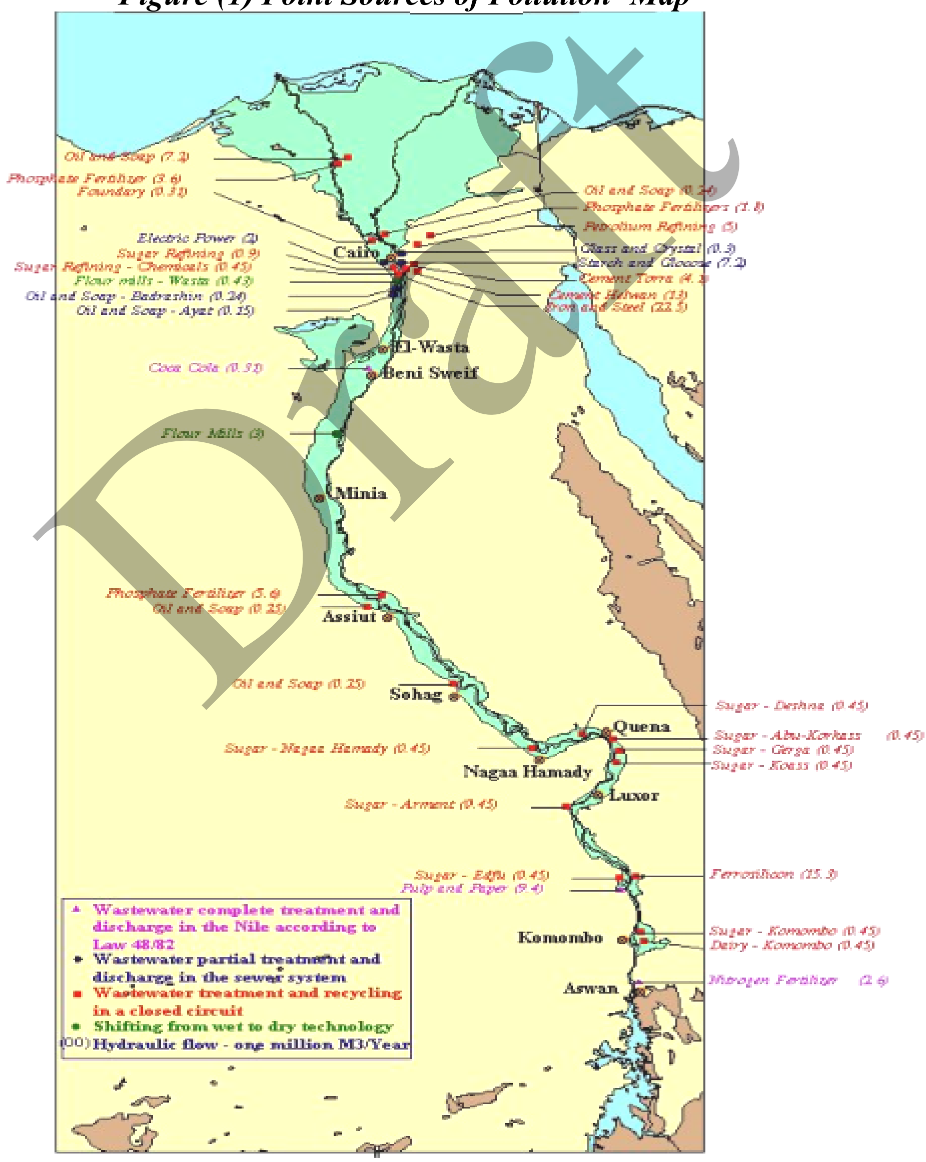
4.3.1. Industrial Pollution

Egyptian industry uses 638 Mm^3/yr. of water, of which 549 Mm^3/yr. are discharged to the drainage system. Industrial activities in the Greater Cairo and Alexandria regions use 40% of the total. The River Nile supplies 65% of the industrial water needs and receives more than 57% of its effluents. More detailed information about water consumption, wastewater discharge and point sources of pollution & loads from different industrial sectors are provided in (Table 1& 2).

4.3.1.1. Upper Egypt

Sources of industrial Pollution along the Nile in Upper Egypt area are mainly agro-industrial and small private industry. Sugar cane industries are significantly influences Nile water quality at Upper Egypt-South zone. Hydrogenated oil and onion drying factories influence Nile water quality at Upper Egypt-North zone (Fig.1)

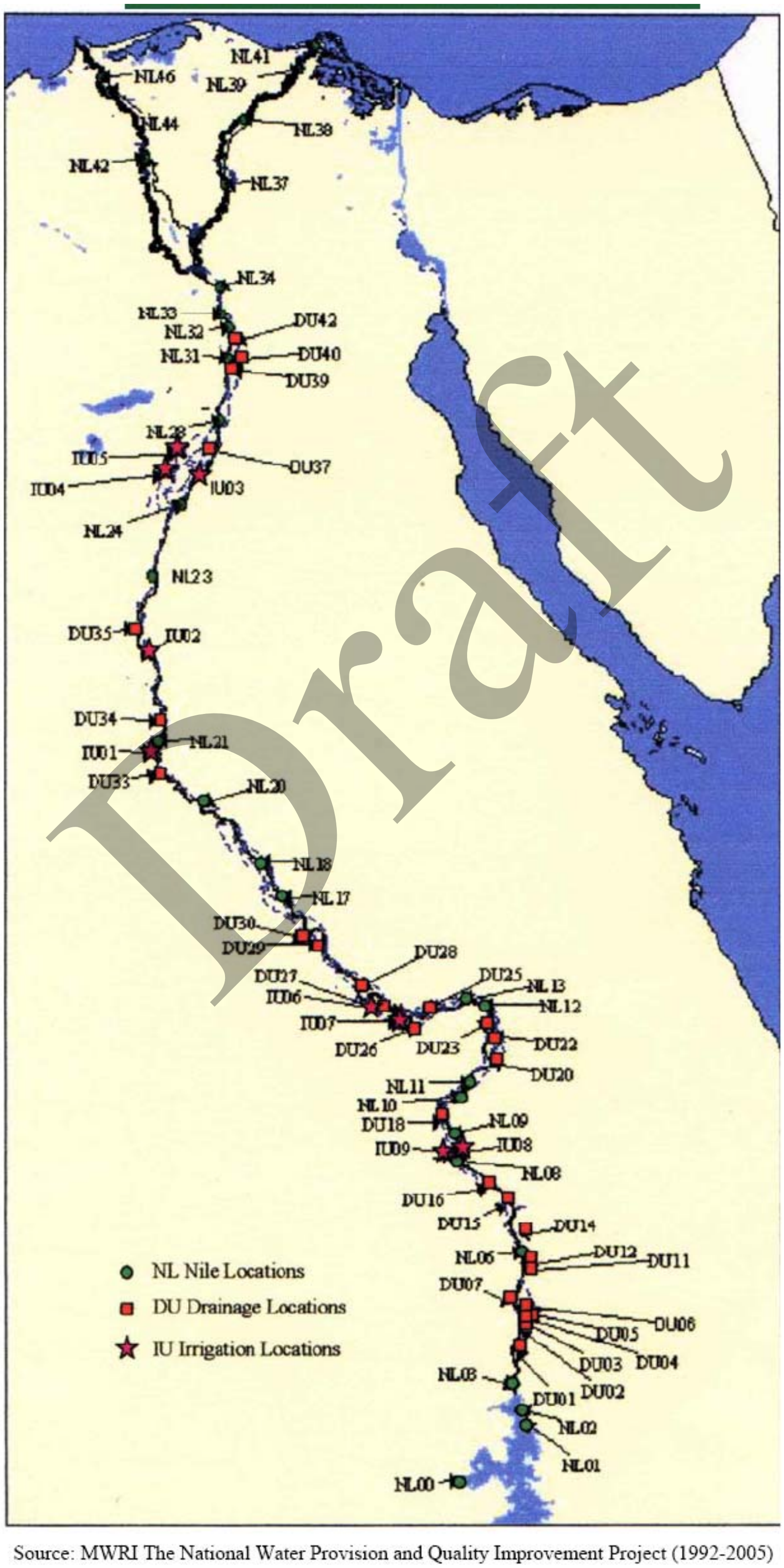
Figure (1) Point Sources of Pollution- Map



4.3.1.2. Greater Cairo

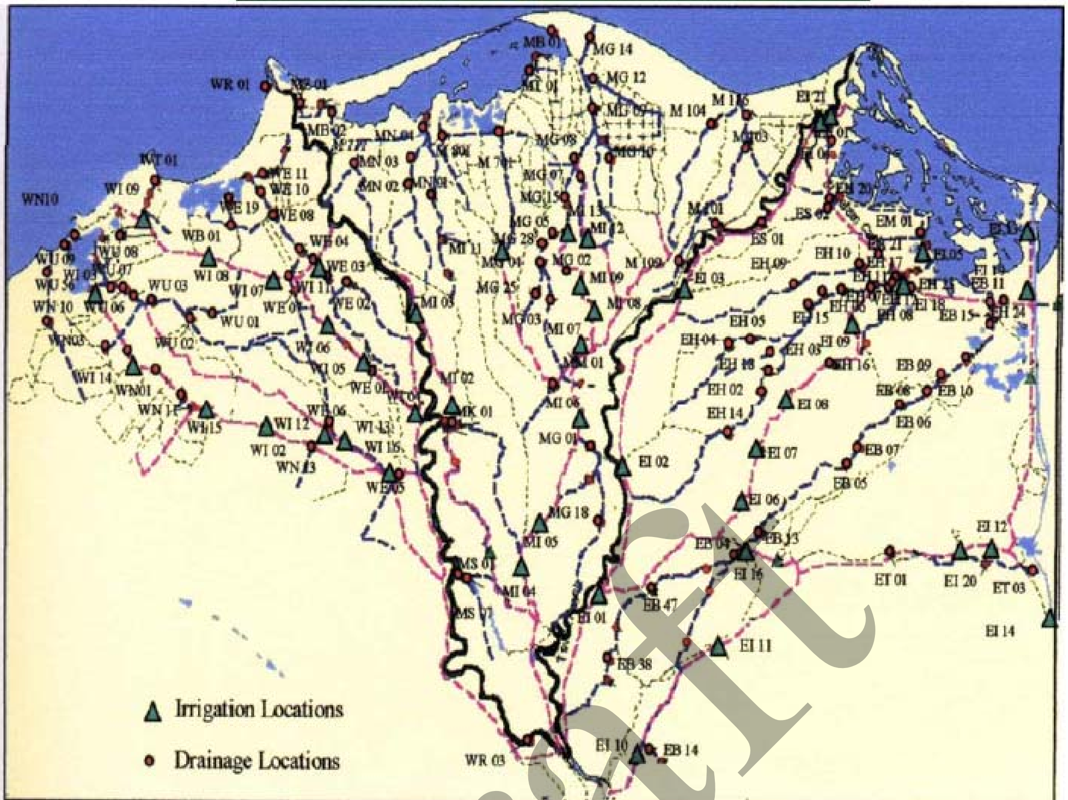
The area has a population of approximately 18 million and encompasses many industrial and commercial activities. Heavy industry is located around, South of Cairo, and, North of Cairo. Many small industries and some heavy industry are randomly located throughout the city.

Figure (2) Water Quality Monitoring Network along the Nile



Source: MWRI The National Water Provision and Quality Improvement Project (1992-2005)

Figure (3) Canals & Drains Water Quality Monitoring Network



Source: MWRI The National Water Provision and Quality Improvement Project (1992-2005)

Although wastewater discharges of the small industries are generally low, concentrations of certain industries in specific areas, such as the tanning industry may cause local contamination problems. An overview of pollution sources is given in Figure (1). They include 23 chemical industries, 27 textile and spinning industries, 7 steel and galvanizing industries, 32 food processing industries (including a brewery), 29 engineering industries, 9 mining and refraction industries, and petrol and car service stations. Bakeries (>350), marble and tile factories (>120) and tanneries in South Cairo.

4.3.1.3 Rosetta & Damietta Branch

The Rosetta receives the water of a number of agricultural drains, which are heavily polluted by industrial and domestic sewage. The drains receive large parts of the wastewater of Cairo. The wastes in the drains contain high levels of suspended and dissolved solids, oil, grease, nutrients, pesticides and organic matter. It is suspected that toxic substances are present as well. The Damietta Branch also receives polluted water of a number of agricultural drains; The Fertilizer Company is considering the major point source of industrial pollution at Damietta branch.

At present industrial use of water is estimated at 5.9 BCM/year out of which 550 MCM/year is discharged untreated into the River Nile. 125 major industrial plants are located in the Nile valley which represents about 18% of the existing industries and discharging 15% of the heavy metal loads. 250 industrial plants are located in Greater

Table (1a) Industrial wastewater discharge to the river Nile system

District	Ultimate sink (M m^3/yr.)*				Total
	Nile	Canals	Drains	Lakes	
Upper Egypt	192	5	2	5	204
Greater Cairo	80	21	20	7	128
Delta	27	85	13	1	126
Alexandria	13	7	33	35	88
Others	0	0	3	1	4
Total	312	118	71	49	550

Table(1b)Water use and wastewater discharged from different industrial sectors

Industrial Sectors	(Mm^3/yr.)			
	No. Plants	Water Use	Water Discharge	Consumption
Chemical	53	127	98	29
Food	119	296	277	19
Textile	75	114	88	26
Engineering	39	13	12	1
Mining	11	69	60	9
Metal	33	19	14	5
Total	330	638	549	89

Table (2a) Pollution loads discharged to different districts

District	Flow (Mm^3/d)	(ton/day)					
		BOD	COD	Oil	TSS	TDS	HM
Upper Egypt	204	37	72	5	68	532	0.20
Greater Cairo	128	71	120	93	97	135	0.75
Delta	125	34	42	24	86	224	0.50
Alexandria	88	91	186	45	40	246	0.17
Other Gov.	5	2	3	1	5	15	0.03
Total	550	235	423	168	296	1152	1.65

Table(2b)Pollution loads from different industrial sectors

Industrial Sectors	Flow (Mm^3/d)	(ton/day)					
		BOD	COD	Oil	TSS	TDS	HM
Chemical	98	26	178	23	33	241	0.94
Food	277	142	182	110	168	666	0.17
Textile	88	39	47	24	64	191	0.30
Engineering	12	5	7	2	3	13	0.03
Mining	60	14	17	8	24	29	0.20
Metal	14	3	-	1	4	11	0.01
Total	549	225	431	168	296	1151	1.65

Source: Wahaab, R.A.and Badawy, M.I. (2004)

Cairo which represents 35% and contributing about 40% of the total metal discharges. The Delta excluding Alexandria has some 150 industries which contribute about 25% of the heavy metals discharging to drains. Alexandria is a major heavy industrial center with some 175 industries, about 25% of the total in Egypt.

4.3.1.4.Alexandria Area

Alexandria is a major industrial center with some 175 industries, about 25 percent of the total in Egypt. These industries include paper, metal, chemical, textile, plastic, pharmaceutical, oil and soap; and food processing. These plants are reported to contribute some 20 percent of the total wastewater of Alexandria. The industries discharge their effluents mainly to Lake Mariut and partially to the sewerage network. According to a survey made by Drainage Research Institute, different types of industrial wastes are disposed to Lake Maryut. At least 17 factories discharging directly to the lake through pipelines; 4 factories collect their wastewater in trenches. Moreover, 19 factories lying in the vicinity of the treatment plants; 22 factories discharging to nearby drains and then to the lake.

It is worth mentioning that the total amount of BOD discharged to the river Nile by industrial plants equals 270 ton/day. This amount corresponds to the untreated discharge of wastewater from more than six million people. It can be concluded that these substances are discharged mainly from the industrial activities in the Greater Cairo region and in Delta (0.75 and 0.50 ton/day). The average concentration of heavy metals (HM) in the effluent is less than 5 g/1, which is slightly, more than a normal background figure (Table 2a).

The results represented in Table (2b) shows that the food processing industry is responsible for more than 50% of the BOD load. However, the chemical industry is responsible for more than 60% of the heavy metal discharges. The high BOD load from the food processing industry is attributable to 10 sugar factories between Aswan and Cairo, for which the total BOD load was estimated at 490 ton/day in 1980. More recently the BOD load from some sugar factories has been reduced significantly due to recovery of molasses at the source. Since the economic viability of this industry is not clear, a restructuring program for the industry would need to consider both environmental and economic viability issues for this industry.

4.3.2. Domestic Pollution

Available information revealed that the total wastewater flows generated by all governorates, assuming full coverage by wastewater facilities is estimated to be 3.5 BCM/year. Approximately 1.6 BCM/year receives treatment. By the year 2017, an additional capacity of treatment plants equivalent to 1.7 BCM is targeted (National Water Resources plan, 2002). Although the capacity increase is significant, it will not be sufficient to cope with the future increase in wastewater production from municipal sources and therefore, the untreated loads that will reach water bodies are not expected to decline in the coming years. as demonstrated in Table (3).

In many cases, domestic wastewater is collected from the center of the towns and from the villages and, dumping it into a nearby irrigation canal is quite common. Therefore, domestic waste disposal significantly contributes towards water quality degradation. It is worse mentioning

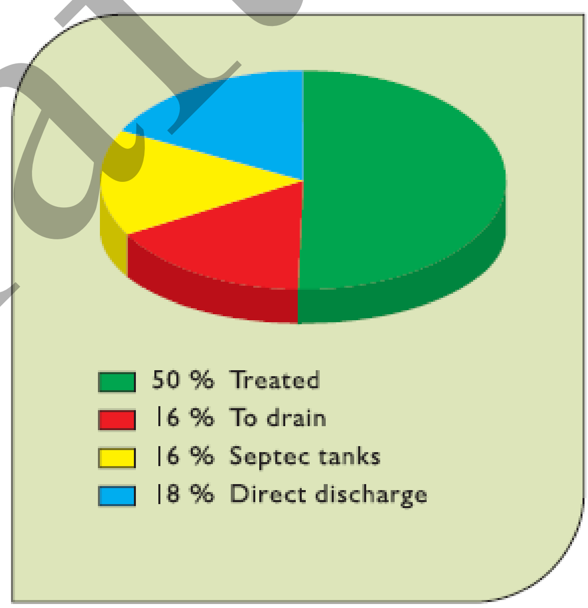
that no well-controlled sludge management program exists in Egypt. This may, especially in urban areas such as Greater Cairo, lead to in adequate sludge disposal, cause general environmental problem and, in the worst case, eventually influence water quality in a negative way.

Table (3) Projections of Wastewater Treatment Coverage

Year	Population	People Serves	People Not Served
1997	60 Million	18 Million	42 Million
2017	83 Million	39 Million	44 Million

The constituents of concern in domestic and municipal wastewater are: pathogens, parasites, nutrients, oxygen demanding compounds and suspended solids. In Greater Cairo and other cities, the sewerage systems also serve industrial and commercial activities. Therefore, instances of high levels of toxic substances in wastewater have been reported. As these toxic substances (heavy metals & organic micro-pollutants) are mainly attached to suspended material, most of it accumulates in the sludge. Improper sludge disposal and/or reuse may lead to contamination of surface and ground water.

Domestic Wastewater In Egypt
(Source: MWRI, 2005)



In general, the bulk of treated and untreated domestic wastewater is discharged into agricultural drains. Total coliform bacteria reach 106 MPN/100 ml as recorded in some drains of Eastern Delta. It is important to mention that all drains of Upper Egypt flow back into the Nile. Many irrigation canals and agricultural drains may be contaminated with pollutants from domestic and industrial sources. Moreover, many of irrigation and agricultural drain are used for irrigation.

Physico-chemical characteristics and fecal coliform counts of 42 major drains at the tail ends, before discharge into the Nile indicated that out of the 43 drains, only 10 are complying with the standards set by Law 48/1982 (Article 65) regulating the quality of drainage water which can be mixed with fresh water. In terms of organic load, it was found that the highest organic load is discharged from Kom Ombo drain (218.1 ton COD/d, 59.7 ton BOD/d). This is followed by El-Berba drain (172.7 ton COD/d; 59.7 ton BOD/d). It is worth mentioning that these two drains contribute 76% of the total organic load (calculated as COD) discharged into the Nile by drains from Aswan to Delta Barrage. This is followed by Etsa drain which contributes about 11% of the total COD load (56.8 ton COD/d).

4.3.3. Wastewater Treatment Systems

The treatment systems in Egypt can be divided into two basic types: aerobic and an aerobic treatment. The four most common aerobic treatment technologies are activated sludge, aerated lagoons, oxidation ponds, trickling filters and rotating biological contactors (RBC). Activated sludge and oxidation dishes represent 58% of the technologies and 72% of the total wastewater treatment capacity (El-Gohary, 2002). In Greater Cairo, the capacity of the El Gabal El Asfar secondary treatment plant (WWTP) was $3x10^6$ m^3/day and services 12 million people. A secondary WWTP with $0.33x10^6$ m^3/day treatment capacity, exists at El-Zenein and $0.4x10^6$ m^3/day treatment plants exist at Berka ($0.6x10^6$ m^3/day to primary standard) and Shoubra El-Kheima (about $0.6x10^6$ m^3/day).

Fifty nine waste water treatment plants with total capacity of approx. 3,700,000 m^3 /day are operational; 34 are under construction, with a total capacity of almost 5,000,000 m^3 /day (Table 4). Most of the installed treatment plants provide some form of secondary treatment, although not all of them are functioning well (Annex -2 show detailed report about WWTPs in Egypt).

Table (4) Overview of Types of Operating Wastewater Treatment Plants in Egypt

Type of Treatment					
P Treatment Only	1	720.000	720.000	720.000	720.000
Fixed Film reactors Trickling Filter	19	625.000	32.895	12.000	75.000
Activated Sludge					
Conventional Act. Sludge	9	1.911.000	212.333	26.000	600.000
Oxidation Ditch	14	88.740	6.339	550	50.000
Small Ready Made Systems	4	4.040	1.010	600	2.200
Oxidation Ponds	9	242.600	26.956	300	75.000
Aerated Oxidation Ponds	3	108.00	36.000	22.000	60.000
Total	59	3.699.380	62.701	781.450	1.582.200

Table (5) Wastewater Treatment Facilities & Ultimate Sinks along the river Nile ystem.

Region		Discharge Towards	*Capacity
Upper Egypt			
8 Treatment	1 aerated Oxidation Pond 7 Trickling Filter	Mainly Agricultural Drains, Some to Land Reclamation	225.000
Greater Cairo			
Helwan	Activated Sludge	Land Reclamation	35.000
Berka	Activated Sludge	Agricultural Drain	600.000
Zenein	Activated Sludge	Agricultural Drain	330.000
Abu-Rawash	Only Primary Treatment	Land Reclamation	720.000
Alexandria			
East	Activated Sludge	Lake Mariut	475.000
	Activated Sludge	Lake Mariut	175.000
Delta norate			
Zegazig	Activated Sludge	Agricultural Drain	90.000
Banha	Trickling Filter	Agricultural Drain	75.000
Shibeen Al-Kawn	Trickling Filter	Agricultural Drain	74.000
Tanta	Aerated Oxidation Pond	Agricultural Drain	60.000
Mahalla	Trickling Filter	Agricultural Drain	60.000
Kafr Al-Zayat	Activated Sludge	Agricultural Drain	90.000
Mit Mazah	Oxidation Pond	Agricultural Drain	75.000
Damietta	Activated Sludge	Lake Manzala	90.000
Ras El-Bar	Extended Aeration	Mediterranean Sea	50.000
Dakhla	Oxidation Pond	Agricultural Drain	62.000
28 Other	Oxidation Pond Aerated Oxidation Pond Extended Aeration Oxidation Ditch Trickling Filter Activated Sludge Aqualife	Mainly Agricultural Drains and Lake Manzala	228.000

* Only plants with a capacity > 50.000 m^3 / day are listed separately.

Geographical overview of the operational wastewater treatment facilities on the Nile River system are given in Figure (1) & Table (5). Most of the existing wastewater treatment plants in Egypt operate according to the activated sludge process (conventional activated sludge; extended aeration; oxidation ditch), a smaller part are fixed film reactors (trickling filter) and stabilization ponds (oxidation ponds and aerated oxidation ponds) . The last sub-type, aerated oxidation ponds are, because of their algae activity, not considered to be secondary treatment. Especially in the Greater Cairo area, high levels of toxic substances in sewage are reported (Taylor Binnie & Partners, 1992).

As those toxic substances (heavy metals, toxic organic substances) will be mainly attached to suspended materials, most of it will be removed by appropriate secondary treatment. Nevertheless, the remaining toxic substances may still contaminate surface waters. Moreover there is no national program in Egypt for sludge disposal. Improper sludge disposal may lead again to contamination of surface and groundwater.

It is worth mention that the total municipal sewage in Egypt is about 3.5 billion cubic meters per annum, which is three times the amount of annual produced rainfall. In addition, the nitrogen content of this amount sewage is estimated at 0.14 million ton. The price of an equal amount of the inorganic fertilizer is $30 million. The net water requirements of cotton and winter wheat are 12,240 m^3/ha/season and 10,800 m^3/ha/season. Based on the previous data, reuse of domestic sewage in Egypt could add 0.25 million ha of cotton or 0.28 million ha of wheat, which represent 6%-7% of the present 3.9 million ha cultivated area.

4.3.4. Canals & Rayahs

Water quality monitoring campaigns conducted to date have included irrigation canals to a very limited extent. In general, canals have water quality similar to that at the point of diversion from the Nile. The flow in the canals varies with irrigation demands. Most of these canals are sources for drinking water treatment plants.

Twelve canals and rayahs have been monitored during the February 2001- campaign. Available data indicates that dissolved oxygen, BOD and total solids concentrations in all surveyed canals and Rayahs are within the permissible limits (Table 6). The shaded values in the table denote non-compliance with standards. With regard to COD values, only *El-Lahoun* and *Sako* complied with the standard values .

With the exception of Ibrahimia Canal and El-Beherri Rayah, fecal coliform counts in all surveyed canals exceeded the WHO Guidelines (1000 MPN/100 ml). In Monoufi and Nasery Rayahs, the fecal coliform counts were 10^4 MPN/100 ml. This indicates the presence of human wastes. Heavy metals concentrations in Canals and Rayahs were within the permissible limits.

4.3.5. Agricultural Pollution

Agricultural is the major non-point source pollution, with a number of potential impacts on the environmental and human health. In many agricultural areas, local surface and groundwater contamination has resulted from leaching of nitrates from fertilizers, and bacteria from livestock and feed wastes. Agricultural pesticides are both a potential diffuse source of water contamination. The major impacts of agriculture on water quality in Egypt:

(I) increase salinity,

(II) deterioration of quality due to fertilizers and pesticides and;

(III) possible eutrophication of water bodies due to an increase in nutrients from fertilization.

It is estimated that in Upper Egypt, approx. 4 billion m^3 of drainage water returns to the Nile every year. This drainage water has a much higher salinity than the originally ingested irrigation water and contributes to an increase of salinity of the River Nile along its course from the High Aswan Dam to the Delta. Fortunately, the high mixing ratio of Nile and drainage water keeps the increase of salinity within acceptable limits. Salinity increases from 160 mg/l at the High Aswan Dam to 250 mg/l in Cairo.

Table (6) Results of Field Analysis for Canals and Rayahs

Canal & Rayah	DO	COD	BOD	RDS	TSS	FC
Consent standards	5	10	6	500	NA	1000*
Menoufi Rayah	5.97	16	3.02	225	29	10000
El-Beherri Rayah	7.58	14	1.74	220	6	1000
El Nasey Rayah	6.71	12	3.96	220	16	10000
Astoun Canal	7.03	11	1.82	200	8	1600
Kelabia Canal	7.57	15	1.71	205	12	1500
East Naga Hamadi Canal	6.31	25	5.78	213	9	1750
West Nagahamadi Canal	7.22	18	4.32	200	6	2500
Ibrahimia Canal (Dairot)	7.84	37	3.55	200	8	2000
Ibrahimia Canal (El-Minia)	8.12	23	3.08	200	17	650
Ibrahimia Canal (Beni-Suef)	7.38	21	2.01	230	12	1500
El-Lahoun	7.08	10	1.89	305	12	5000
Sako	6.98	10	2.68	280	40	1100

* **WHO (1989) Guidelines for Unrestricted Irrigation**

In the Delta, because of the domestic and industrial pollution from Cairo and because of intensive agriculture, salinity in the drainage and irrigation systems further increases, salinity of drainage water discharged into the Mediterranean Sea or the northern Lakes averaged 2260 mg/l. More than half of this drainage water has a salinity < 2,000 mg/l and could be potentially reused for irrigation and drinking water supply after appropriate treatment and mixing. Due to more intensive use, salinity of the discharged drainage water may increase in the next years and re-use of drainage water may become more complicated than before.

With the construction of the High Aswan Dam in 1964, silt deposits on the Nile flood plains have decreased from 24 million tons per year to 2.1 million tons per year. This decrease has been responsible for a significant increase in the use of chemical fertilizers, resulting in increased values of nutrients in canals and drains.

4.3.6. Agriculture Drains

According to the National Water Resources plan for Egypt (NWRP), 2001, the Nile River from Aswan to Delta Barrage receives wastewater discharge from 124 point sources, of which 67 are agricultural drains and the remainder is industrial sources. Figure (2 , 3) shows the industrial and the agricultural drain outfall points schematically.

4.3.6.1. Drains in Upper Egypt & South Cairo.

Physico-chemical characteristics and fecal coliform counts of 43 major drains at the tail ends, before discharge into the Nile are presented in Table 6. The parameters that are non-compliant with Law 48 are shown shaded in the table. The data indicates that out of the 43 drains, only 10 are complying with the standards set by Law 48/1982 (Article 65) regulating the quality of drainage water which can be mixed with fresh water. This is demonstrated graphically in Figures (4,5) for selected parameters. The remainder of the drains exceeds the consent standards in one or more of the parameters. The worst water quality is that of Khour El-Sail Aswan, Kom Ombo, Berba and Etsa drains.

In terms of organic load, it was found that the highest organic load is discharged from Kom Ombo drain (218.1 ton COD/d, 59.7 ton BOD/d). This is followed by El-Berba drain (172.7 ton COD/d; 59.7 ton BOD/d), (Table 5.2). The shaded values highlight the drains that are the worst cases by far. It is worth mentioning that these two drains contribute 76% of the total organic load (calculated as COD) discharged into the Nile by drains from Aswan to Delta Barrage. This is followed by Etsa drain which contributes about 11% of the total COD load (56.8 ton COD/d).

4.3.6.2. Drains in the Delta

Delta drains are mainly used for discharge of predominantly untreated or poorly treated wastewater (domestic & industrial), and for drainage of agricultural areas. Therefore, they contain high concentrations of various pollutants such as organic matter (BOD, COD), nutrients, fecal bacteria, heavy metals and pesticides.

The drainage water is becoming more saline; on average its salinity increased from 2400 g/m3 in 1985 to 2750 g/m3 in 1995. But there are local variations. For example, in the southern part of the Nile Delta drainage water has salinity between 750 and 1000 g/m3, whereas the salinity in the middle parts of the Delta reaches about 2000 g/m3 and in the northern parts between 3500 and 6000 g/m3.

In a recent study published by DRI (2000), it has been estimated that the Delta and Fayoum drains receive about 13.5 BCM/year. Almost 90% of which is contributed from agricultural diffuse source, 6.2% from domestic point sources, 3.5% from domestic diffuse sources and the rest (3.5%) from industrial point sources (Table 9). It was also found that Bahr El-Baqar receives the greatest part of waste water (about 3 BCM/year). This is followed by Bahr Hados, Gharbia, Edko and El-Umoum, with an average flow of 1.75 BCM/year for each. The wastewater received by the rest of the drains is less than 0.5 BCM/year for each.

In terms of organic loads, as expressed by COD and BOD values, Bahr El-Baqar drain receives the highest load followed by Abu-Keer drain. Also, El-Gharbia Main receives significant amounts of organic pollutants.

Table (7) Water quality of agricultural drains: Upper Egypt.

No.	Drain Name	Location (KM)	Discharge mm3/day	COD mg O_2/l	BOD mg O_2/l	DO mgO_2/l	TDS mg/l	FC MPN/100ml	Heavy Metals
	Consent Standard			15 mg/l	10 mg/l	5 mgO_2/l	500 mg/l	5.00E+03	3
1	Khour El sail Aswan	9.9	0.10	102	32.80	1.91	1190	3.25E+04	0.31
2	El Tawansa	37.3	0.01	8	1.01	6.16	710	3.50E+03	0.50
3	El Ghaba	46.6	0.19	11	1.00	7.8	570	1.85E+03	0.75
4	Abu Wanass	47.2	0.20	7	1.28	7.03	463	3.00E+03	0.39
5	Main Draw	48.9	40 l/s	17	1.48	7.34	460	3.00E+04	0.61
6	El Berba	49.1	0.15	113	42.70	3.85	414	2.25E+04	0.70
7	Com Ombo	51.0	0.14	151.6	41.50	2.25	325	2.25E+04	2.15
8	Menaha	55.0	-	4	1.52	7.86	285	7.50E+03	0.26
9	Main Ekleet	57.0	0.02	4	1.53	9.21	340	1.50E+03	2.44
10	El Raghama	64.7	0.04	10	1.55	8.56	390	1.75E+03	0.30
11	Fatera	70.5	0.78	5	2.04	7.7	564	3.50E+03	0.54
12	Khour El sail	70.8	0.17	2	1.05	9.07	500	2.00E+03	0.34
13	Selsela	73.9	50 l/s	3	1.25	6.38	380	3.20E+03	1.26
14	Radisia	99.9	0.13	16	3.06	9.02	1430	2.30E+03	0.22
15	Edfu	116.2	0.27	15	1.59	9.49	817	3.00E+03	2.37
16	Houd El Sebaia	139.5	0.05	16	1.83	6.77	495	1.75E+04	0.76
17	Hegr El Sebaia	149.1	0.05	19	2.55	7.82	670	4.50E+03	0.51
18	Mataana	187.7	0.12	39	3.15	6.45	613	1.75E+04	1.29
19	El Zeinia	236.0	NA	NA	NA	*	*	*	NA
20	Habil El Sharky	237.7	0.08	30	1.78	8.45	560	4.00E+02	1.06
21	Danfik	251.6	0.01	34	2.52	8.51	367	1.50E+03	1.05
22	Sheikia	265.3	0.06	37	1.72	7.55	662	3.75E+03	4.68
23	El Ballas	270.7	0.01	144	10.78	9.17	1395	1.50E+04	0.59
24	Qift	275.9	0.03	30	1.60	9.11	375	2.50E+03	0.39
25	Hamed	331.2	0.07	11	1.00	7.18	1015	9.00E+02	0.35
26	Magrour Hoe	340.4	0.06	21	3.24	8.2	185	1.60E+03	1.05
27	Naga Hammadie	377.8	0.21	13	2.17	8.11	375	3.30E+03	1.67
28	Mazata	392.8	0.01	10	2.19	8.37	495	2.50E+02	0.23
29	Essawia	432.7	0.07	9	2.43	6.61	200	1.50E+03	0.51
30	Souhag	444.6	0.05	9	2.81	7.42	440	8.00E+02	0.38
31	Tahta	486.4	0.01	21	2.01	7.86	980	1.40E+03	0.29
32	El Badary	525.4	0.12	6	3.27	7.25	255	9.00E+02	0.48
33	Bany Shaker	588.6	0.02	13	2.25	7.47	485	1.00E+04	0.30
34	El Rayamoun	637.4	NA	21	15.85	2.77	290	1.50E+03	0.16
35	Etsa	701.2	0.57	100	38.00	1.58	575	3.50E+04	0.19
36	Absoug	780.5	0.19	29	1.89	7.34	640	3.00E+03	0.34
37	Ahnasia	807.2	0.54	14	1.31	7.08	610	3.75E+03	0.26
38	El Saff	871.3	NA	NA	NA	*	*	*	NA
39	El Massanda	879.6	0.14	45	4.99	5.57	715	3.00E+03	0.19
40	Ghamaza El Soghra	884.5	0.06	42	2.52	6.37	235	9.50E+02	0.46
41	Ghamaza El Kobra	885.0	0.05	32	3.79	7.39	290	7.50E+02	0.28

No.	Drain Name	Location (KM)	Discharge mm3/day	COD mg O_2/l	BOD mg O_2/l	DO mgO_2/l	TDS mg/l	FC MPN/100ml	Heavy Metals
42	El Tibeen	898.1	0.02	25	15.20	3.71	840	3.25E+04	0.39
43	Khour Sail Badrashin	910.2	NA	NA	NA	*	*	*	NA

▭ : Not complying

Fig. (4): COD values of Upper Egypt drains at their points of discharge into the Nile

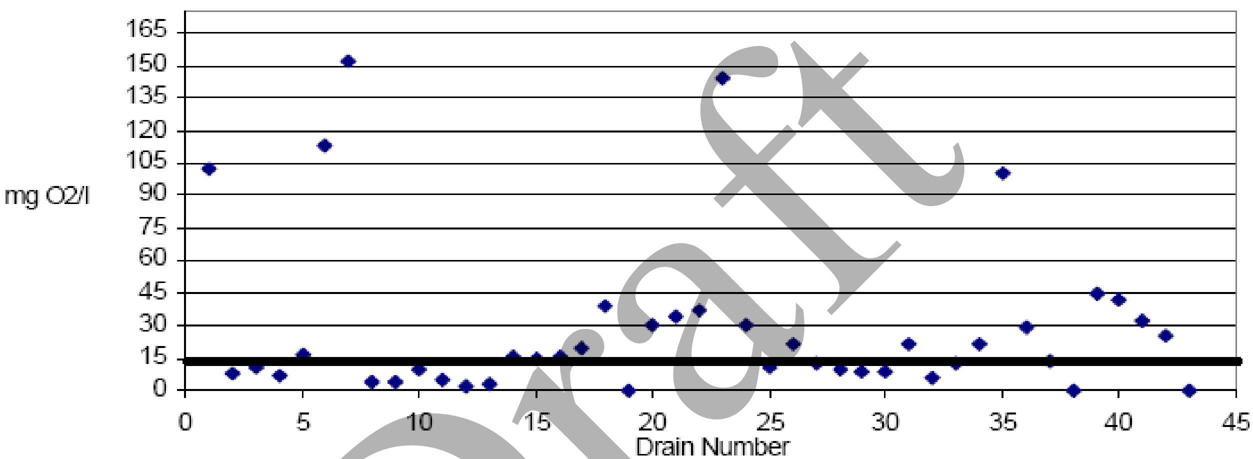


Fig. (5): BOD values of Upper Egypt drains at their points of discharge into the Nile.

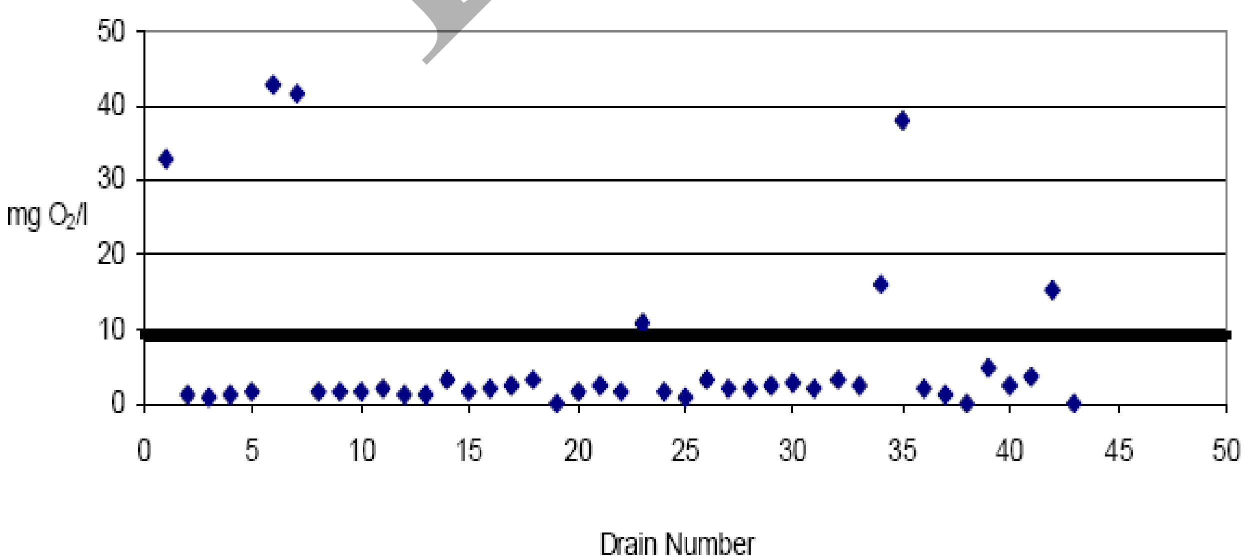


Fig. (6): TDS values of Upper Egypt drains at their points of discharge into the Nile.

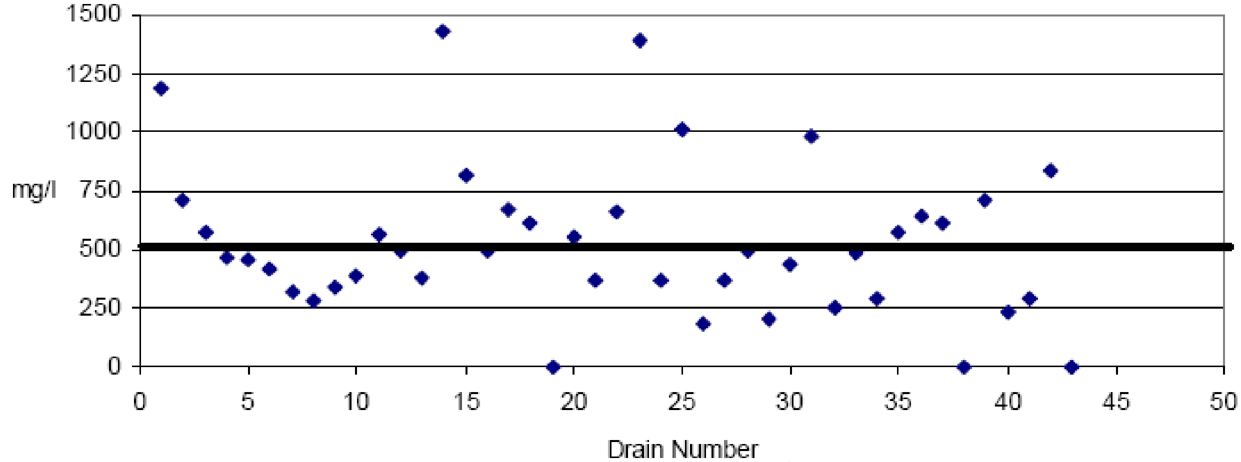


Fig. (7): FC count in Upper Egypt drains at their points of discharge into the Nile.

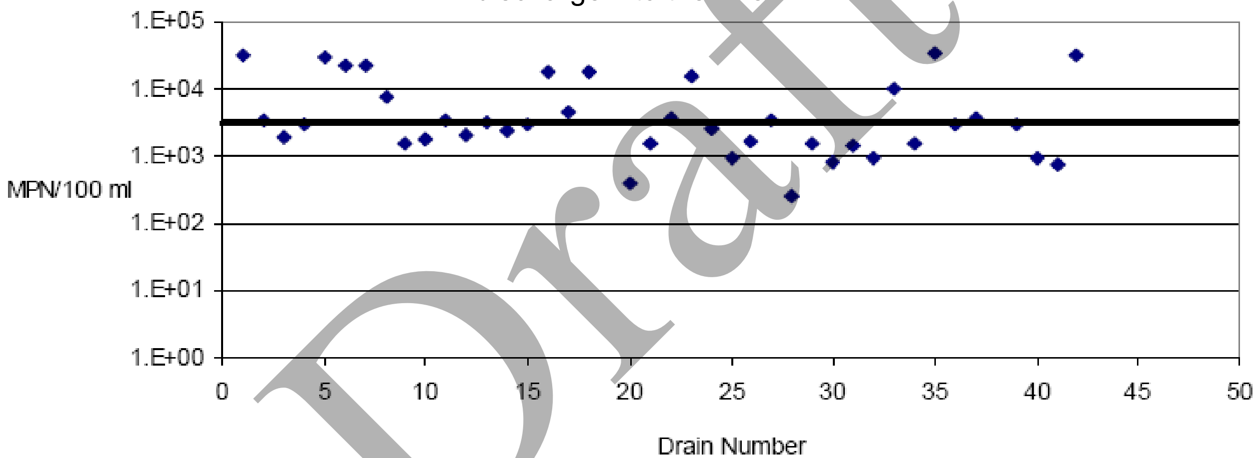
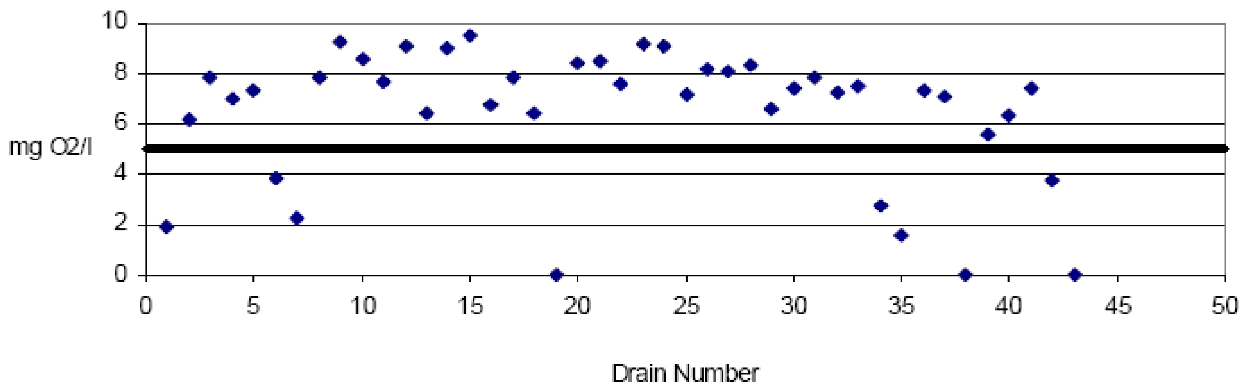


Fig. (8): DO concentrations of Upper Egypt drains at their points of discharge into the Nile.



Source: Monitoring Campaign by MWRI, 2001

Table (8) Loads of organic and inorganic pollutants into the Nile from Upper Egypt drains.

No.	Drain Name	Location (KM)	Discharge mm3/day	COD kg/day	BOD kg/day	Heavy metals kg/day
1	Khour El sail Aswan	9.9	0.098837	10.08137	3.241854	0.030333075
2	El Tawansa	37.25	0.006484	0.051872	0.006549	0.003245242
3	El Ghaba	46.55	0.194087	2.134957	0.194087	0.146341598
4	Abu Wanass	47.15	0.199061	1.393427	0.254798	0.078330504
5	Main Draw	48.85	0.003456	0.058752	0.005115	0.002106432
6	El Berba	49.1	0.15282	172.6866	65.25414	0.10720323
7	Com Ombo	51	0.143865	218.0993	59.70398	0.309122726
8	Menaha	55	NA	0	0	0
9	Main Ekleet	57	0.020166	0.080664	0.030854	0.049174791
10	El Raghama	64.65	0.044712	0.44712	0.069304	0.013346532
11	Fatera	70.45	0.779492	3.89746	1.590164	0.418197458
12	Khour El sail	70.75	0.170387	0.340774	0.178906	0.058016774
13	Selsela	73.85	0.00432	0.01296	0.0054	0.005454
14	Radisia	99.85	0.1307	2.0912	0.399942	0.02908075
15	Edfu	116.2	0.2689	4.0335	0.427551	0.63742745
16	Houd El Sebaia	139.5	0.048989	0.783824	0.08965	0.037256135
17	Hegr El Sebaia	149.1	0.049541	0.941279	0.12633	0.02524114
18	Mataana	187.7	0.122499	4.777461	0.385872	0.158207459
19	El Zeinia	236	NA	0	0	0
20	Habil El Sharky	237.7	0.079119	2.37357	0.140832	0.084222176
21	Danfik	251.55	0.008224	0.279616	0.020724	0.00865576
22	Sheikia	265.3	0.05983	2.21371	0.102908	0.279794995
23	El Ballas	270.7	0.006383	0.919152	0.068809	0.003788311
24	Qift	275.9	0.032637	0.97911	0.052219	0.012744749
25	Hamed	331.2	0.067068	0.737748	0.067068	0.023239062
26	Magrour Hoe	340.35	0.058709	1.232889	0.190217	0.061497678
27	Naga Hammadie	377.8	0.2149	2.7937	0.466333	0.35920535
28	Mazata	392.75	0.005868	0.05868	0.012851	0.001329102
29	Essawia	432.7	0.074202	0.667818	0.180311	0.037731717
30	Souhag	444.55	0.0475	0.4275	0.133475	0.01826375
31	Tahta	486.4	0.006276	0.131796	0.012615	0.001829454
32	El Badary	525.4	0.11994	0.71964	0.392204	0.05703147
33	Bany Shaker	588.6	0.019602	0.254826	0.044105	0.005968809
34	El Rayamoun	637.4	NA	0	0	0
35	Etsa	701.15	0.567976	56.7976	21.58309	0.105359548
36	Absoug	780.5	0.194386	5.637194	0.36739	0.066965977
37	Ahnasia	807.2	0.541652	7.583128	0.709564	0.138933738
38	El Saff	871.3	NA	0	0	0
39	El Massanda	879.6	0.14148	6.3666	0.705985	0.02624454
40	Ghamaza El Soghra	884.5	0.059616	2.503872	0.150232	0.027214704
41	Ghamaza El Kobra	884.95	0.048036	1.537152	0.182056	0.013618206
42	El Tibeen	898.1	0.02017	0.50425	0.306584	0.007795705
43	Khour Sail Badrashin	910.15	NA	0	0	0
sum				516.6321	157.8541	3.449520092

Fig. (9): COD loads contributed by the agricultural drains from Aswan to delta barrage .

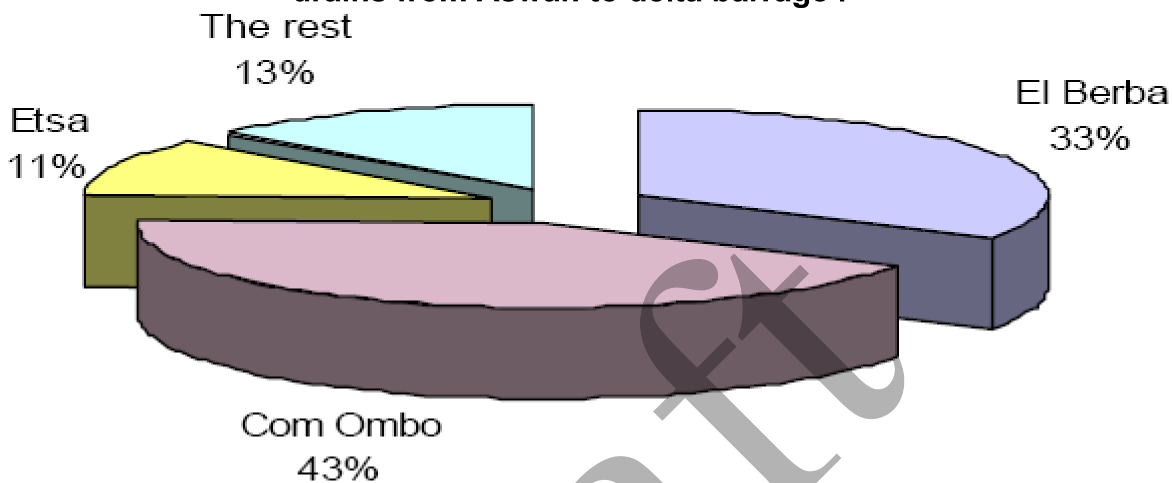
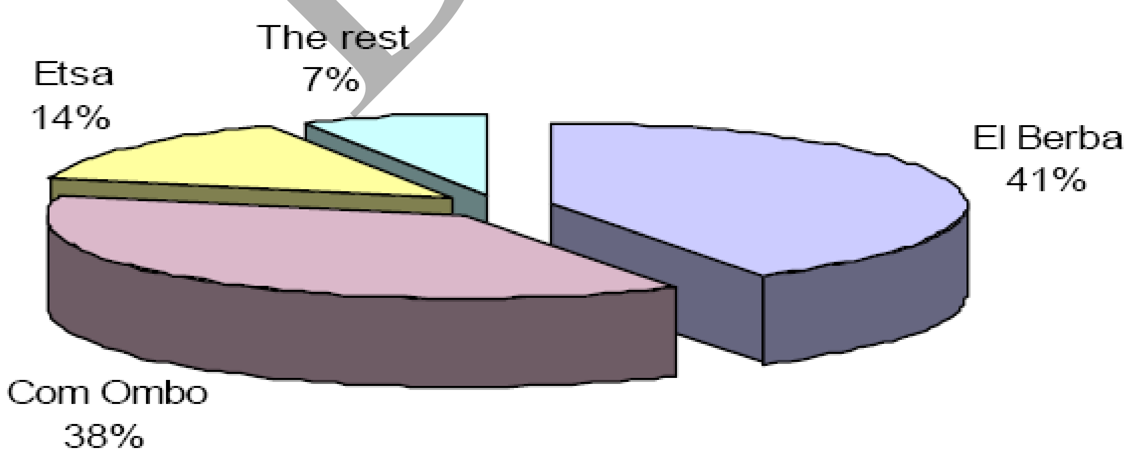


Fig. (10): BOD loads contributed by the agricultural drains from Aswan to delta barrage.



Source: MWRI, 2001

4.3.7. Pesticides used in Egypt:

In Egypt, as in many other agricultural countries, pesticides are widely used to control harmful pests, mainly, cotton, maize, and rice. Pesticides in Egypt are different types such as organochlorine, organophosphorus, cabamates, ureas, anilides and pyreethroid. The four general categories of pesticides are herbicides, insecticides, fungicides and bactericides. Herbicide control unwanted vegetation, insecticides kill insects, fungicides destroy fungi and bactericides are lethal to bacteria.

4.3.7.1.Insecticides

Concern over the environmental and health effects related to pesticides use in the 1950_s with the organochlorine insecticides, including DDTs, lindane, endrin and other organochlorine, insecticides, which were used extensively for agricultural control of insects until 1982. These groups are characterized by long persistence in the environment and bio - accumulation in fatty tissues. More than 13,000 tones of DDT, 45,000 tones of toxaphene, 10, 500 tones of endrine and 11, 300 tones of lindane were used in Egypt in the period between 1952 and 1981 (El-Sebae 1982).

Organophosphorus insecticides, such as dimethoate, diazinon monocrotophos, fenitrothion, chloropyriphos and formathion, are of great significance in pest control and increasingly used instead of organochlorine insecticides. Organophosphorus insecticides represent more than 80% of total insecticides used in Egypt during 2000. These compounds are much less persistent in the environment (Aly and Badawy, 1984) but are toxic to non- target creatures such as aquatic organisms, birds and some beneficial insects.

Among more developed insecticides used in Egypt are carbamates and synthetic pyrethroid. The carbamates are substituted esters of carbamic acid. Their advantage over other kinds of pesticides formerly used stems from the fact they are more biodegradable than the organochlorine compounds and are less toxic to mammals than organophosphorus pesticides. However, some carbamates are highly toxic such as aldicarb (LD50 1 mg/kg) and some others are suspected carcinogens and mutagens (Njagi and Gopalan 1980).

Aldicarb and methomyl are widely used in Egypt as carbomate insecticides. These compounds and their metabolities are highly soluble in water (Miles and Delfino 1984), and their stability under certain environmental conditions has made them serious threat to drinking water (Lemely and Zhong 1984). Aldicarb is systemic pesticide, applied directly to plant roots so that upon irrigation it can easily leach into groundwater (Jones 1986).

4.3.7.2.Fungicides

Fungicides account for 65.5% of pesticides used in Egypt, agricultural use constitutes the majority of applications. Fungicides used are mainly inorganic, and include 593.7 tones Cu oxychloride and 9118.8 tones sulphur. However, the amount of total organic compounds used as fungicides was 1786.1 tones. Captan, chlorothalonal, moncozeb, malathion, metalaxy and thiophenoate are among the most used organic fungicides. Among the crops requiring fungicide treatment are potatoes, tree fruits and berries. Fungicides containing the active ingredients mancozeb and chlorothalonil are commonly used in potato and orchards fields. Grapes and strawberries are treated with thiophanate- methyl.

4.3.7.3.Herbicides

Herbicides account for less than 4% of the pesticides used in Egypt. Among the most used compounds atrazine, glyphosate, bromoxynil and furon. Herbicides are used to control weeds and to kill the tops of potato plants before harvest. The use of herbicides has dropped since the early 1990_s and the phenoxy compounds, 2,4-D and 2,4,5-T, were replaced by atraizne and glyphosate herbicides. The total amount of herbicides reduced from 1352.5 tones while in 2000 it was 584.7 tones.

In 1952 the total usage of pesticides was only 2000 tones. Since then, pesticides use has been increased to reach its maximum in 1975 (Table 1). Starting from a shift was made to shorter-acting materials. The idea of controlling pests and vectors by biological programmes as an alternative to chemicals or in combination with pesticides becomes realized. Therefore, chemical pesticides use has been steadily declining.

Table (1) Amount of pesticides and chemical fertilizers used in Egypt

Year	Pesticides (tons)	Chemical fertilizer (1,000 tons)
1952	2,100	730
1960	16,300	1,400
1965	25,100	2,150
1970	25,600	2,450
1975	27,400	5,750
1980	20,500	4,500
1985	18,400	5,900
1990	17,200	6,240
1995	16,435	6,395
2000	6,500	-

In the Last few years, a significant decrease in pesticide consumption has taken place. In 2000, only 6,500 tones of pesticides were used, compared to 16,400 tones used in 1995. This decreased was largely the result of integrated pest management program (IPM).

Table(2) Commonly used pesticides in Egypt

Item	Amount of formulated materials (tons)
Organophosphorus insecticides	1,950
Carbamate insecticides	550
Synthetic pyrethroids insecticides	800
Photoxin	100
Acaricide(Kelthane)	500
Rodenticides	1,500
Fungicides	593
Herbicides	584

4.3.8. Laws and legislation of pesticide applications in Egypt

The pesticide monitoring law No. 53 of 1966 and the supplementary decrees No. 215, 381 and 256 issued in 1985, 1988 and 1990, control the introduction and handling of pesticides in Egypt. According to the law a Pesticide Committee (PC) under the Ministry of Agriculture (MOA) and the Ministry of Health (MOH) is responsible for enforcing the law. Introduction of new pesticides in Egypt include the procedures of registration, formulation and importation, and control on the use and handling of pesticides. The control is carried out by inspectors posted in each agricultural department of the Ministry of Agriculture and the Central Pesticide Laboratory in Cairo.

New pesticides are only accepted in the country after a long application procedure. This includes registration, followed by a period of testing during 3 years of field trials in which the effectiveness of the pesticide against the pest is investigated. The registration includes such data as the recommended rate of usage, treatment after misuse (poisoning), production data, warning signs and toxicological data. After acceptance and recommendation of the pesticide, these data must be indicated on the pesticide package. Upon importation of large quantities of pesticides, PC is authorized to take representative samples of the pesticides to cheek the chemical and biological contents.

4.3.9. Integrated Pest Management (IPM)

No doubt chemical pesticides are still the major crop protection agents in Egypt even while application of these chemicals has had a negative environmental impact. Integrated Pest Management (IPM) is an ecologically based pest control strategy that considers all available management options, including inaction. The principle objectives of IPM are to develop economically, socially and most of all environmentally acceptable pest control tactics and the managed resource as a component of a functional ecosystem.

The Ministry of Agricultural (Egypt) has taken several measures to reduce pesticide application and limit its hazardous effects on the environment. Among these actions, implemented tinder the IPM programme, are: application of less-toxic pesticides, use of natural products as pesticides agents, releasing predators to cat rodents and insects in cultivated areas, seeking suitable cultural methods and balanced fertilizer use to help decrease pest populations, introducing genetic engineering technology to increase plant resistance to pests, improving sprayer techniques, use of non-toxic bioregulators to increase plant resistance to pests, use of genetic manipulation messenger chemicals such as sex attractants and establishment of database systems in pest control programmes.

4.3.10.Pesticides Residues in the river Nile system:

River Nile

Beta HCH , lindane, aldrin, dieldrin, heptachlor, endrin, p,p'DDT, and its analogous were detected in the River Nile (Table3. The highest detected level of DDTs was at Aswan Dam, reaching 1.048 ug/l, which is considered slightly above World Health Organization and Egyptian guidelines of 1 ug/l in the drinking water. The highest concentration of total organochlorine insecticides was found 7.5 km up-stream of Aswan (2.275 ug/l).

High concentration of p,p'DDT in water samples taken from upstream of Aswan sites indicated to a recent application of the product by some upstream countries. In general, levels of organochlorine insecticides in River Nile water are still within safety margins, compared to the permissible limits for drinking waters (WHO 1984).

The residue levels of organochlorine insecticides and PCBs in water and sediment samples collected from River Nile were determined. Seven sites were selected to represent different regions in Delta Nile and El-Rayah El-Beheiri. These sites are Delta Barrage at Cairo Kafr El-Ziate, Desouk, Edfina, Rosetta, El-Mansora and Demitta. Kafr El-Ziate was the most polluted location showing 1495 ng/l for water and 7.4 mg/kg for sediment. However at Rosetta, who is down stream with respect to Kafr El-Ziate, the total concentration of organochlorine insecticides and PCBs (GT) was decreased to reach 473.98 ng/l for water and 3.8mg/kg for sediment. (Abdalla, 1989).
The levels of organochlorine insecticides had been monitored in Tilapia fish collected from different locations in the River Nile and two canals. BHC, lindane, DDT and its metabolites were identified and quantified. Fish samples collected from El-Mahmodia and Abo El-Gheit canals were found to contain higher levels of organochlorine insecticides than samples collected from River Nile (Table 3. This may be due to the pollution of these canals by pesticides as they are located in agricultural areas and subjected to the application and leaching of pesticides. Data in Table (3) showed that p, p' DDT and its metabolites were predominant in fish samples collected from Manzala Lake and River Nile. Also, the results demonstrated that fish samples from both locations are contaminated with low levels of OCI and PCBs.

Drains and Irrigation Canals

Drains are of concern because their water is reused for irrigation and drainage water from pesticide-treated land is pumped into major drains that finally discharge their waters into the River Nile. It was estimated that 4 billion m3 of drainage water from agricultural drains returns to the River Nile or Lakes (Welsh and Mancy, 1992). El-Serw and Hadous drains are of significance as they play a major role in north Sinai development project. Water from two drains will mix with the Nile River at Dimitta branch at 1:1 ratio to go to El-Salam canal. The highest amount of total DDTs was found in Hadous drain it reached 451ng/l. The mean concentration for lindane and PCBs was 7.6 and 14.5 ng/l, respectively (Badawy et. al., 1995).

A study of drains in 1991 showed that DDT and its metabolites were common at all location, reaching the maximum in the Delta regions and the minimum in the pesticides factory out- fall. The highest level of DDTs was detected after winter closure period in Delta Barrage.
The residues of organochlorine insecticides in Upper Egypt drains were evaluated Beta -HCH, lindane, heptachlorepoxide, DDT and its metabolites were detected in all water and sediment samples. However, aldrin and dieldrin were not detected. DDTs were predominate components in the samples, reaching the highest concentration (1553.6ng/l) in water samples collected from the Desamy drain and 36.56mg/kg in sediment samples from the Etsa drain.
Little information is known about canal pollution with pesticides in Egypt. However, canals are probably polluted with pesticides that come from land use, spray drift, washings of spraying equipment, or from River Nile.

Ismaillia and El-Mahmodia canal are the main sources for drinking purposes and irrigation in the Suez Canal area and Alexandria. PCBs have been identified and quantified in two canals. The maximum concentration (77 ng/l) was detected in the samples collected from Ismaillia canal. In El-Mahmodia canal, the main source of drinking water supply in Alexandria, organochlorine insecticides have been measured in water and fish samples. Water analysis results indicated that the average concentration of lindane and its isomers ranged from 0.39 to 6.26ng/l. However, the average concentration of p,p’ DDT and its metabolites ranged from 1.2 to 30.8ng/l. The maximum concentrations of heptachlor, and heptachlorepoxide were 0.12 and

0.65 ng/l, respectively. These results indicate that organochlorine insecticides residues are far below WHO guideline (1984).

Table (3) Quantity of the Most Frequently Used Pesticides, Applied in the Different Governorates

Governorate	Pesticides used (ton/year)					area(1000 feddan)[1]	of use (kg/ feddan)
	eb	Malathion	Dimethoate	- os	yl		
Qena, Souhag	44	58	24	55	11	713	0.27
Assiut, Minia, Beni Sueif	176	37	127	36	60	853	0.51
Fayoum	55	26	36	26	16	379	0.42
Giza, Cairo	58	70	27	68	18	183	1.32
Qalubiya	58	28	19	27	10	299	0.47
Minufiya	76	36	43	35	27	380	0.57
Sharqiya	150	43	79	42	35	860	0.41
Beheira	219	91	154	88	79	928	0.68
Other governorates Delta	108	77	57	76	32	1.050	0.33
	944	644	566	453	288	5.645	0.48

1) Net Cropping Area of the Considered Crops

Coastal Lakes

The distribution and residue levels of BHC, lindane, endrine, p,p'DDT and its metabolites in Mugil and Tilapia species collected from Egyptian Delta lakes were evaluated (Table 4). Residues of BHC and p,p'DDT were found in all fish samples collected from four lakes. The high levels of p,p'DDT and p,p'DDD in fish samples is an indication of recent application of DDT. The order of mean concentration for total organochlorine insecticides tends to be Edku (39.03-61.44)> Maryut (28.57-38.78)> Manzala (22.40-25.13)> El-Borullus (8.82-39.02), results are represented in ug/kg wet weight. The order is a function of the amount of pesticides received by the lakes, their area, and their ability to exchange their water. Edku Lake has no

access to the Mediterranean Sea and receives both municipal and agricultural wastewater. Maryut Lake though linked with the sea and has the smallest area as compared with other lakes. Manzala Lake, which located in the most productive agricultural region of the Nile Delta, receives municipal and agricultural wastewater. However, the lake exchanges its water with the Mediterranean Sea and Suez Canal, and receives fresh water from its associated canals. Hence, the dilution effects and the extended area of the lake tend to decrease the concentration of residues. El-Burullus Lake has direct access to the Sea is located in a less developed agricultural region, and its area comes next to that of Manzala Lake (Badawy and El-Dib, 1984).
With regard to residual pesticide concentrations in lake Manzala , analysis carried in 1990 (UNEP,1992) indicated the presence of BHC, heptachlor , aldrin, p,p'DDT and its metabolites. The highest concentration was that of p,p' DDE which ranged between 18.2 and 173.3 ng/l, with an average value of 76.87 ng/l. Average concentration of malathion (organophosphours insecticides) was 425 ng/l.
A recent survey carried out by Badawy and Wahaab (1997) confirmed that the concentration of p,p'DDE in sediment samples in Manzala area near the major drains is rather high. This implies that: (1) the situation may have been worse in the past when DDT was more frequently applied, or (2) The drainage channels may assist the degradation of p,p' DDT to its anaerobic degradation product p,p'DDE prior to discharge into the Lake.
The concentration of chlorinated insecticides and PCBs in fish and sediment are generally low in samples collected from Lake Manzala area. Therefore, the health risk from chlorinated hydrocarbons is insignificant. The most significant contamination was observed in the samples collected from the lake near the major drains. Referring to the FAO/WHO acceptable daily intake (ADI) can assess the public health implication of fish contamination by the chlorinated hydrocarbons. The percentage of ADIs for lake Manzala fish ranged from 0.02% to 4.8% and the public is not at risk from fish consumption, even if totally dependent upon fish as a protein source (Badawy 1998).
Organophosphrous pesticides have rapidly replaced the persistent organochlorine compounds for most pest control purposes. Some of the organophosphours pesticides however, are present in the marine environment for an appreciable period of time, particularly associated with sediments. They are usually characterized by a very high specific toxicity but for the most part of aquatic environment they are not readily accumulated in living tissue. They are normally therefore, associated with events of acute toxicity (fish kills) or cause a weakening of critical metabolic processes (cholinesterase inhibition).

The measurement of several OP pesticides in the sediments of Lake Manzala reveals a previously unsuspected threat to the environment. Levels of these compounds are quite low but there is still insufficient information in the scientific literature to link dose/effect relationships. It is impossible to evaluate whether the measured concentrations pose a threat to the environment.

Their presence, however, gives some cause for concern as they may reflect sporadic discharges to the aquatic environment through the drains. Such discharge could cause fish kills. There are also unconfirmed reports that fishermen in the region occasionally employ Alathion or other compounds as a poison for catching fish with pesticides from agricultural drains.

Table (4) Organochlorine Insecticides and PCBs in River Nile & branches

Sampling Site	ng/L					
	SHCH	SHCBs	SDDTs	Cyclodiene	EOCs	PCBs
Lake Nasser	650.46	81.30	841.47	20.86	1594.1	59.86
Aswan	220.36	36.66	1048.24	28.50	1333.8	56.38
Kom Ombo	187.71	31.16	1035.25	41.27	1295.4	85.65
Esna	177.62	32.20	586.3	75.37	871.49	15.65
Naga Hamady	123.16	24.56	297.72	40.65	486.09	32.84
Assiut	143.65	28.37	100.56	75.28	247.86	58.46
El-Minia	163.76	30.35	82.42	16.77	293.30	28.58
Beni Suef	285.40	42.85	56.83	26.50	411.58	25.30
Delta Barrage	22.00	10.00	2.65	29.75	64.40	8.28
Kafer-El-Ziate	249.34	49.65	29.75	415.37	744.16	652.84
	166.27	53.56	37.21	186.82	443.86	295.46
Edfina	107.26	77.80	10.133	228.11	423.30	71.76
Rosetta	185.87	16.70	98.51	32.39	333.42	140.52
El-Mansoura	151.01	92.61	102.67	48.43	394.72	32.43
Demietta	26.12	3.90	90.87	65.57	186.46	73.66

∑ HCHs = α, ß and ¥ HCH
∑HC ßs = α, ß and ¥HCB
∑OCs = Total organochlorine insecticides
∑DDTs = P, P' DDE + P, P' DDD +P, P'-DDT
∑ Cyclodiene = P, P' heptachlor + P, P' aldrin + heptochlorepoxide

Source: Wahaab, R.A. and Badawy, M.B. (2004) .

4.3.11. Fertilizer

Very little information could be made available on fertilizer use and its partition over different crops and/or governorates other than that the total amount of fertilizers used in Egypt amounts approx. 6.5 million tons/year. The excess use of fertilizer and the eventual leaching of fertilizer towards surface and groundwater have been further studied. The pollution potential of fertilizers use can be best demonstrated from the fact that if 10 % of the fertilizer leaches to the agricultural drains, drainage water salinity would increase with approx. 50 mg/l. This does not seem dramatic. However, fertilizer mostly consists of nitrates and phosphates, which in concentrations of around 50 mg/l cause severe eutrophication problems in drainage canals and other water bodies that
indirectly receive drainage water. Excessive use of chemical fertilizers persisted due to agriculture production intensification and attempts to reach the highest production possible/unit area. Usage rates of fertilizers have soared compared to international rates. This has led to increased concentration of nutritious elements in drainage water leading to the eutrophication of irrigation and drainage water and the pollution of Northern lakes. Soil and water pollution has also increased due to the irrationalized use of different pesticides. In addition, wastewater and industrial drainage leakage into watercourses has exacerbated soil and water resource pollution.

4.3.12. Salinity

The salinity measurements made by (Drainage Research Institute (DRI) in the Delta show that closer to the Mediterranean Sea, salinity in the drainage water increases, to reach level close to 10,000 mg/l close to the coast. Although part of the salinity increase may be caused by leaching of salts from the soil, it is believed that most of this increase is caused by upward seepage of brackish groundwater. This theory is supported by observations from DRI and RIGW with regard to chemical composition (major ions) of adjacent drainage and ground water. At the same time, simple calculations show that the present salt.
In the context of water quality management, agriculture must be seen as a widespread non-point source of pollution. Pollutants include leached salts, nutrients like nitrogen and pesticides. These non-point sources will be collected in agricultural drains to form point sources of pollution for the River Nile, lakes and irrigation canals. Although there are different mechanisms for retaining the pollutants by passing the polluted water through soil, the non-point sources of pollution may influence the groundwater quality.

It is estimate that because of irrigation in Upper Egypt, nearly 2.3 Bm3 of drainage water is returned to the Nile annually, either directly or indirectly. This mean that total soluble salt concentration of the Nile is higher in lower Egypt (250ppm) as compared to Upper Egypt (180-200ppm) (Abu Zeid,1988)-(Fig.11). Fortunately, because of the high dilution effect of the Nile, this increase in salt concentration is not significant in terms of any type of possible water use.

4.3.13. Assessment of Ambient Water Quality Status

Generally speaking, water released from Lake Nasser generally exhibits the same seasonal variation and the same overall characteristics from one year to another.
Downstream changes in river water quality are primarily due to a combination of land and water use as well as water management interventions such as:

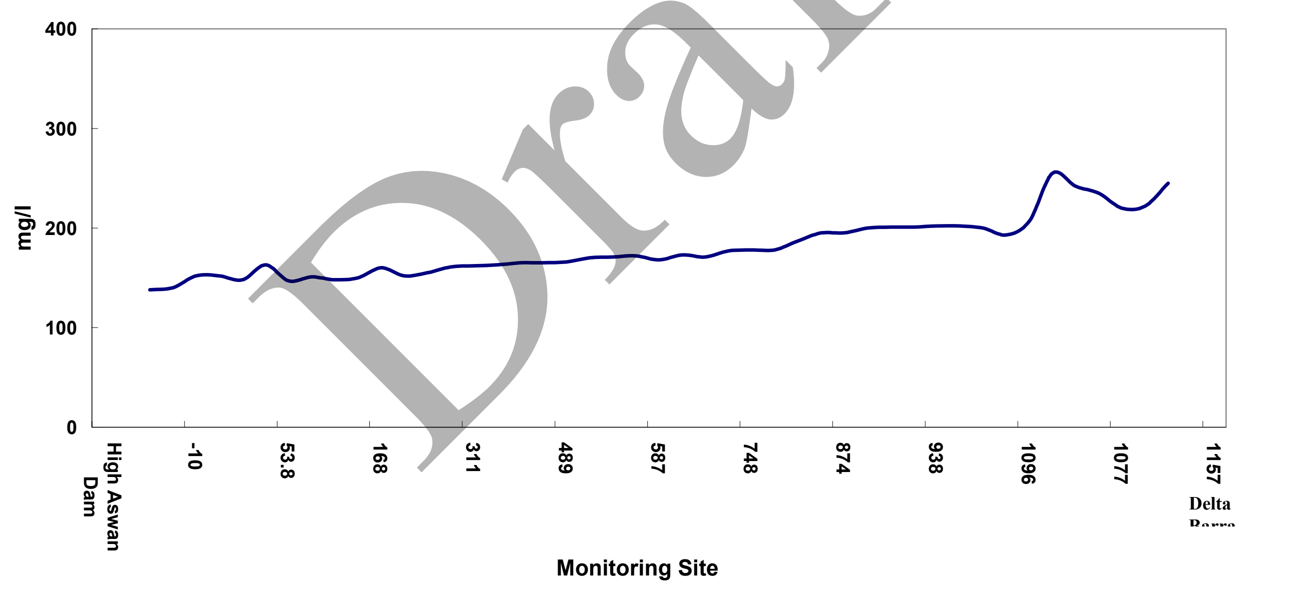
(a) different hydrodynamic regimes regulated by the Nile barrages,
(b) agricultural return flows, and

(c) domestic and industrial waste discharges, including oil and wastes from passenger and river boats.

4.4. River Nile from Aswan to Delta Barrage

Chemical Contamination— From the available data, the following can be concluded that Dissolved Oxygen Concentration (DO) situation is not alarming. Specific "hot spots"could not be detected. In all monitored sites DO concentrations were higher than 7.0 mgO_2/l, indicating the high assimilation capacity of the Nile. Chemical Oxygen Demand (COD) values showed slight, but steady increase from south to north. 21 samples out of the 35 samples were not complying with the standard value given by law 48/1982 for ambient water quality (10 mgO_2/l). Biochemical oxygen Demand (BOD_5) which is a measure for biodegradable organic compounds showed a random distribution but did not exceed the standard value (6 mgO_2/l) given by the law. The relationship between COD/BOD values indicates the presence of nonbiodegradable organic compounds, from industrial sources. An increase
in TDS from 171 mg/l at Aswan to 240 mg/l at the Delta Barrage has been recorded. But this is within the permissible limit given by the law.

Figure (11)TDS for the River Nile as of February 2000



Biological Contamination—Law 48/1982 did not specify a standard for fecal coliform (FC) counts for the ambient water quality of the Nile River. Therefore, the value given by the WHO (1989) as a guideline for use of water for unrestricted irrigation (10^3/MPN 100ml) has been taken as a guide for the evaluation of the water quality in this report.

The results of the microbiological examination indicated a great variation in the spatial distribution of the fecal coliforms counts. Great exceedances have been found around the catchments areas of Kom Ombo, El-Berba, Main Ekleet and Fatera drains. FC counts in the water samples taken from the specific bank side, where the drain water is pumped, are even higher. This proves the presence of untreated human wastes in these drains.

4.5.Damietta and Rosetta Branches

6.2.1 The Damietta branch

Major sources of pollution to Damietta branch are Talkha fertilizers factory, High Serw Drain and high Serw Power station.

Assessment of the results of the monitoring trip which was carried out during February 2001 indicates the following:

- Dissolved oxygen concentration ranged from 7.8 mgO_2/l at its southern part to 6.2 mgO2/l ,at the northern part.
- Nutrients concentrations (nitrogen & phosphorus) were within the permissible limits.
- The chemical oxygen demand exceeded the standard set by law 48/1982.

Table (9) Effluent (m3/day) discharged to agriculture drains in Delta

Drain	Domestic point Sources m^3/day	Industrial Point Sources m^3/day	Domestic Diffuse source m^3/day	Agricultural Diffuse source m^3/day	Total m^3/day
Bahr El-Baqar	184000.0	64268.0	122795.0	4521678.0	6548741.0
Bahr Hados	80000.0	6135.0	207754.0	4836000.0	5129889.0
Faraskour	2490.0	0.0	13272.0	186758.0	202520.0
El-Serw El-Asfal	7710.0	0.0	18769.0	508515.0	534994.0
El-Gharbia Main	156500.0	44460.0	293315.0	3927556.0	4421831.0
Tala	179.0	300.0	45076.0	1087148.0	1134318.0
Sabal	79000.0	0.0	39925.0	1196384.0	1315309.0
No. 8	0.0	0.0	42428.0	469848.0	512276.0
Bahr Nashart	22000.0	13968.0	108915.0	968859.0	1113742.0
No. 7	12500.0	0.0	39778.0	390056.0	442334.0
No. 1	39350.0	20960.0	78329.0	1204654.0	1343293.0
No. 9	0.0	0.0	88029.0	595644.0	683673.0
Zaghloul	0.0	0.0	1838.0	122890.0	124728.0
Edko	20000.0	7470.0	57346.0	4232034.0	4316850.0
Borg Rashid	0.0	0.0	0.0	311246.0	311246.0
El-Umoum	25000.0	0.0	81890.0	5163208.9	5270098.9
Abu-Keer	0.0	22897.0	15803.0	621592.2	660292.2
El-Batts	22396.0	0.0	26213.0	1468340.8	1516949.8
El-Wadi	3000.0	0.0	13272.0	1600340.6	1616612.6
Total (m^3/day)	2311740.0	180458.0	1294747.0	33412752.5	37199697.5
Total Billion $m^3/year$	0.84	0.066	0.47	12.2	13.6
% Ratio	6.2%	0.5%	3.5%	89.7%	

- BOD values comply with the consent standard.
- TDS increased from 240 mg/l up to 372 mgO_2/l, but the values are still within the permissible limits are not significant in terms of any type of possible water use.
- FC counts exceeded the WHO Guidelines in almost all sampling sites. This is an indication of the discharge of human wastes in Damietta branch

4.6.Rosetta Branch

High concentrations of organic compounds, nutrients and oil & grease were recorded. Major sources of pollution are Rahawy drain (which receives part of Greater Cairo wastewater), Sabal drain, El- Tahrrer drain, Zawiet El-Bahr drain and Tala drain. At Kafr El-Zayat, Rosetta branch receives wastewater from Maleya and Salt and Soda companies.

Dissolved oxygen concentrations, as indicated by the results of the February 2001 monitoring trip ranged from 5.1 mgO2/l at the southern part to 6.3 mgO_2/l at the northern part of the branch.

Nutrient concentrations are within the permissible limits. COD and BOD values exceeded the standards, but were similar to those recorded for Damietta branch.

TDS ranged from 240 at Delta barrage up to 415 mg/l at the end of the branch. With regard to FC, high counts were detected at Kafr El-Zayat, after which the water complied with the WHO Guidelines (1989) for unrestricted irrigation.

5.Northern Lakes

The river Nile has tow main branches, and many man-made distribution canals and drains that collect drainage water from irrigated lands. These drains dump its water into four ancient depressions, forming lakes along the delta coast. These four lakes (Manzala, Burullus, Edku, and Mariut) represent a vital economic resource in Egypt, due to their shallow depths and huge quantities of nutrient-rich water disposed from agriculture drainage. They produced 152,095 tons of fish harvest in 1998 which represents 28% of the total fish production in this year.

5.1.Lake Manzala

Lake Manzala is the largest northern lake. It is situated in the northeast corner of the Nile delta, and falling in the jurisdiction of five governorates. It is separated from the Mediterranean Sea by a sandy beach ridge which has three open connections(bugaz) between the lake and the sea. The surface area of the lake is 280,000 feddans. Lake Manzala has the largest fishery production (78,261 tons in 1998) compared to the other northern lakes. The fish species of the lake have been changed, which previously were characterized as marine fish.

After the construction of AHD, the mullet –based brackish water fishery has been replaced by tilapia–based fisheries due to the constant inflow of freshwater with high nutrient concentration. Tilapia represented about 51% of the lake fishery while mullet represented about 3.6% of the total harvest.

The gradual reduction in fish biodiversity is attributed to the decrease in overall salinity. Additionally, water pollution and excessive eutrophication in the southeast region is the major indicator limiting the species inhabiting this region to the tolerant ones.

5.2.Lake Burullus

Burullus lake is situated along the Mediterranean coast and occupies a more or less central position between the two branches of river Nile. The lake is oval in shape with estimated area of about 114,520 feddans. It is a shallow basin with variable depth ranging between 0.6 and 1.6 meters.

The lake has about 70 islands, of which 55 are artificially created by filling reed-infested area with soil. Burullus lake receives its water from different sources:

- sea water, through natural inlet at it's northeast border;
- brackish water dumping from agricultural reclaimed areas and drains; and
- brackish-salty water, through the bramble Manila on the wet coast.

After the closure of AHD, margins of the lack were made develop land reclamation for agriculture expansion. Eight drains were constructed to leach the soil salinity into the southern shore of the lake. Burullus lake is considered one of the highly productive lakes in the Mediterranean with about 31% of the delta lake's area. Burullus lake produced 59,033 tons, representing about 42% of all delta lakes. It has the most productive mullet fishery of the delta lakes due to wide lake- sea connection, which allows high recruitment of mullet fry from the sea each year.

During 1960s and 1970s, the lake produced the highest percentage of mullet out of the total mullet catch. However, starting 1980s, there has been a limitation in water exchange through the connection with the sea, which resulted in reducing marine water zones in the lake. In 1998, Tilapia presented 60.4% in lake catch (35,700 tons) while mullets and other marine species presented 20.1% (11,885 tons). The fishery of sea had gradually decreased in 1991, and completely disappeared in 1999. This indicates that the environmental changes in the lake are in favor of species preferring water with lower salt content.

5.3.Edku lake
It is the smallest northern delta lakes. It is located about 30 km to the Northeast of Alexandria. The lake area reaches about 27,470 feddans. Edku lake is the third fishery productive among delta lakes (10,280 tons in 2001). The source of lake water is coming from two agricultural drains. Bersik drain enters the lake from the southern edge and Edku drain enters from eastern side of the lake. Exchange of water between the northern side of the lake and the sea is insured through a narrow slit 'Boughaz El-Maadia'. The area of the lake is divided into three basins due to emergence of a number of islets.

The salinity of Edku lake varies locally and seasonally. It fluctuates from less than 0.09 % in the eastern basin to about 1.4 % at El-Maadia region inside the Boughaz. Edku lake contributes 7% of the overall production of northern lakes (10,300 tons), of which 90% Tilapia and only 5% mullet.

5.4. Lake Mariut
Mariut lake is situated southwest of Alexandria along the Mediterranean coast. The area of the lake is 15,000 feddans. Mariut lake receives a water blend of agricultural, domestic sewage and industrial wastes from several anthropogenic sources. The main inflows are through Nubaria canal, and various large drainage channels serving the rich agricultural area of the Nile delta. The other sources are the Umum Drain (agricultural rain), Qalaa drain (mixed wastewater), rainfall, and Alexandria urban and industrial wastewater beside seepage of groundwater from the surrounding area.

AHD stopped the annual autumn flooding of the Nile into the lake, although Nile water still enters the lake in a more controlled manner through the Nubaria Canal. The loss of silt deposition by the Nile in the delta has lead to increased fertilizer use to maintain soil fertility. This process has raised the opportunity to greater nutrient inputs to the lake via drains.

Fishery statistics show that Mariut lake was the most productive (14,000 tons per year) lake during 1974-1977 compared to the other northern lakes. Since 1980s, its productivity began to decrease from 14100 tons in 1980 to 5,500 tons in 1985, reaching below 2,000 tons in 1990, and then remained in the average of 3,500 to 4,506 tons. Mariut lake has no connection with the sea, so no marine fish were found in catch in 1998. Tilapia and catfish contributed 72%and 27% of the harvest while Eels and grass carp 1% and mullets 0.02%.

5.5. Qarun lake
Qarun lake is an inland closed basin of 23,000 ha, and an average depth of 8 m. In the ancient times, Qarun lake was connected with river Nile forming a natural reservoir of freshwater, which supplied Fayoum depression with floodwater of the Nile. Whenever the lake became disconnected from the river Nile, its water level lowered and its surface

shrunk due to evaporation, until a new flood raised its level and size again. Consequently, salinity has been steadily increasing.

The mean salinity had increased from about 11 ppt in 1906 to about 34 ppt in 1982, and at present, the average salinity reaches 39 ppt. It is estimated that 589,000 tons of salt enters the lake annually. If the level of salinity to continues increase, it may reach 50 ppt by the year 2020 transforming the lake into a dead sea. The only source of water supplying the lake is the agricultural drains (especially wadi and Bats drains).

With the increase in salinity the fish funa changed; freshwater species disappeared, and were replaced by introduced species from the Mediterranean: mullets, sole, and shrimps. The annual maximum sustainable yield (MSY) for nutrient-rich marine enclosure would be in the order of 75 kg/ha, or, for the whole lake, some 1,700 tons. This yield was reached in the seventies, but thereafter it decreased to 1,500 tons in the late eighties and to around 1,000 tons now (40% tilapia species,20% mullets,10% sole, and 10%shrimps). This decrease is partly due to hypersalinity in some areas. There were several stocking programs to the lake started in 1929 with mullets, in 1938 with soles, in 1970 with sea bream, sparus aurata, sea bass, dicentrachus labrax and eels, Anguilla species were introduced and prawns' species was transplanted to the lake in 1977.

The harvest composition has changed due to the high salinity level of the lake. Glancing at the 2002 harvest, green tilapia (tilapia Zillii) represents about 49 % of the catch, mullet 27,5%, soles 16,3 % and shrimp 6%.

5.6.Wadi Al-Rayaan Depressions

In mid seventies, the yearly increasing volumes of drainage water of the Fayoum depressions threatened to raise the level of Qarun lake beyond acceptable levels. Therefore, a tunnel was constructed to spill excess drainage water to Wadi El Rayaan depressions, resulting in two lakes (Rayan I and Rayan III), connected by a connection waterway. The connection is called Rayan II.. The total area of the lakes amounts to 18,000 ha.

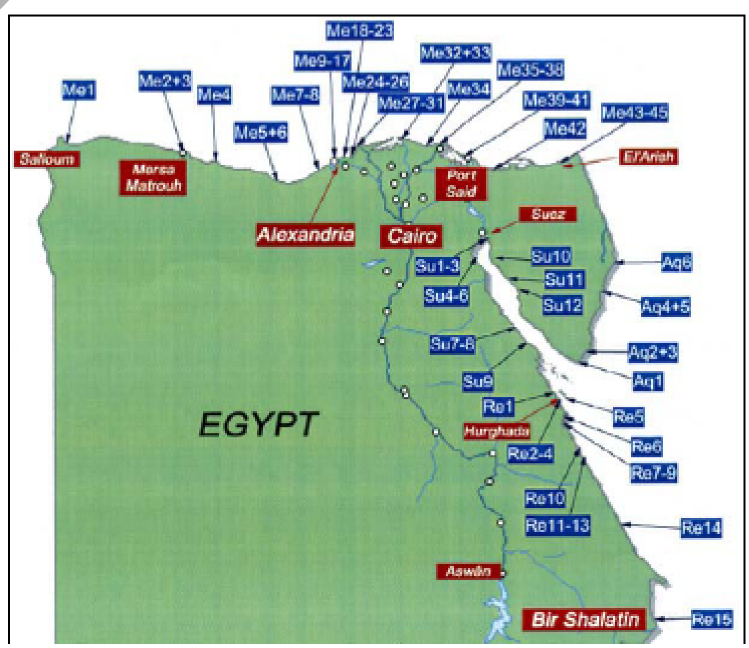
Fishing activities have started in 1983. The present production is in the order of 1,073 ton (of which tilapia 42-9%, mullet 29.5%, Nile perch 14.2 %, and carp 7.2%). With no precipitation and a very high evaporation rate, a rapid increase in salinity takes place. For the dominant fish species small further rises in salinity are ineffective; the production will move towards more tilapia and a larger share of mullets.

6.0.Coastal Zones

The Egyptian coastline extends 3000 kilometers (World Resources 2004) along the Mediterranean Sea and Red Sea beaches in addition to the Suez and Aqaba gulfs. Natural conditions on Egyptian Mediterranean coasts differ significantly from those on the Red Sea coasts in terms of salinity, sea currents and temperature. Such difference has led to different biodiversity and ecosystems in each.

Nearly 40% of industrial development activities are practiced in Egyptian coastal zones, in addition to a number of urban and tourism development activities. Furthermore, coastal zones monopolize the seaports infrastructure, in addition to agricultural and land reclamation sectors, as well as a developed road network capable of accommodating all development aspects. Egyptian coastal zones production is estimated at 85% of Egypt's production of oil and natural gas; The Gulf of Suez production alone is estimated to be 36 million tons. In addition, the crude oil and natural gas production in the Mediterranean coastal zones is increasing every year.

Through many joint efforts on the regional and international levels under the Global Program of Action for the Prevention of Marine Pollution From Land-based Activities (GPA/LBA & MEDPOL), it was possible to identify many polluted areas in need of urgent action. Most of the adverse impacts were identified and their volume estimated in order to enable their elimination.
Data pointed out to the existence of ***hot spots*** that need special attention where pollution has exceeded permissible limits, such as Abu Qir and El Max.
Environmental inspection program results indicated an increase in the number of land-based sources that have adjusted their status and complied with Egyptian Laws and regulations, or that have active environmental compliance programs in place.
Moreover, evidence provided by applied marine environment quality monitoring programs showed a noticeable improvement in the quality of marine environment since the launching of these programs in 1998, particularly in the Mediterranean Sea at the Hot Spots.

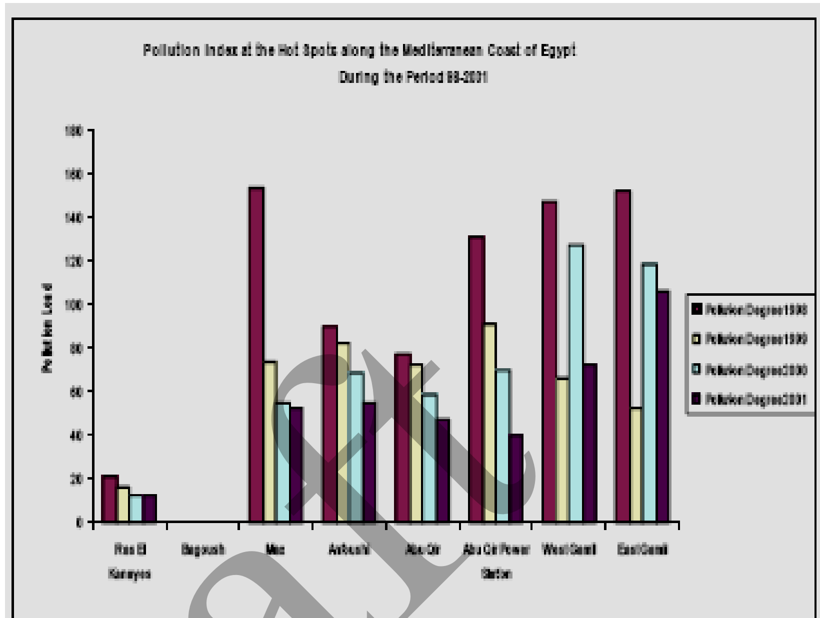


Monitoring Sites on Mediterranean Sea and Red Sea

6.1.Implementation of the Environmental Monitoring Program

The integrated coastal water quality monitoring program comprises a network of water quality monitoring stations, as reference stations, and other areas for water quality monitoring in polluted areas. Indicators showed a partial improvement in treated sanitation water quality and that most of it was disposed of following different treatment methods. Similar results were provided by marine and coastal environment water quality monitoring programs launched by EEAA - in cooperation with research institutes in Egypt and the Danish International Development Agency (Danida) – and also by pollutants monitoring programs implemented by the Mediterranean Action Plan (MAP) Programs.

The program included continual sample analysis for four years, from about 48 stations on the Mediterranean Sea and 41 on the Red Sea. Monitoring is undertaken once every two months along the Egyptian coast on the Mediterranean Sea from El Saloum to Rafah and from Suez to Shalatin on the Red Sea. A high-quality database was set up for this program based on international standards.



7.0.Water-Borne Diseases

Throughout history, epidemics related to water- borne or water-related pathogens have plagued Egypt (annex 1). Some of these events are briefly recounted (Helwa,1995) here as follows:

- The 1973 typhoid epidemics was localized in a small village in Damietta Province, where about 400 students and villagers fell ill.
- In the summer of 1983, infective diarrhea started in a small village in Giza Province and later spread to other areas. The causative organisms were isolated in drinking water network, which was contaminated by an overflow of sewage caused by broken pipe connection.
- The 1986 typhoid epidemic affected the old section of Suez City. It was the result of heavy contamination of the old water treatment plant intake by untreated human wastes.

The Ministry of Health monitors routinely for pathogenic bacteria, viruses, and parasites in natural water around Egypt. Results of these surveys indicate that the following pathogens have been found in Egyptian waters:

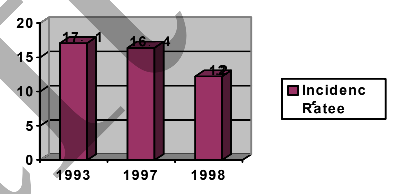


Fig.1. Incidence rate of Paratyphoid

- ***Salmonella***: Have been detected in Alexandria sewage discharged into Mariut lake, El-Mahmoudia canal and Alexandria beach.
- ***Shigella***: The causative agents of bacillary dysentery were isolated from Mariut lake. E.histlita and E.coli were detected also in tap water in Abbis II village even though water is treated and chlorinated.
- ***Vibrio Cholera***: As a preventive measure, local health authorities in Egypt collect 110 water samples daily from the Nile and main canals, at the intake point of water treatment plants, and from drains and sewage discharges. The samples have been analyzed for *Vibrio cholera*, with results so far negative.
- ***Parasites***: A clear decline in the presence of infective stage of human with Schistosomiasis (Cercaria). The results indicated a decreasing infected snails (intermediate host)population. Infected canals are by now treated with molluscicide.
- ***Hepatitis A virus***: No figures are available in Egypt
- Hepatitis E virus: Have been detected among children , specially in the rural areas.
- ***Viral gastroenteritis***: Gastroenteritis and diarrheal diseases are the most common diseases transmitted by water. These viruses are responsible for 40% among children's under five years of age in Egypt. These diseases are spread by fecal
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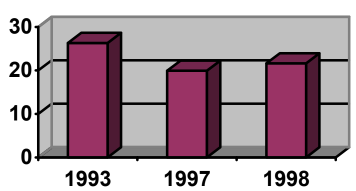
Fig.2.Incidence rate of viral hepatitis



contamination and transmitted to humans via contaminated water supply and food.
Fig.(1) shows the incidence rate of typhoid and paratyphoid decreased from 17.12/100.000 in 1993 to 12.2/100.000 in 1998, while Fig.(2) shows the incidence rate of viral hepatitis decreased from 26.3/100.000 in 1993 to 21.6/100.000 in the same year (Anwar, W.A. 1999).

- ***Poliomyelitis virus***: These viruses have been detected in sewage in Egypt. It is the only water-borne disease which has a potent vaccine giving testing immunity to vaccinated children. For this reason, the disease is now being eradicated in Egypt.

7.1.Factors responsible for contamination of Egyptian Waters:

- Eighty percent of the urban population is reported to have acceptable sanitation, including toilet facilities (55% in developing countries). Seventy–seven percent of the urban population is connected to public sewers.
- In rural areas only 5% of the population is connected to sewers and only about 25% is considered as having some sanitary facilities (15% in developing countries) (Egypt Environment Action Plan).
- About 20% percent of the total population(5% urban and 25% rural) lacks safe public drinking water supplies and rely instead on potentially contaminated, untreated surface water or hand pumps which tap often contaminated shallow groundwater.
- Not all the existing sewage treatment facilities are providing complete secondary treatment of wastewater, and the effluents discharged are either only partially treated or left untreated, especially in the rural areas of Egypt. In addition, in most cases many industries combine their wastes with sewage, discharging them into fresh waterways.
- The contaminated discharge of contaminated agricultural drain waters into fresh waterways constitutes a health hazard due to fecal contamination and the presence of pathogenic organisms.

It is worth mentioning however, that the contamination of natural water results in increased water purification costs and rates. Currently, there are a total of 63 drinking water treatment plants drawing from surface waters, 13 from the Nile and 50 from canals. In 13 of the 26 provinces, drinking water comes from unsafe sources, water samples collected from these provinces showed a high percentage of samples not complying with the bacteriological standards. This was more evident in northern delta, in Damietta, Ismailia, Port Said, Matrouh and Giza.
There are 308 compact water treatment units located on secondary and tertiary canals receiving drains water, 50% of which are located in Northern Delta, namely Dakahilya, Behera, Kafr Al-sheikh and Damietta. Due to poor operation of these units, frequency power failure and contaminated intake, people are consuming water of questionable bacteriological quality. Consequently, the potential for the spread of water-borne and oral diseases is high.

8.0.Ecological Zones & Forest

Egypt, with land extending about one million square kilometers under arid and hyper arid climatic conditions, is endowed with varied agro-ecological zones with specific attributes of resource base, climatic features, terrain and geomorphic characteristics, land use patterns and socio-economic implications. The zones could be identified as follows:

- **North Coastal Belts:** including North West coastal areas and Northern areas of Sinai.
- **The Nile Valley:** encompassing the fertile alluvial land of Upper Egypt, the Delta and the reclaimed desert areas in the fringes of the old valley.
- **The Oases and Southern Remote Desert Areas:** including East Owaynat, Toushki, and Darb El Arbien Areas and Oases of the old Nile valley
- **The Desert Inland:** including the plateau and dry valleys of Sinai and elevated areas in the Southern Eastern Desert

With an active participation of Egypt, the formulation of the UN Convention to Combat Desertification(UNCCD) adopted in Paris in 1994 , gave emphasis to combating the major threats to sustainability in countries of dry land. The main objectives of the Convention include the following:

- Prevention and/or reduction of land degradation.
- Rehabilitation of partly degraded land.
- Reclamations of decertified land.

Commitment by parties to UNCCD include preparing of a National Action Plan (NAP) to combat desertification. According to the convention, NAP should identify the factors contributing to desertification and prescribe the practical measures to combat it. Active factors of desertification and their impact are necessary varied. NAP of Egypt comprised of sub-components, each of which is geared to address the specific attributes of each agro-ecological zone distinguished.

8.1. Desertification and Man-Made Forests

The desertification of irrigated agricultural lands in Egypt is the result of various practices. One such practice is that of urban development, and building on fertile agricultural lands. In addition, despoliation of agricultural land through the erosion of the surface layer of the soil, has left the agriculture land infertile and rendered it unsuitable for cultivation. Likewise, the pollution of soil from wastewater, or from the use of pesticides and chemical fertilizers, and the salinization of agricultural soil are factors contributing to desertification.

Jatropha curcas in Luxor Forest

Egyptian-Chinese Friendship Tree forest at Sadat City

Egypt is currently witnessing many new projects aimed at expanding the green stretch in the deserts.

This is to be achieved by establishing forest plantations, i.e. man-made forests. Most of the man-made forests in Egypt are irrigated by treated sewage water, resulting in the production of trees with high quality timber.
In addition, Egypt has developed, and is currently implementing, a strategy for combating desertification. This includes the establishment of nurseries for the afforestation of new roads, the improvement of existing plantings along roads, and the stabilization of sand dunes through tree planting.

Programme Implementation Sites in Egypt

The main objectives of this National Program or NAP are as follows:

- Solve the problem of 2.4 billion cubic meter of accumulated wastewater; disposal of such quantity represents a major environmental problem.
- Benefiting from this huge water quantity and not squandering a water resource that could be exploited economically.
- Limiting the discharge of wastewater into the River Nile or in seas in order to prevent bacteriological and chemical pollution of water (from heavy elements and harmful organic compounds), and the degradation of fish wealth, river and marine bio-ecological systems. Discharging into open desert also pollutes both surface and deep underground reservoirs.
- Preventing adverse practices related to the use of untreated wastewater in producing agriculture and food products.
- Contributing to the provision of health benefits to individuals as a result of eradicating reproduction sources of insects and disease vectors caused by the accumulation of stale wastewater.
- Transforming an area of 400,000 feddans from desert into ecologically rich areas in terms of:
    1. Preserving the soil.
    2. Enriching natural and biological components in arid and semi-arid areas.
    3. Forming attraction and development zones for potential inhabitants of these areas.

4. Adding productive desert lands to the agricultural environmental system.

- Participating in cleaning air pollutants, adding climate soothing factors in arid and semi-arid areas mostly adjacent to desert boundaries, and protecting cities and housing areas from sand dispersion and dust storms.
- Participating in restoring the equilibrium of the biosphere components through increasing oxygen quantity and absorbing quantities of carbon dioxide.

8.2. Programme Implementation Sites

This program is implemented in areas surrounding wastewater stations in the different Egyptian governorates with a desert backlog as indicated in Table (1).

Table (1) List of established afforestation areas irrigated by treated sewage in Egypt

Sr.	Gover-norate	Forest	Area (Feddan)	Plant Discharge Capacity (m^3)/day	Irrigation System	Cultivated Plant Varieties
1	Ismailia	Sarabioum	1000	90000	Drip irrigation	Cupressus sp. – Pinus sp. – Khaya senegalensis – Casuarina sp. – Eucalyptus sp. – Morus sp. – Concarpus sp. – Agava sisalana – Dendrocalamus strictus
2	Mounefia	El Sadat*	500	18000	Drip irrigation	Cupressus sp. – Pinus sp. – Acacia saligna – Casuarina sp. – Eucalyptus sp. – Agava sisalana – Morus sp. – Khaya senegalensis – Ornamental trees and plants
3	Luxor	Luxor	1700	30000	Modified Flood and Drip Irrigation	Khaya senegalensis – Eucalyptus sp. – Acacia saligna – Morus sp. – Jatropha curcas
4	Kena	Kena	500	23000	Modified Flood Irrigation	Eucalyptus sp. – Khaya senegalensis
5	South Sinai	Tur Sinai	200	3500	Modified Flood and Drip Irrigation	Casuarinas sp. – Eucalyptus sp. – Morus sp. – Popular sp.
6	Aswan	Edfu	300	8000	Modified Flood Irrigation	Khaya senegalensis
7	New Valley	El Kharja	400	13000	Modified Flood Irrigation	Khaya senegalensis – Casuarina sp. – Eucalyptus sp. – Terminalia sp. – Tamarix sp.
8	New Valley	Paris	200	18000	Drip Irrigation	Cupressus sp. – Pinus sp. – Acacia saligna – Casuarina sp. – Eucalyptus sp.
9	Giza	El Saf	500	65000	Drip Irrigation	Khaya senegalensis – Casuarina sp.
10	Dakahleya	Gamasa	150	1500	Drip Irrigation	Cupressus sp. – Pinus sp.
11	South Sinai	Sharm El Sheikh	60	3000	Drip Irrigation	Casuarina sp. – Eucalyptus sp. – Ornamental trees and plants
	Total		**5510**			

* Egyptian-Chinese Friendship Forest

Table (2) List of under establishment afforestation areas irrigated by treated sewage in Egypt

Sr.	Governorate	Forest	Area (Feddan)	Plant Discharge Capacity (m^3/Day)	Irrigation System	Cultivated Plant Varieties
12	Aswan	Aswan	500	8000	Drip Irrigation	Khaya senegalensis – Acacia saligna – Eucalyptus sp. – Terminalia sp.
13	Aswan	Nasr El Nouba	100	1400	Drip Irrigation	Khaya senegalensis – Acacia saligna – Eucalyptus sp. – Terminalia sp.
14	Beni Sueif	El Wasta	500	10000	Drip Irrigation	Khaya senegalensis – Jatropha curcas
15	New Valley	Moot	700	10000	Drip Irrigation	Terminalia sp.
16	North Sinai	El Arish	200	15000	Drip Irrigation	Khaya senegalensis – Jatropha curcas
17	Assiout	Assiout	40	50000	Drip Irrigation	Khaya senegalensis – Jatropha curcas
18	Sohag	West of Sohag	1000	28000	Drip Irrigation and Modified Flood Irrigation	Khaya senegalensis
19	Sohag	East of Sohag	1000	28000	Drip Irrigation and Modified Flood Irrigation	Khaya senegalensis
20	Red Sea	Hurghada	200	10000	Drip Irrigation	Casuarina sp. – Khaya senegalensis
21	South Sinai	Noueiba	200	4000	Drip Irrigation	Casuarina sp. – Khaya senegalensis
22	Suez	Attakah	400	30000	Drip Irrigation	Jatropha curcas – Eucalyptus sp. – Cupressus sp. – Casuarina sp.
	Total		**4840**			

8.3.Ongoing activities and future plan action

Afforestation are currently cultivated and irrigated by treated sewage water. Some tember forests have been planted, and there are plans for providing necessary funding for cultivating 80 thousand feddans of forest-trees (10 thousand feddans annually), adjacent to sewage water treatment plants on the desert backlog. The project aims to cultivate 400,000 feddans using 2.4 billion cubic meter of treated wastewater annually.

Tree planting and green areas in Egyptian Governorates

Tree planting projects and increasing green areas are considered one of the most important projects given particular concern by the Ministry of State for Environmental Affairs.

The Ministry puts great efforts in contributing in the establishment of gardens in Greater Cairo and all other governorates.
The Ministry has also provided technical and financial contributions for developing slum areas and establishing public gardens and tree planting in their access roads, as well as exploiting empty spaces within cities and residential neighborhoods to increase green areas.

Agava sisalma in Ismailia Forest

Tree planting in Environment Youths Neighborhood, El Kharga Oasis

Green Belt project around Greater Cairo
The general objectives of this project are as follows:
• Spreading green areas in available empty spaces around the ring road of Greater Cairo to beautify the capital develop a feeling and care for trees and the taste of citizens.
• Contributing in environment pollution protection by intensifying greenery around Greater Cairo in order to mitigate harmful vital impacts affecting public health and safety.
• Investing the areas around Greater Cairo through tree planting for achieving national economic benefit from cultivated trees.

9.0.Biodiversity

Egypt's unique geographical position at the junction between two large continents (Africa and Asia), and its inclusion as part of the Mediterranean basin, has indelibly influenced both the people and the biota of the country socially, economically and biologically.

As part of the Sahara of North Africa, Egypt has the climate of the arid Mediterranean region, with notable differences between the coastal and inland areas. Under such harsh geographical and bioclimatic conditions, it is to be expected that the biotic wealth of Egypt is not only poor relative to the total area of the country, but also sparse and widely scattered. In the process of identifying the different types of fauna and flora in Egypt, certain groups (e.g. flowering plants) have been carefully surveyed and well-documented, while others (e.g. mosses and liverworts) have not received adequate attention. Each of these habitats has its unique fauna and flora and numerous land and marine areas are listed as protected sites. An estimated 18,000 species of flora and fauna are in the Egypt. With regard to flora, there are 44 species of viruses, 238 bacteria, 1,260 fungi, 1,148 algae, 369 non-flowering vascular plants and 2,072 flowering plants species. The fauna include 10,000 species of insects, 1,422 other vertebrates, 755 fishes, 105 reptiles and amphibians, 470 birds and 126 species of mammals[2]. However, to date, there are no clear statistics that quantify the rate of biodiversity loss in Egypt.

Egypt's biodiversity has faced threats from various sources. These include intensive agriculture systems, which entail the widespread use of agricultural chemicals in the form of fertilizers and pesticides. Another source of threat is the effects of industrialization. Industrialization programs have accelerated enormously in the second half of the 20th century, and have contributed to the rapid deterioration of the environment. Moreover, excessive hunting of animals and destruction of plant life have endangered the existence of several species of resident and migratory birds, as well as a number of hoofed animals (e.g. gazelles and antelopes).

Accordingly, Egypt is exerting tremendous effort to combat the threats to biodiversity through the conservation of wildlife, natural resources and natural habitat. This is clearly manifested in the declaration of 21 protected areas by prime ministerial decrees in accordance with Law 102/1983, covering about 8% of the total national surface, with plans to have this extended further to 17% by 2017(Table 1 & Figure 1) .

9.1.Biodiversity National Legislation

The legislative tools for biodiversity conservation and sustainable development in Egypt were issued as laws and ministerial decrease and can be summed up in chronological order as follows:

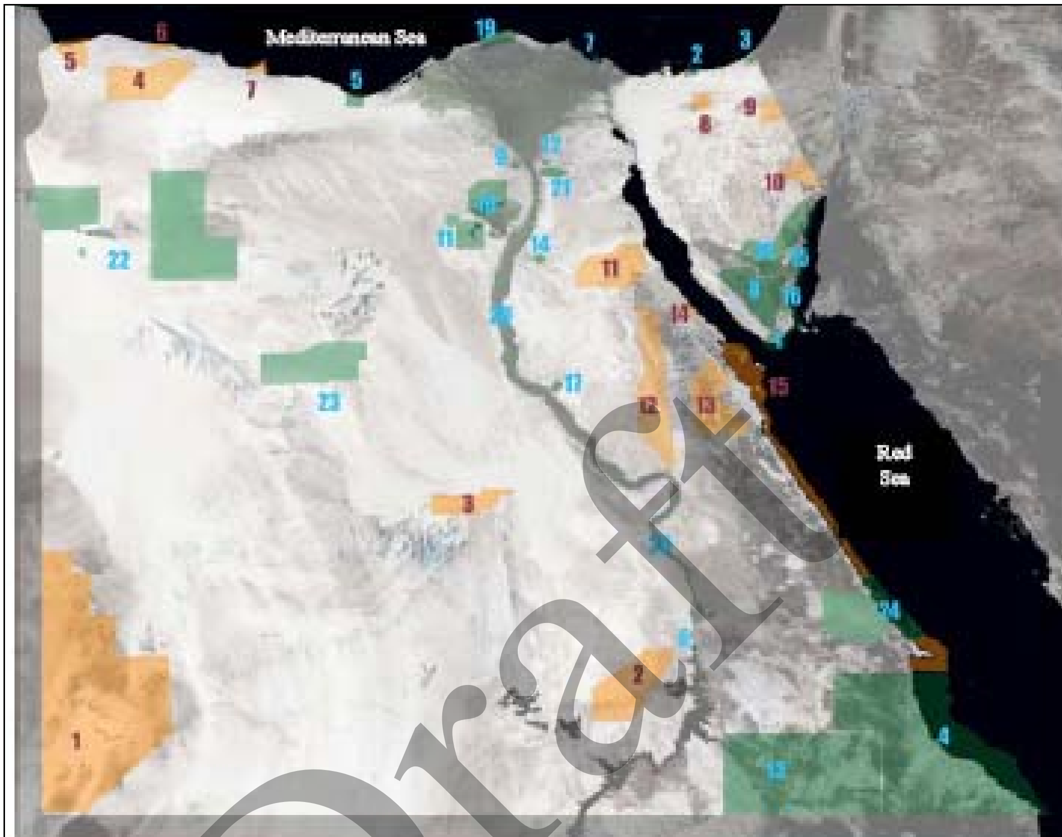
- Law 53 of 1966 (also known as "The Law of Agriculture"). Among the numerous articles and clauses of this law, article 117 prohibits the hunting of birds and other wild animals useful to agriculture. It also bans the trading and killing of these birds as well as the destruction of their nests. Article 118 of the same law prohibits the cultivation of plants harmful to these birds and wild animals, bans the importation of material used in their hunting and prevents the use of all forms of traps. The prevention of cruelty to animals is spelled out explicitly in article 119 .

- Ministerial decree 28 of 1967 specified the species of birds and other wild animals under protection covered by article 117 of the previous law.
- Law 72 of 1968 concerning the prevention of pollution of sea water by oil**.**

Table (1)Status of Species in Egypt

Category	**Known Species**	**Common Species**	**Uncommon Species**	**Rare Species**	**Threatened Species**	**Vulnerable Species**	**Endangered Species**	**Extinct Species**	**Insufficiently known**
Marine Algae	753	260	----	493	----	----	----	----	----
Freshwater Algae	871	794	----	----	----	----	----	77	----
Avifauna	452	436	----	----	5	10	1	----	----
Mammals	98	41	-----	28	----	----	10	5	14
Terrestrial Reptiles	91	41	----	22	11	6	11	----	----
Terrestrial Amphibians	7	4	----	3	----	----	----	----	----
Freshwater Reptiles	4	----	----	3	----	----	----	1	----
Freshwater Amphibians	7	3	----	4	----	----	----	----	----
Mollusks	41	24	----	16	----	----	----	1	----
Echinoderms in the Red Sea, Gulfs of Aqaba and Suez, and Suez Canal	207	131	----	76	----	----	----	----	----
Echinoderms in the Mediterranean Waters	48	30	----	18	----	----	----	----	----
Cartilaginous Fishes in the Mediterranean	56	12	35	9	----	----	----	----	----
Bony Fishes in the Mediterranean waters	297	84	177	35	----	----	----	1	----

Figure (1)Present and future protected areas in Egypt



Current Protected Areas				
Ras Mohamed	2	Zaranik	3	Ahrash
Elba and Red Sea islands	5	Al Omayed	6	Saluga & Ghazal
Ashtum El Gamil	8	Saint Katherine	9	Dome Hassana
Qaroun Lake	11	Wadi El Rayan	12	Petrified Forest
Allaqi Valley	14	Wadi Sanour Cave	15	Abu Galum
Nabq	17	Wadi El Asiouty	18	Taba
Burulus	20	Nile Islands	21	Wadi Degla
Siwa	23	White Desert	24	Wadi El Gemal - Hamata

Future Protected Areas						
El Gilf el kebir	2	Kurkur & Dungul	3	Om El Dabadib	4	El Qasr
El Saloum	6	El Shuwaila	7	Ras El Hekma	8	El Maghara
El Qusima	10	Wadi Gerafi	11	El Geleala El Qebleya	12	Wadi Qena
Shayeb El Banat	14	Malahet Ras Shuqeir	15	The Red Sea	16	Qattara Depression

Table(2) List of Protected Areas in Egypt

Protectorates Names	Declaration Date	Type of Protectorate	Area km^2	Governorate	Prime Ministerial Decree
Ras Mohamed National Park	1983	Wetland	850	South Sinai	Decrees 1068/1983 and 2035/1996
Zaranik Protectorate	1985	Wetland	230	North Sinai	Decrees 1429/1985 and 3379/1996
Ahrash Protectorate	1985	Wetland	8	North Sinai	Decrees 1429/1985 and 3379/1996
El Omayed Protectorate	1986	Desert	700	Matrouh	Decrees 671/1986 and 3276/1996
Elba National Park	1986	Desert	35,600	Red Sea	Decrees 450/1986 and 642/1995
Saluga and Ghazal Protectorate	1986	Wetland	0.5	Aswan	Decree 928/1986
St. Catherine National Park	1988	Desert	5,750	South Sinai	Decrees 613/1988 and 940/1996
Ashtum El Gamil Protectorate	1988	Wetland	180	Port Said	Decrees 459/1988 and 2780/1998
Lake Qarun Protectorate	1989	Wetland	250	El Fayoum	Decrees 943/1989 and 2954/1997
Wadi El Rayan Protectorate	1989	Wetland	1,225	El Fayoum	Decrees 943/1989 and 2954/1997
Wadi Alaqi Protectorate	1989	Desert	30,000	Aswan	Decrees 945/1989 and 2378/1996
Wadi El Assuti Protectorate	1989	Desert	35	Assuit	Decrees 942/11989 and 710/1997
El Hassana Dome Protectorate	1989	Geological	1	Giza	Decree 946/1989
Petrified Forest Protectorate	1989	Geological	7	Cairo	Decree 944/1989
Sannur Cave Protectorate	1992	Geological	12	Beni Suef	Decrees 1204/1992 and 709/1997
Nabaq Protectorate	1992	Wetland	600	South Sinai	Decrees 1511/1992 and 33/1996
Abu Galum Protectorate	1992	Wetland	500	South Sinai	Decrees 1511/1992 and 33/1996
Taba Protectorate	1998	Wetland	3,595	South Sinai	Decree 316/1998
Lake Burullus Protectorate	1998	Wetland	460	Kafr El Sheikh	Decree 1444/1998
Nile Islands Protectorates	1998	Wetland	160	All Governorates on the Nile	Decree 1969/1998
Wadi Digla Protectorate	1999	Geological	60	Cairo	Decrees 47/1999 and 3057/1999

Figure (2) Location of the protected areas in Egypt

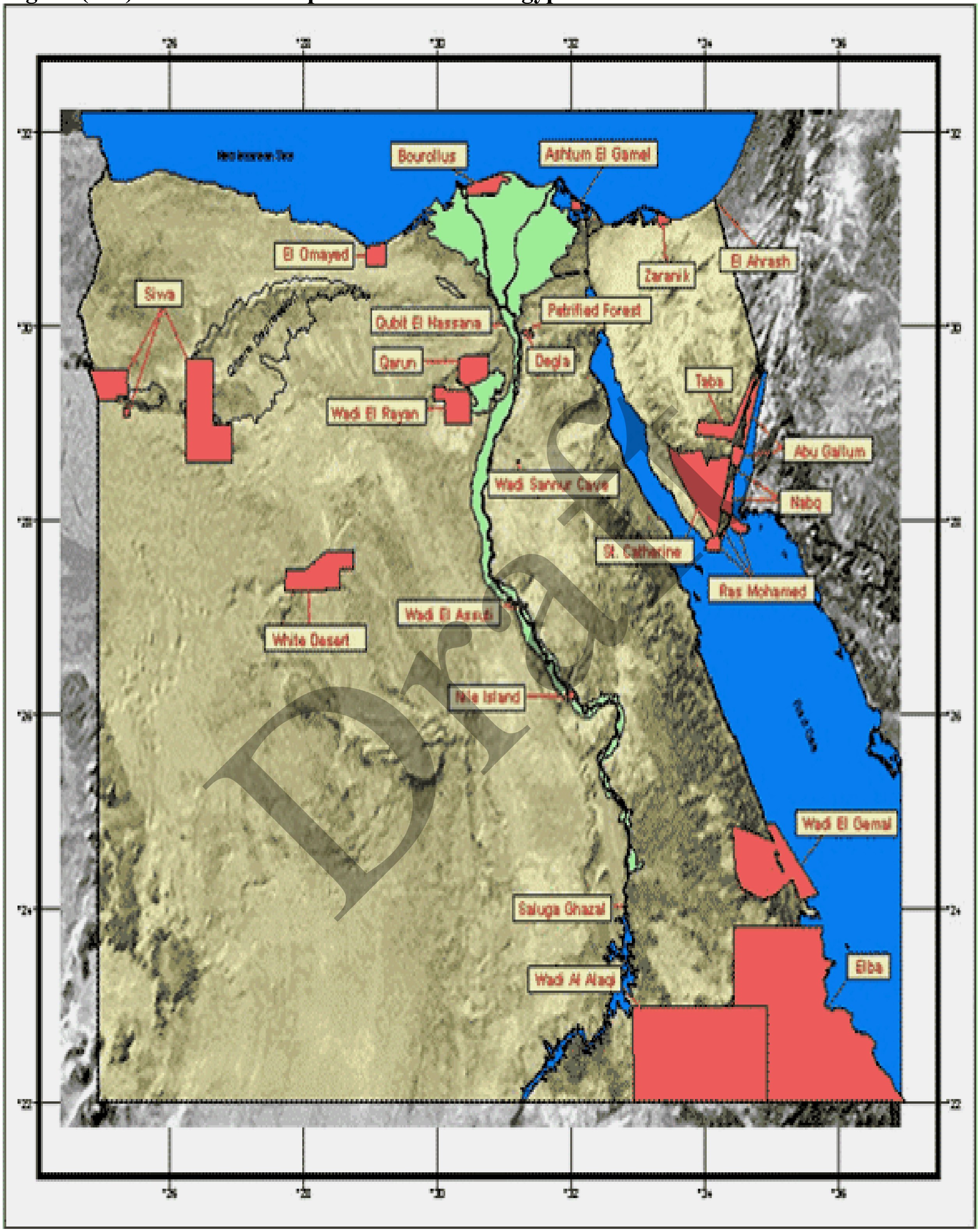
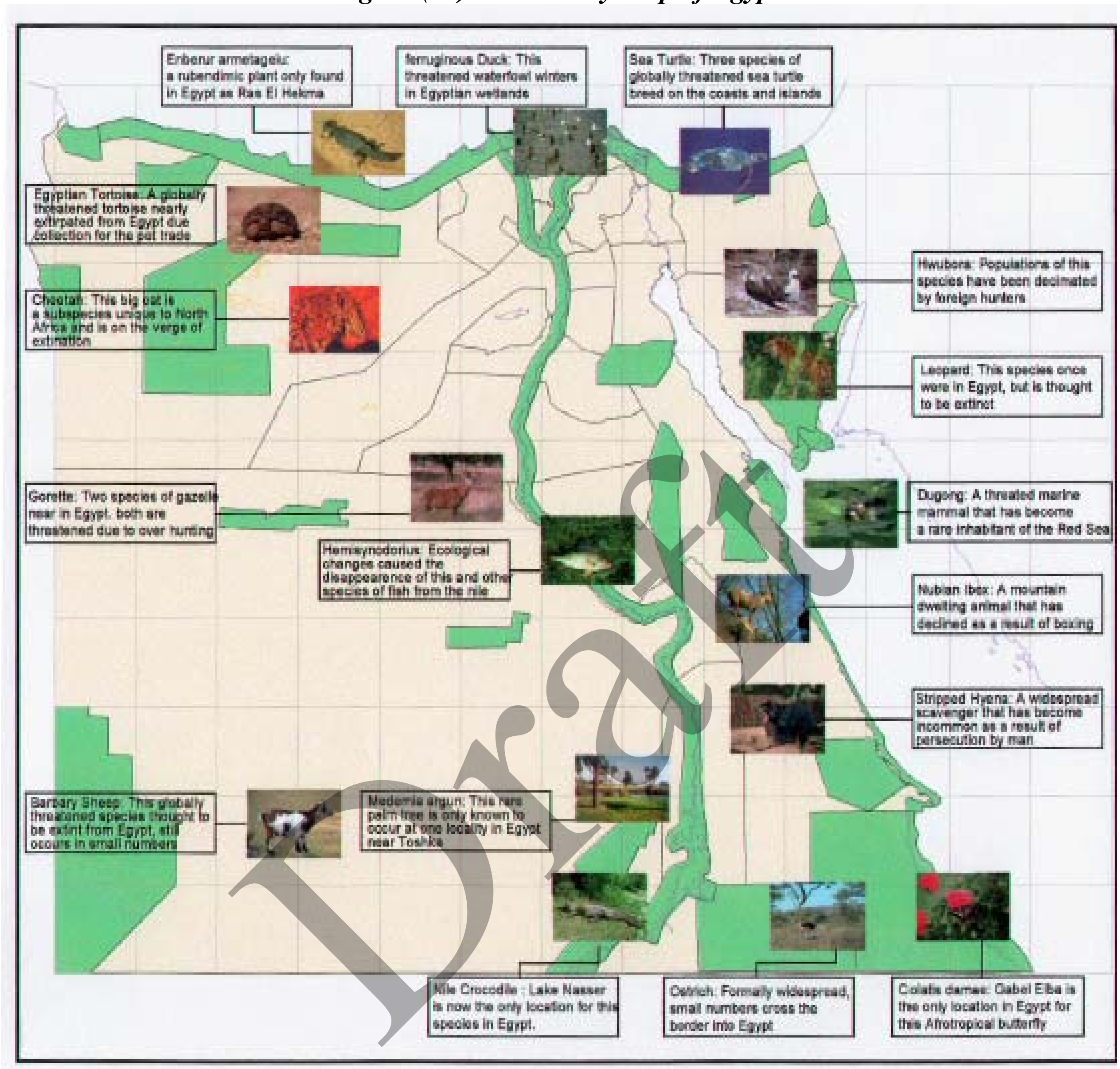


Figure (3) Biodiversity Map of Egypt



- Ministerial decree 349 of 1979 established the Egyptian Wildlife Service as the first governmental authority concerned with the protection of wildlife in the country.
- Ministerial decree 66 of 1982 prohibited hunting all species of birds and other wild animal in certain areas of the Sinai Peninsula, as well as fishing and catching all species of molluscs and corals in various other specified regions.
- Law 48 of 1982 for the protection of the River Nile and other water courses against pollution. It prohibits the discharge of solid, liquid and gaseous wastes with certain levels of pollutants into the Nile and all freshwater bodies; while the Ministry of Irrigation determined the maximum allowable levels of polluting elements in such wastes, the Ministry of Health is empowered to carry out the required analysis of samples of these wastes.

- Law 102 of 1983 set up the legal framework for the declaration and management of protected areas and regulates the conservation of natural resources.
- Law 101 of 1985, levied an additional tax on aeroplane tickets issued locally, in order to secure a suitable source of funding to finance programmes for developing tourism and environmental protection.
- Law 4 of 1994 is by far the most comprehensive environmental legislation to date. It authorizes the EEAA to prepare an Environmental Contingency Plan (article 25), and forbids the hunting of specified types of wild birds and animals (article 28) as well as the destruction of their natural habitats.

9.2. Biodiversity Conventions and Agreements

Since 1936, Egypt is party to a large number of regional and international conventions, treaties and agreements dealing with the conservation of nature in general and biodiversity in particular. The following list is extracted from the latest edition of UNEP's Register of International Treaties and Other Agreements in the Field of the Environment 1996:

- Convention Relative to the preservation of Fauna and Flora in their natural state. London, 1933 (ratified in 1936).
- Agreement for the Establishment of a General Fisheries Council for the Mediterranean. Rome, 1951.
- International Plant Protection Convention. Rome, 1953
- International Convention for the Prevention of Pollution of the Sea by Oil. London, 1963.
- Phyto-sanitary Convention for Africa. Kinshasa, 1968.
- African Convention on the Conservation of Nature and Natural Resources. Algeria, 1968. (ratified in 1972).
- Convention for the Protection of the Mediterranean Sea Against Pollution. Barcelona, 1976 (ratified in 1978).
- Convention on International Trade in Endangered Species of Wild Fauna and Flora. Washington, 1978.
- International Convention for Regulation of Whaling. Washington, 1981 (ratified in 1989).
- Convention on the Conservation of Migratory Species of Wild Animals. Bonn, 1979 (ratified in 1982).
- United Nations Convention on the Law of the Sea. Montego Bay, Jamaica, 1982 (ratified in 1983).
- Protocol Concerning Mediterranean Specially Protected Areas, Geneva, 1983 (ratified in 1986).
- Convention on Wetlands of International Importance especially as Waterfowl habitat. Ramsar, Iran, 1971 (1975), (ratified in 1988).
- Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment. Jeddah, 1990.
- Convention on Biological Diversity, Rio de Janeiro, 1992 (ratified in 1994).
- Agreement for the Establishment of the Near East Plant Protection Organization. Rabat, Morocco, 1993 (ratified in 1995).
- International Tropical Timber Agreement. Geneva, 1994 (ratified in 1996).
- Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean. Barcelona, 1995.

9.3. Ongoing efforts of EEAA in the area of biodiversity conservation
EEAA is currently developing programs and measures to support Egypt's protectorates. At present there are 21 protectorates covering about 8.5 percent of Egypt's area. Some of the best known of these protectorates are Ras Mohamed, Nabq, Taba, Saint Catherine and Zaraneeq. Supportive measures include preparing qualified cadres, offering essential equipment, monitoring the resources and the impact of human activities and other activities on natural protectorates and formulating plans for managing and improving these protectorates. EEAA has collaborated with various international donors to implement projects that aim at conserving biodiversity. Some of these projects are:

- Project for conserving the wetland and the environmental systems along the Mediterranean shores (CEF) 1999-2004.
- Program for conserving Gulf of Aqaba protectorates (EU) 1995-2002
- Project in Saint Catherine protectorate (EU) 1995-2002.
- Project for developing Wadi El-Rayan protectorate (Italian Government 1998-2001).
- Program for developing Egyptian Environmental Policies in regard to the Red Sea (United States Agency for International Development 1999-2001 first stage), continuing to 2005.

However, there is still an insufficiency of scientific information in the field of biodiversity conservation, despite the extensive research work noted above. More research is needed to enable accurate monitoring to support biodiversity conservation. In addition, management skills and procedures need to be upgraded and more efforts are needed to raise general awareness of biodiversity issues.

9.4.Tourism
Egypt, for over seventy centuries, maintained a world culture and civilization that has generously contributed to the rest of the world. Tourism continues to be a main source of hard currency for the country, playing an important role in the balance of payments. The industry currently ranks second among Egypt's major sources of foreign currency.
Tourism is a fast growing sector in the Egyptian economy. More growth is expected in the tourism industry in the coming years as foreign investments continue to increase.

9.5.Tourism and the Environment
Tourism depends on the environment to sustain it as it relies on the utilization of natural, historical, cultural, and human resources in the local environments. The current boom in the tourism industry is expected to be sustained by developing new types of tourist activities such as safari tourism and eco-tourism.
i. Positive Impact
The generated income from tourism assists in the development and improvements of facilities for protecting and regenerating environmental resources that benefits both the residents and tourists as well. However, in order to reap these benefits better management of tourism is needed and the industry should operate within an overall plan that preserves the natural and cultural heritage of Egypt, upon which the tourist industry depends.
ii. Negative Impact
The quality of the environment is frequently the primary attraction of tourists. However, their presence in increasing numbers accelerates all the problems caused by human recreational

activities. This can lead to a considerable pressure on the environment that attracted tourists in the first place and in particular on the local environment where tourists visit.

The phenomenal coral reef formation is vulnerable to environmental changes, such as climate change. Harmful activities also threaten the existence of coral reefs, such as sewage discharge, spillage and human handling. In addition, fast development of tourism in Hurghada, Sharm El-Sheikh and on the Gulf of Aqaba has led to building more hotels to accommodate for the increase in number of local and international tourists put more pressure on the fragile eco-systems in these areas. Thus, there is a threat to Egypt's coral reefs and immediate action is required protect this precious natural gift.

9.6.Ecotourism

Ecotourism can be defined as purposeful travel to natural areas to understand the culture and natural history of the environment, taking care not to alter the integrity of the ecosystem, while producing economic opportunities that make the conservation of natural resources beneficial to local people.

As mentioned earlier, there are 21 natural protectorates in Egypt. The protectorates can earn some of the money needed for monitoring and maintenance "Travel and Learn" packages to suit the needs of various segments of the population such as schoolchildren, college students, etc… Proper selection of natural protectorates -or even other natural sites- and careful design of "Travel and Learn" packages is a necessary prerequisite to ensure maximum economic benefit. Programmes focusing on nature and conservation can be designed for tourists.

10.0.Agriculture

Agricultural practices have had the greatest impact on soil degradation. In recent decades, however, human management of agro-ecosystems has been steadily intensified, through irrigation and drainage, heavy inputs of energy and chemicals, and improved crop varieties led to some general growth in agricultural production, this process has made agro-ecosystems more and more artificial and often unstable and prone to rapid degradation for the following reasons:

- **Irrigation:** Limited water resources required for matching agricultural expansion and the inappropriate utilization of available resources is an obstacle for horizontal expansion. The use of traditional efficient irrigation techniques and the inadequacy of drainage systems have led to the increase in water logging and salinization. Salinity is a potential limiting factor that stifles land productivity in Egypt. Over-exploitation of water for irrigation has led to the depletion of groundwater resources, which has resulted in excessive intrusion of salt water from sea into ground water aquifers.
- **Fertilizers:** Technological advanced cultivation practices, together with the availability of high yield varieties have led to improved crop yields in Egypt over the past two decades. The increased application of chemical fertilizers to supply nutrients is another unsustainable practice in agricultural production. The consumption of the chemical fertilizers in the last years is about one ton per feddan of the cultivated area. The expansion in consumption of fertilizers has been encouraged by the fact that their market is free, and this led to excessive and inefficient application, with consequent economic losses and increased environmental damage.
- **Pesticides:** Pesticides use in Egypt is extremely difficult to assess, simply because there is no possible supervision on small growers and their use of these chemicals. Pests do not only affect the quantitative yield crops both pre-harvest and post-harvest infestations also affect food and feed quality.
- **Soil Erosion**: Further constraints include physical ones, like wind erosion, which affects vast areas on the fringe of desert where the topsoil is sandy and thin. It is one of the serious problems because the fertility depletion through decline in soil organic matter and reduction in nutrient reserves by crop removal, leaching and acidification. Furthermore, the shores of the Delta are being eroded. After the construction of Aswan High Dam, the River Nile is not able to bring sediments to the shores of the Delta. That region is below sea level and is prawn to be submerged with rising sea levels due, in part, to global warming.

10.1. Soil Degradation and Contamination

The term 'soil degradation' refers to weakening the current and future capability of soil to produce agricultural products. There are various forms of soil degradation:

- Displacement of soil material by water and wind, which is significant in Egypt.
- Chemical degradation of soil from loss of nutrients or organic matter, salinization, and pollution.
- Physical degradation of soil where the physical process that caused soil degradation is compaction, sealing and crusting, water logging, and subsidence of organic soils.

The use of traditional efficient irrigation techniques and the inadequacy of drainage systems have led to the increase in water logging and salinization. Salinity is a potential limiting factor that stifles land productivity in Egypt. Over-exploitation of water for irrigation has led to the depletion of groundwater resources, which has resulted in excessive intrusion of salt water from sea into ground water aquifers.

According to published research, vehicle emissions affect the soil of the agricultural land around traffic roads. A strip of at least 40 m parallel to the Cairo-Alexandria Agricultural Road receives air pollutants, mainly lead, carbon monoxide, nitrogen oxides and sulfur dioxide. These pollutants fall on the plants as well as passing directly into the soil.

Pollutants carried by irrigation water are also a major source of soil pollution. An estimated 50 percent loss of productivity of agricultural land was recorded at Helwan and Shoubrah El-Kheima. Severe damage to plants has been reported in areas close to the industry in Kafr El-Zayat, Edfu, Abu Za'abal and others. Toxic heavy metals accumulate in the tissues of vegetation grown adjacent to sources of air pollution, such as lead smelters, and near traffic roads.

10.2. Major Watershed in Egypt

Watershed is located in northeast coast and in the north Sinai of Egypt. The average annual rainfall over the north western coast region, port said, El-Arish , and Rafah is about 150mm, 80mm,113 mm and 313mm respectively. Recently, dikes have been erected in many places to help in water harvesting and minimize water loss.

10.3. Wetlands in Egypt:

Wetlands are lands transitional between terrestrial and aquatic systems where the water table in usually at or near the surface or the land in covered by shallow water Cowardin et al (1979).

Egyptian wetlands are classified into two broad categories coatal and inland wetlands. The major problem of coastal wetlands in the northern part of Nile Delta is the intrusion of saline water into fresh water aquifer. Depressions of western desert or other areas along the Nile valley can be further classified as either natural wetlands (Wadi el Natrun depression), or manmade wetlands (Siwa oasis).

10.4.Water logging / Salinity

The salt affected soils in Egypt is located in the north, east and west of Nile Delta, soils adjacent to lakes Edko, Maryut, El-Burrullus and El Manzala ; and also in some areas such as Wadi El-Natrun, Oases and El-Fayoum. This is mainly due to due to the wide use of flood irrigation and
unaccounted-for water usage, water irrigation from the Nile is exaggerated leading to soil water logging and poor drainage of excessive water that exceeds the growing plants needs. Thus, soil salinity components reach a level causing damage to plant production and deterioration to some of the chemical and biological soil elements. Some lands become so rich in soda due to the increase in sodium element causing more degradation in physical elements. During the

seventies, sedimentary soil area affected by salinity and soda was estimated to be 30 to 35% of the total Nile valley and Delta area (State of Environment Report, 2005).

10.5. Soil types and locations.

The Nile Delta area are covering about 10.000 Km^2 (836723 ha) and 175 Km from south to north and 220 Km from east to west along its base at the north. Most of the southern part is now cultivated, while a part of the northern Delta is being occupied by extensive shallow lakes and marshes and in part consists of low-lying salty ground which is under reclamation. The Nile Delta and Valley soils are classified to main three orders namely: Entisols, Aridisols and vertisols, Table (1 &2) and Map (1). Maps (2), (3) shows the Nile delta slop & elevation.

Table (1) Characteristics and classification of soils in Nile Delta

Order	Suborder	Order	Suborder	Great groups	Sub groups
Entisols	Fluvents	Torrifluvents	Typic Torrifluvent	6.1	Sandy loam, fluvial, non saline
		Ustifluvents	Typic Ustifluvents	1.1	Fine loam, highly saline, 1% slope
			Veritc Ustifluvents	2.0	Fluviomarine, clay, highly saline 1-2% slope.
	Psamments	Quartzi-psamments	Tyic quartzi-psamments	2.3	Sandy, slightly saline, 2% slope.
Aridisols	Orthids	Salorthids	Aquolic salorthids	9.9	Sandy to clay, highly saline, 1-2% slope
Vertisols	Torrerts	Haploterrerts	Typic haplotorrerts	77.1	Caly, non saline, 1-2% slope
		Salitorrerts	Typic salitorrerts	1.5	Clay, highly saline, 1-2% slope

10.6. Soil Topographic Map of Egypt

The Map is reflected the general features of soil cover of all provinces in ARE (Map 4), which includes Cities, villages, International and territorial boundaries, altitudes, different elevations, airports, canals-navigable and non-navigable, marshes salt, sand dunes, mines……. ….etc.

Table (2) Areas under reclamation in Egypt

Name	Land Management Category	Area Fadden
East of Delta: Cairo-Ismailia Desert Road	V	30.200
Desert fringes Bilbeis	V	11.600
Adleya/ extension	V	13.800
Ramsis/ tenth of Ramadan	III	31.500
El Shebab (youth province)	V	47.500
Manayif	IV	37.500
South of Cairo- Ismailia Desert Road	III	103.600
West of Bitter Lake	III	38.200
Khahara	V	27.300
Salhiya Desert	III	56.000
Along Huseiniya Lanal	V	17.000
South Port Said	I	62.500
East Bahr El Baqqr	I	11.800
South Huseiniya	I	72.800
North huseininya	I	66.000
South port said plain	I	43.500
El-Matariya	I	8.900
Faraskur	I	5.000
West of Delta:		
Lake Maryut	I	11.000
Barseek (Lake Edku)	I	27.000
Hager	I	17.000
East of Desert Road	V	58.000
Kafr Dawud/ Sadat City	III	99.600
Bustan	V	30.300
Bustan extension	V	18.900
Beheira	III	92.000
El Nasr Lanal	II	67.000
Zawyet Sidi Abdel Ati	III	22.000
El-Hamman	II	18.000
Ras El Hikma	II	43.000
El Dabaa	II	31.200
Shoukry Valley	V	35.000
Central Delta :		
Dry Part of Burnllns	I	55.300
Baltim and Kashaa	I	3.700
Middle Egypt:		
Upper Wadi Asyut	III	25.000
Lower Wadi Asyut	III	5.100
East of Asyut	V	36.700
West of Manfalut	V	19.100

I: Excellent , II: Good, III: Fair, IV: Poor, V: Very Poor, VI: Non-Agriculture

Table (2) Continue

Name of LDU	Land Management Caterory	Area feddan
West of el Qusiya	V	12.300
West of Dairut	V	20.500
Abu Sir	III	3.700
South El Saff	V	15.600
North El Saff	V	23.500
Wadi Arian		10.500
Upper Egypt:		
Wadi el Kharit	III	16.500
Wadi Shait	III	9.500
Wadi Natash	III	80.000
Tributaries Wadi Natash	III	22.500
Kom Ombo West	III	345.000
Wadi El Kobaniya	V	18.800
El Saayds	IV	1.000
El Saayda West	III	81.000
Wadi Seraf	V	8.400
West Nasim	V	3.300
Higaza	V	3.700
Qift	V	5.500
Wadi Laqeia	V	48.500
Wadi Qena	V	1.400
West of Qena	V	26.300
Wadi Samhud	V	3.500
West of Girga	V	3.900
West of Tahta	V	24.200
Wadi Abu Shih	V	2.300
El Ghanayim	V	3.500
Sinai:		
Tina plain	I	50.000
North Coastal Area	IV	56.000
East of Bitler Laker	V	27.500
East of Suez	V	42.000
El Qaa Plain	III	2.000
El Arish	II	1.000
Scahered areas	III	1.000
New Valley:		
El-Zayat	I	1.500
Dakhla	II	29.000
West Mawhub	II	2.000
Abu Minqar	V	4.500
Farafra	II	31.500
Karawein	V	30.000
Bahariya	V	30.000
Siwa Oasis	V	23.460

I: Excellent , II: Good, III: Fair, IV: Poor, V: Very Poor, VI: Non-Agriculture

Table 3: Major Physoigraphic Units and Locations

Major physiographic unit	Location	Area km^2
Mountain	It is occur in western, eastern desert and Sinai.	
Ridges	It is occur in western coast of Mediterranean sea	-
Escarpment	It is occur in western coast of Mediterranean sea	-
Plain	It is occur in the coastal of Mediterranean and Red Sea, western and eastern desert and Sinai.	-
Valley	It is occur in the Nile Valley	-
Depression	It is occur in western desert, which Including: Qathara El- Farafra Oasis El- Baharia Oasis Siwa Oasis El-dakhla oasis El-kharga oasis El-fayoum Wadi el-rayan Wadi el-natrun	19500 8000 1800 1000

Table 4: Current Land Use and Land Cover

Land cover and land use type	Area in feddan
Cultivated land	8.200.000
	16.000.000
	different crops
Intensively cultivated: wheat	2.850.000
Oil crops	264.000
Sugar cane	314.000
Sugar beet	140.982
Maize	160.632
Cotton	---------
Moderately cultivated	
Vegetable crops	---------
Fruit crops	---------

Table 5: Agro-ecological Zones and Their locations ***(Maps, 3,4)***

Agro-ecological zone	**Altitude**	**Major land forms/ physiographic units**	**Major soil types**	**Dominat land use farming zone**
Nile Delta	0-50m	-The young deltaic plain -The Mediterranean coastal plain	-Flood plain -Aeolian deposits -Fluviomarine -Lagoonal deposits -Beach deposits -Coastal Aeolian deposits	Crop pattern and rotation includes: Field crops, vegetables and fruit crops
Nile Valley	20-50m	-Rubble terraces -River terraces, (west) -Kom Ombo. -Wadi Botloms -Outwash plains -Alluvial fans (East Kom Ombo)	-Gravelly sand soils -Alluvial soils -Sandy to gravelly sand soils -S. to Gr.S.Soils -S.to Gr. S.Soils	Areas under reclamation in Middle and upper Egypt

10.7. Climate of Egypt

The climate of Egypt belongs to arid-desertic to semi-desertic conditions. It is characteristics by long hot rainless summer and short rainy mild winter with scarce rainfall. The other seasons are also characterized by unstable climate.

There are 15 meteorological stations used for estimating the climatic data for Egypt, (EMACA of Egypt,1996). Climate data are shown in Annex (7) and Maps (5-13).

10.7.1. Temperature

The maximum air temperature is affected by the geographical location of Egypt north the Equator. It increases generally from north to south. The temperature gradient varies from month to month, where the difference between the maximum temperatures from north to south reaches 15°C in May and June, and 5°C in January. The maximum air temperature reaches its highest value at the south during June while August is the hottest month at the north coast.

The minimum air temperature all over Egypt occurs during January. The water surfaces and the high lands complicate such distribution, since the temperature gradient is well-defined near the coasts of the Mediterranean and Red Sea during spring and summer seasons and turns to be weak during autumn and winter Seasons. This is due to the relatively low sea surface temperature during the first period and relatively high during the second one.

The maximum temperature decreases over mountainous areas in Sinai and the Red Sea coast. This decrease is very evident during winter over Sinai Mountains, while it becomes more intense over the Red Sea Mountains during summer.

10.7.2. Relative Humidity:

Since the humidity distribution depends upon the nature of underlying surface, topography, distance from sea, and dominant synoptic situations, it is found that the highest R.H. exists over northern coast of A.R.E. during summer, reaching more than 70% and decreasing inwards to reach 20% far to the south with appreciable gradient at the north and weak gradient at the south.

Moreover, a steep R.H. gradient is evident near the Red Sea coast, which weakness westwards. While over Sinai, the humidity gradient is strong near the coasts circumventing low R.H. region (30%) over southern mountains. In the autumn the values of R.H. are greater than 70% in Nile Delta and the eastern coasts of the Mediterranean, while it is less than 70% over the eastern coasts and reaches 30% in the south. Also during winter, the humidity is still high in both east and south leading to well- defined decrease in the gradient than that observed over both northern coasts and Sinai. This feature is reversed during spring thus humidity starts to decrease southwards resulting in gradient greater than the winter gradient to approach the characteristics of the summer distribution.

10.7.3. Precipitation

Precipitation over Egypt is usually associated with unstable weather conditions due to the invasion of cold air masses in the upper atmosphere and low pressure troughs in the lower atmosphere. The rainy season in Egypt extends from autumn to spring. Maximum precipitation occurs during Winter due to the passage of the Mediterranean depressions. The north east of Delta is distinguished by highest amount of precipitation due to the characteristics of the topography where the prevailing air stream is mainly perpendicular to the coast. However the north coast of the country is distinguished by maximum precipitation which decreases rapidly inland to Middle Egypt becoming too rare in Upper Egypt and Western desert.

During autumn and spring heavy unstable conditions occur east of the country when upper air cold troughs reaching from Europe and associated with extension of the Sudan Monsoon low in the lower levels over the east of the country. The instability increases over Sinai and the Red Sea Mountains, causing thunderstorms and heavy showers and sometimes extends to Middle and Upper Egypt. These heavy showers can cause flash floods in some location of these areas. No precipitation occurs during July and August and it is very little only at north-west coast during June and September.

It is noticed that Maximum precipitation in one day during the year is concentrated in the area located north-west of the country, and then rapidly decreases to Middle Egypt and to the Red Sea Coast.

10.7.4. Atmospheric Pressure

The atmospheric pressure over A.R.E. during different seasons is influenced by four synoptic systems namely: Sudan low, subtropical anticyclone, Indian monsoon low and Mediterranean traveling depressions.

During spring and autumn, the pressure distributions are more or less similar where eastern and southern Egypt are influenced by Sudan low with the subtropical high pressure dominate over northwestern region with greater intensity during autumn than during spring in general.

In winter, both the Sudan low and subtropical anticyclone advance southwards and Mediterranean traveling depressions frequently invade northern region causing thunderstorms and showery conditions.

The effect of Indian monsoon low is much pronounced over north and east of Egypt during summer where the subtropical anticyclone or its ridge affects western and southern region.

It is normal practice that surface air temperature over Egypt depends upon the eastwards or westwards movement of such pressure system. Thus heat waves occur when the Indian monsoon low extends westwards while these circumstances cease when this pressure system retreats to east giving opportunity for the subtropical to dominate over the whole region.

10.7. Surface Wind

The surface wind in Egypt shows variable directions in the different seasons. It is clear that the south westerly dominate over north Egypt during winter, while the northerly and north westerly winds prevail over the rest of the country.

During summer, the north westerly dominates all over Egypt with a percentage frequency of occurrence greater than that during winter.

During both Spring and Autumn, as transitional season, the north westerly also dominate most of the country except at the north eastern region where the north easterlies prevail during these seasons.

It is worth, mentioning that the percentage frequency of occurrence of the north westerly, and its speed ranges over the Red Sea coasts are higher during all seasons than over the other regions.

11.Data Quality and Gaps

Although twenty five agencies under seven ministries are involved in water quality monitoring program, there are many gaps as follows:

1. All monitoring programs are focused only on the conventional parameters but do not cover the sediment and fish samples. Moreover, very limited data is available about the micro-pollutants (pesticides, heavy metals and hydrocarbons).

2. There is a high incidence of water-borne diseases in Egypt, especially in Delta region. In the same time, little attention is paid to pathogenic organisms & parasites in water in the current monitoring programs.

3. The essential components for effective environmental monitoring are consistency and continuity. If the database or collection system from one source is inconsistent with the base or system used by another source of data, conclusions cannot (or should not) be made based on comparison of the two data sets. In Egypt there are many governmental and academic bodies collecting data but it is rare to find full comparability between any two sources.

4. Furthermore, environmental data need consistency and continuity over time because it is generally changes, deterioration or improvement that is of interest. Many Egyptian data sets have begun as part of a development project supported by donor funds. Unfortunately many lapses once the foreign-assisted project is finished. For decision making purposes, monitoring the state of the environment over time needs to be supplemented with information concerning violations of the laws. Data concerning violations is not available because of lack of enforcement of existing laws.

5. There is a lack of inter-ministerial cooperation and data sharing. Many available reports related to water quality issues relied on old water quality data, which minimize the benefit of these studies.

6. Another important concern is the reliability and validity of the data. In view of the lack of uniformity among the various measurement programs, available data exhibit both random and systematic errors.

12.Conclusions & Recommendations

From the available data stated in this report, it can be concluded the following main points:

1. An increase in suspended substances at some points above approved limits which may be due to the existence of cultivation, Khour El-Sail Aswan, Kom Umbo drain & Sugar Factory, Edfo Sugar Factory, Etsa drain , Oil & Soap factories in Sohag and sanitary drainage from some villages, towns, sugar factories in Giza , and floating hotels.
2. Although the impact of discharge of these wastes on ambient water quality of the Nile has not been significant in recent years due to the high dilution factor and the high self assimilation capacity of the Nile water, special attention should be given to mitigate pollution from these sources as their effects may become significant during low flow years.
3. Major sources of pollution of Rosetta branch is El- Rahawy drain in the southern part and industry at Kafr El-Zayat.
4. Damietta branch is receiving, and is adversely affected by industrial wastewater from Talka fertilizers factory.
5. Delta drains receive high concentrations of organic and inorganic pollutants from industrial, domestic as well as diffuse agricultural wastewater. High priority should be given to those drains receiving high loads of pollution such as: Bahr El-Baqar, Bahr Hadous, El-Garbia Main, El-Rahawy and El-Umoum drains.
6. Maryut and Manzala Lakes, are the most polluted Northern lakes in Egypt due to the discharge of sanitary and industrial wastes via agriculture drains. Lake Maryut is reported to be more saline than lake Manzala and to have some concentrations of heavy metals, an appreciable organic loading, and a very high coliform level.

Recommendations

- It is important to recognize that a water quality monitoring program should sample more than just water. Sediments may contain high concentrations of heavy metals, hydrocarbons, and nutrients that add to water concentrations under appropriate circumstances. Fish, because they concentrate heavy metals and certain organic compounds, are sensitive indicators of pollution, and pose human health threats when they bioaccumulate toxic pollutants.

- Lake Nasser is the reference point for the remaining monitoring points along the Nile course. Transboundary of upstream pollutants and micropollutants concentrations in water, fish and sediment in lake are scarce and should be also studied. A detailed ecosystem study should be carefully prepared for the lake.

- Pathogen and parasite problems, specially in Damietta, Rosetta branches, Canals & Rayahs in Delta, require identification of acceptable practices to dispose of human wastes, development and implementation of education programs.

- Salinity problems require development of a water management framework to identify ways to reduce salinity and increase usable water supply; continuing evaluation of salinity control projects; and assessment of minimum Delta outflow to achieve optimum salt balance in the Nile system.

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Annotated References

1. **Proceeding of the International Conferences on Water Management, Salinity and Pollution control Towards Sustainable Irrigation in the Mediterranean Region, 22-29 Sept.1997, Valenzano (Bari), Italy. Sponsored by WWC, CIHEAM/MAI-B and AIIA**

   KEYWORDS: Mediterranean Countries, Egypt, Water Quality and Pollution Control, Water Resources and Irrigation Water Management, Wastewater re-use, Capacity building for water quality management, Fertilizers and water quality.

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   KEYWORDS: Burundi, DRC, Egypt, Ethiopia, Kenya, Rwanda, Sudan, anzania, and Uganda

   This report does not go into all the details recorded in the National Reports but highlights significant points regarding the Nile monitoring. Most of the countries have undertaken analyses of the Nile but the quality of the data is very mixed and it is impossible to draw any detailed accurate overview. To derive an accurate picture, recommendations on sampling and analysis are included in the report. ***It is worth mentioning however that, the section concerned with Egypt data and assessment is very weak & disjointed.***

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   KEYWORDS: Egypt, water utilization, women's participation, sanitation, hygiene

   In Egyptian communities as elsewhere, women are central agents for improving hygiene and sanitation in water use. This paper focuses on the sanitation of drinking water. It shows how women, through the gender division of labour, in Egypt are key actors for systems and projects that wish to improve the hygienic use of water. Moreover, the paper demonstrates the continuity between household tasks showing that contamination of household drinking water results not only from contamination from the water source but also through crossover contamination from other unhygienic practices related to animal husbandry, latrines, and food preparation.

4. **Bishai, H., Abdel- Malek, S., and Khalil, M.(2000) "Lake Nasser". Publication of the National Biodiversity Unit-No.11-2000, Cairo, Egypt**

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   KEYWORDS: schistosomiasis, zoonoses, urban areas, disease control, agriculture,aquaculture, health hazards

   A broad report covering a number of control strategies and technical issues of control, as well as assessments of control programs in countries where the various forms of schistosomiasis are endemic. The report raises concerns over aquaculture and urban schistosomiasis. In particular, the report raises concerns over the risk to farmers in peri-urban areas and reinforces the importance of a safe water supply and proper sanitation.

7. **NGO's Guideline Manual Egypt(2000) Chamber of Engineering Industries, Federation of Egyptian Industries, FEI, Cairo , Egypt**

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11. **Birley, Martin H. and Karen Lock. "Health and peri-urban natural resource production" Environment and Urbanization. Vol. 10 no.1, April 1998, 89-106.**
KEYWORDS: urban areas, natural resources, public health

This paper examines the health problems facing the enterprises and inhabitants of periurban areas, including risks posed by malaria, heavy metals, the re-use of solid and liquid wastes, agro-chemicals, biomass fuels and food contamination. It also emphasizes how both research and assessment procedures are required to ensure that natural resource production in peri-urban areas also safeguard human health. For a more detailed report of this study, see the on-line report at **www.liv.ac.uk/~mhb/publicat/Periurban/Start.html.**

12. **Chimbowu, Admos and Davison Gumbo (ENDA-Zimbabwe) "Urban Agriculture Research in East & Southern Africa II: Records, Capacities and Opportunities" Cities Feeding People Series. No. 4, Ottawa: International Development Research Centre (IDRC) 1993.**

KEYWORDS: Southern Africa, East Africa, urban agriculture, research capacity, research needs

This report assesses the research capacities and opportunities for urban agriculture in East and Southern Africa and makes recommendations for research areas, needs and field specialists in the area. The Report includes a section on urban agriculture, water, waste and disasters which reflects on some of the public health concerns. In particular the section looks at pollutants, solid waste, and zoonotic diseases associated with urban livestock keeping. Among the suggested research projects, the authors call for a study into the use of agrochemicals in urban agriculture and their possible ecological effects.

13. **AQUA-TEC Egypt/ EEAA, TCOE (1995) The proceeding of the 1st International Conference of Potable Water Management and Water Treatment Technologies. Cairo 5-7 Dec.1995**

14. **Hardoy, Jorge E. and David Satterthwaite. "Health and Environment and the Urban Poor" in Gurinder S. Shahi, Barry S. Levy, and Todd Kjellström (Eds.) International Perspectives on Environment, Development and Health; Towards a Sustainable World. New York: Springer Publishing Company Inc., 1997, 123-162.**

KEYWORDS: urban environment, public health, poverty, hazardous wastes, gender analysis

This paper looks at an array of health problems associated with urban nvironments in the South. The authors draw attention to the geography of inequality in the aspects of human and environmental health which have differential impacts according to age, sex, gender roles and migrant status. The authors argue that the people most vulnerable to environmental hazards are those least able to avoid them. Of particular interest for urban agriculture is the focus on chemical and industrial pollutants in urban areas. The authors mark chemical pollutants as one of the four most pressing urban environmental concerns. They claim that reports from

Third World cities of severe health problems arising from human contact with toxic or hazardous wastes are increasingly common.

15. Lamba, Davinder (Mazingira Institute). "Urban Agriculture Research in East Africa: Record, Capacities and Opportunities" Cities Feeding People Series no. 2 Ottawa: International Development Research Centre (IDRC), 1993.

KEYWORDS: East Africa, urban agriculture, research capacity, research needs

This review of UA research in East Africa divides itself between areas of strength and areas of weakness in the research record. In particular the report shows that research into health risks are understudied areas for each of the countries examined. Among the health concerns raised are air quality, use of untreated sewage, pollution from industrial firms and water quality.

16. Mlozi. M.R.S., I.J. Lupanga and Z.S.K. Mvena "Urban Agriculture as a Survival Strategy in Tanzania" in Jonathan Baker and Ove Pedersen Eds. The Rural-Urban Interface; Expansion and Adaptation. Uppsala: Nordiska Afrikainstitutet, 1992, 284-294.

KEYWORDS: Tanzania, urban agriculture, soil pollution

This a general article about urban agriculture in Tanzania. Among the issues addressed as limitations to urban farming was the contamination of crops, particularly in areas like Tabata in Dar es Salaam where urban farmers had settled on refuse dumps. Among the recommendations in the conclusion, the authors call for authorities to improve presently unusable land, and for town planning officials to liaise with professionals such as agriculturalists, veterinarians, engineers, police, health workers, medical personnel, sociologists and conservationists in the initial plot identification phase.

17. Bruins, Henrik J. "Drought mitigation policy and food provision for urban Africa: Potential use of treated wastewater and solar energy" Arid Lands Newsletter no. 42 Fall/Winter 1997. 25/5/1999 <http://ag.arizona.edu/OALS/ALN/aln42/bruins.html>.

KEYWORDS: Africa, drought, water resources, waste water, water reuse, health hazards, water treatment

This article is a revised version of a paper originally submitted to a workshop sponsored by the Netherlands-Israel Development Research Programme (NIRP) in June 1996. While advocating the use of urban wastewater the author suggests that agricultural extension education, legislation and supervision concerning the use of treated wastewater by individual farmers is needed in view of the possible health hazards. The author follows a 1986 World Bank report in advocating the use of wastewater stabilization ponds as a robust method of wastewater treatment well suited to the needs of developing countries.

18. **Kolsky, Peter J. and Ursula J. Blumenthal. "Environmental health indicators and sanitation-related disease in developing countries: limitations to the use of routine data sources" World Health Statistics Quarterly 1995, 48(2): 132-139.**

KEYWORDS: developing countries, environmental health, health indicators, sanitation, disease, water management

This article explores conceptual issues in the development and use of environmental indicators for disease related to water and sanitation in developing countries. The article focuses on faecal contamination. Among the concerns raised is the limitation of routinely-collected data on faecal contamination and water quality because these often address concerns over the health of the aquatic ecosystem rather than human health. The authors call for pragmatic alternatives to routinely collected data.

19. **Pescod. M.B. (Warren). "The Urban Water Cycle, including Wastewater Use in Agriculture" Outlook on Agriculture 1992, 21(4): 263-270.**

KEYWORDS: urban, agriculture, water management, waste water, industrial waste,cultural factors, public health

Discusses the advantages and constraints of using wastewater in agriculture. The author expresses particular concern over the possible presence of toxic materials in industrial effluents discharged to sewers which can create unacceptable health isks if its use in agriculture is not strictly controlled. While highlighting the importance of the WHO and FAO guidelines, the author also argues that approaches to wastewater use must be consistent with local socio-cultural, environmental and institutional factors and thoroughly planned as a programme of wastewater disposal and food production.

Annexes

Annexes 1-5

(1) List of Environmental NGOs in Egypt

(2) Environmental Laws.

(3) Industrial point sources of discharges into the river Nile (Aswan to El- Kanater)

(4)Wastewater Treatment Plants in Egypt

(5)Incidence rate of Typhoid and Paratyphoid/100,000 individuals in 1998

Annex (1) List of Environmental NGOs in Egypt

Organization	Governorate	Established	Major activities
Friends of Trees Association	Cairo	1973	environmental protection and education, and community development
Egyptian Association for Packaging Development	Cairo	1974	environmental protection
Arab Office for Youth and Environment (AOYE)	Cairo	1978	environmental protection, and community development
Association for the Protection of the Environment (APE)	Cairo	1984	environmental protection
Central Association for Environmental Protection	Cairo	1989	environmental protection
Egyptian Association for Development of Local Communities	Cairo	1993	environmental protection, and community development
Friends of the Environment and Development Association (FEDA)	Cairo	1993	environmental protection
Association of Enterprises for Environmental Conservation	Cairo	1996	environmental protection, and community development
Participation and Conversation Forum for Development	Cairo	2000	environmental protection, and community development
Liberty Association for Community Development	Alexandria	1966	environmental protection, and community development
Friends of the Environment Association	Alexandria	1990	environmental protection
Egyptian Association for Industry and Environment	Alexandria	1991	environmental protection
Association of Commendable Efforts in Shebin El Kom	Menoufia	1982	environmental protection, and community development

Organization	Governorate	Established	Major activities
Association for Development and Environment	Ismailia	1993	environmental protection, and community development
Coptic Evangelical Organization For Social Services (CEOSS)	Minya	1960	environmental protection, and community development
The National Association for Environmental Protection	El Arish	1989	environmental protection
Baladi Association	Port Said	1973	environmental protection, and community development
Association of Islamic Ytouh	Beni Suef	1967	environmental protection, and vocational training
Association for Local Community Development	Beni Suef	1982	environmental protection, and community development
Association of Environmental Conservation in Fayoum	Fayoum	1991	environmental protection
Association for Environmental Protection and Children Protection in Etay El Baroud	Beheira	1996	environmental protection, and community development
The Women Association for Health Improvement	Sohag	1966	environmental protection, and medical services
Association for Environmental	Assiut	1991	environmental protection

Annex (2) Environmental Laws.

Laws and relevant regulations	Description	Authority
General		
Law 4/1994	Environmental protection law. It addresses coastal and marine pollution and air pollution; hazardous waste and environmental disaster issues	EEAA
PMD 338/1995	Executive Regulation of law 4/1994	EEAA
MD 56/2000	Mandates of the RBOs	EEAA
EEAA CEO decree no 17/2001	Mandates of the RBOs	EEAA
Water pollution		
Law 93/1962	Regulates the discharge of wastewater into public sewer networks	Ministry of Housing and Public Utilities, The Local Authorities
Law 38/1967	General cleanliness and sanitation	The Local Authorities
Law 27/ 1978	Regulates public water resources for drinking and domestic use	Ministry of Health and Population
Law 57/1978	Sets measures for treating ponds and marshes	Ministry of Housing and Public Utilities, Ministry of Local Development
Law 48/1982	Regulates the discharge of wastewater into the River Nile and other waterways	Ministry of Health and Population, Ministry of Water Resources and Irrigation
Law 12/1984	Regulates irrigation, water distribution, groundwater management in the Nile Valley and Delta, and the establishment and maintenance of drainage canals	Ministry of Water Resources and Irrigation
Law 231/ 1984	Amends articles in Law 213/1984	Ministry of Water Resources and Irrigation
Law 874/1996	Prohibits the use, import, handling and preparation of potential carcinogenic pesticides	Ministry of Agriculture and Land Reclamation
MD 63/1997	Prohibits the reuse of empty pesticide containers for packaging, transport or manufacture of any foodstuffs or toys	Ministry of Agriculture and Land Reclamation
MD 44/2000	Regulates the discharge of wastewater into public sewers	Ministry of Housing and Public Utilities, The Local Authorities
Sea Water protection		
Law 280/1960	Regulates activities within the ports and the regional waters	Ministry of Defense
Law 79/1961	Determines measures to be taken in case of marine disasters	The Port and Lighthouse Administration, Ministry of Defense
PD 1948/1965	Establishes a permanent committee for protecting the sea from oil pollution	Located in the Ministry of Defense
PD 45/1983	Signs the Protocol for the protection the Mediterranean from land based pollution sources	EEAA Port Authorities
Minister of Transport Decree 5/1991	Prohibits disposal of waste in the regional water, the Egyptian ports and waterways	All Port Authorities

Annex (2) Continue

Laws and relevant regulations	Description	Authority
Law 4/1994 PD 421/ 1963	Protect sea water from oil pollution, ratification of the Convention for the Protection of Pollution of the Sea by Oil, London	EEAA, The Port and Lighthouse Administration
MD 64/1996	Sets the water specifications of bathing coasts	Ministry of Health and Population
Air pollution		
Law 59/1960	Controls the use of ionizing radiations	Ministry of Health and Population, the office of Protection against Ionizing Radiations
Law 66/1973	Controls air pollution caused by vehicles	Ministry of Interior and its departments
Law 380/1975	Identifies requirements for the establishment of industrial and commercial facilities	Ministry of Housing and Public Utilities, Ministry of Industry and Technological Development, Ministry of Health and Population
Law 55/1977	Regulates the establishment and operation of boilers and thermal stations	Ministry of Industry and Technological Development, Ministry of Military Production, Ministry of Petroleum, Ministry Electricity and Energy
Law 3/1982	Regulates urban planning and land use	Ministry of Housing and Public Utilities and its departments
Law 4/1994 Law 52/1981	Regulate smoking in public places	Ministry of Health and Population, EEAA
Solid Waste Management		
Law 38/1967	Regulates the collection and disposal of solid wastes	Ministry of Local Development and its departments, Department of Civil Defense
MD 134/1968	Implements Law 38/1967, and provides the specifications for dumping sites.	Ministry of Local Development
PD 284/1983	Establishes the Cairo and Giza Beautification and Cleaning Authorities. Their mandates include the collection and disposal of garbage and solid waste	Ministry of Housing and Public Utilities
Hazardous Waste Management		
Law 48/1967	Requires employers to inform their employees that they are dealing with hazardous waste	Ministry of Manpower
Law 137/1981	Requirements for labour safety and health in workplaces	Ministry of Manpower
Law 4/1994	Handling and management of hazardous waste	EEAA, Ministries of Industry and Technological Development, Health and Population, Agriculture and Land Reclamation, Electricity and Energy, Interior and Petroleum
Nature Conservation		

Annex (2) Continue

Laws and relevant regulations	Description	Authority
Law 53 for year 1966	Article 117 of the Law prohibits the hunting of specific types of birds and terrestrial animals	Ministry of Agriculture and Land Reclamation
MD 472/1982	Prohibits the hunting of all kinds of birds in the areas of el Zaranek, Sebkha, Bardawil, Saint Catherine and the Tiran inland; prohibits bird hunting, fishing and the removal of coral reefs in area located on the Gulf of Aqaba between Taba and Ras Mohamed	Ministry of Agriculture and Land Reclamation
Law 102/1983	Controls natural protected areas	EEAA
PMD 1068/1983 and 2035/1996	Establish the natural reserves in Ras Mohamed and the inlands of Tiran and Sanafir	EEAA, Governorate of South Sinai
MD 1058/1984	Prohibits the hunting of Nile crocodiles	Ministry of Agriculture and Land Reclamation
PMD 1429/1985 and 2035/1996	Establish natural reserves in Zaranik and Ahrash, North Sinai	EEAA, Governorate of North Sinai
PMD 450/1986 and 642/1995	Establish natural reserves in Elba along the Red Sea	EEAA, Governorate of Red Sea
PMD 671/1986 and 3276/1996	Establish natural reserves in El Omayed, Matrouh	EEAA, Governorate of Matrouh
PMD 828/1986	Establishes natural reserves in Saluge and Ghazal, Aswan	EEAA, Governorate of Aswan
PMD 316/1988	Establishes natural reserves in Taba, South Sinai	EEAA, Governorate of South Sinai
PMD 459/1988 and 2780/1988	Establish Natural Reserves in Ashtum el Gamil, Port Said.	EEAA, Governorate of Port Said
PMD 613/1988 and 940/1996	Establish natural reserves in St. Catherine, South Sinai	EEAA, Governorate of South Sinai
PMD 942/1989 and 710/1997	Establish natural reserves in Wadi El Assiuti	EEAA, Governorate of Assiut
PMD 943/1989 and 2954/1997	Establish natural reserves in Wadi El Rayan and Lake Qarun	EEAA, Governorate of Fayoum
PMD 944/1989	Establishes natural reserves in the Petrified Forest, Maadi	EEAA, Governorate of Cairo
PMD 945/1989 and 2378/1996	Establish natural reserves in Wadi El Alaqi, Aswan	EEAA, Governorate of Aswan
PMD 946/1989	Establishes natural reserves in El Hassan Dome, Giza	EEAA, Governorate of Giza
MD 1403/1990	Prohibits the hunting of reptiles	Ministry of Agriculture
PMD 1204/1992 and 709/1997	Establish natural reserves in Sannur, Beni Suef	EEAA, Governorate of Beni Suef
PMD 1511/1992 and 33/1996	Establish natural reserves in Nabaq and Abou Galum, South Sinai	EEAA, Governorate of South Sinai
PMD 264/1994	Specifies requirements and conditions that organize the activities in natural reserves	EEAA
PMD 1444/1998	Establishes natural reserves in Lake Burullus, Kafr El Sheikh	EEAA, Governorate of Kafr El Sheikh
PMD 1969/1998	Establishes natural reserves in the Nile Islands	EEAA, all governorates on the Nile

Annex (2) Continue

Laws and relevant regulations	Description	Authority
PMD 47/1999 and 3057/1999	Establish natural reserves In Wadi Digla, Cairo	EEAA, Governorate of Cairo
Desertification		
Law 53/1966	Protects agricultural lands	Ministry of Agriculture and Land Reclamation
Law 124 /1981	Regulates the usage and management of desert land owned by the government of Egypt.	Ministry of Housing and Public Utilities
Law 116/1983	Prohibits the fallowing of agricultural land, or its use in building and construction	Ministry of Agriculture and Land Reclamation
PMD 2906/1995	Addresses the requirements regulating the management and usage of land allocated to the General Organization for Urbanization and Agricultural Development Projects	Ministry of Agriculture and Land Reclamation
Natural Resources		
Law 66/1953	Regulates the management of fuels, mines and quarries	Ministry of Industry and Technological Development Ministry of Petroleum
Law 68/1956	Sets guidelines for the activities of mines and quarries	Ministry of Industry and Technological Development
Law 46/1958	Regulates the work in mines and quarries	Ministry of Industry and Technological Development
Law 123/1983	Regulates the management of cooperatives of water resources	Ministry of Agriculture and Land Reclamation
Law 124/1983	Regulates the management of fishing activities and aquacultures	Ministry of Agriculture and Land Reclamation

Annex (3) Industrial point sources of discharges into the river Nile (Aswan to El- Kanater)

No.	Location from AHD (KM)	Point Source	Bank	BOD		COD		TSS		Oil & Grease		Ammonia	
				1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
		Consent standard		30 mgO_2/l		40 mgO_2/l		30 mg/l		5 mg/l		NA	
1	50.000	Kom Ombo Sugar Ind.	R.B.	144	760	3072	1500	58	46	1.2	9.3	0.01	0.01
2	63.600	Ekleet power station	R.B.	1.2	4.8	2	84	28	79	1.21	2.55	0.01	0.01
3	119.600	Kaleh Power Station	L.B.	1.4	2.0	5	40	15	32	2.26	3.09	0.01	0.10
4	122.450	Edfu Paper Pulp A	L.B.	12	78	27	622	9	158	1.45	11.10	0.01	0.35
5	122.500	Edfu Paper Pulp B	L.B.	13	75	19	354	9	25	0.36	2.81	0.05	0.01
6	123.000	Edfu Sugar Ind.	L.B.	12	260		370	72	35	0.2	7.4	0.01	0.13
7	147.000	Sebaia Phosphate Ind.	R.B.							0.87			
8	204.500	Armant Sugar Ind 1	L.B.		70		161		15		9.6		0.10
9	204.505	Armant Sugar Ind 2	L.B.										
10	204.510	Armant Sugar Ind. 3	L.B.										
11	257.000	Ques Sugar Ind.	R.B.		33		59		20		3.36		0.01
12	265.400	Ginning Mill	L.B.										
13	314.000	Dishna Sugar Ind.	R.B.	74	67	178	800	32	20	0.55	8.32	0.01	0.01
14	337.500	Aluminum Ind.	L.B.										
15	343.200	Naga Hammadie Sugar A	L.B.	12	54	20	117	12	23	1	4.04	0.01	0.01
16	343.250	Naga Hammadie Sugar B	L.B.										
17	443.200	Onion Ind.	L.B.										
18	445.600	Souhag Oil Ind.	L.B.	1	75	8	260	20	61	9.4	5.87	0.01	0.14
19	445.605	Cocacola Ind.	L.B.		75	42	260	397	61	5.53	5.87	0.01	0.14
20	454.700	Seflak Ind.	R.B.		5.4	101	9	12	41	2.66	0.7	0.01	0.1
21	552.200	Mankabad Pipe 1	L.B.		1.5	5	22	13	28	-	2.04	0.7	0.15
22	552.205	Mankabad Pipe 2	L.B.										
23	552.210	Mankabad Pipe 3	L.B.										
24	904.000	Hawamdia Chemical 1	L.B.										
25	904.008	Hawamdia Chemical 2	L.B.										
26	904.300	Hawamdia Chemical 3	L.B.										
27	904.350	Hawamdia Chemical 4	R.B										
28	909.200	Helwan Power Station	R.B.										
29	911.400	Chemical Ind.	L.B.		420		5600		79		48.4		0.17
30	911.400	Hawamdia Suger Moulas	L.B.		445		6000		166		50.2		0.01
31	912.100	Hawamdia Sugar Pipe 1	L.B.	73	440	687	3850	51	285		17.6	0.16	2.51
32	912.105	Hawamdia Sugar Pipe 2	L.B.	33.5	58	591	77	190	25		2.73	0.01	0.01
33	912.115	Hawamdia Sugar Pipe 3	L.B.	2	86	4	185	76	61		3.64	0.01	0.01
34	912.120	Hawamdia Sugar Pipe 4	L.B.	71		1220		131				1.0	
35	912.125	Hawamdia Sugar Pipe 5	L.B.	23		48		48		6.44		0.01	
36	912.130	Hawamdia Sugar Pipe 6	L.B.										
37	915.000	Iron Steel Ind.	R.B.										
38	916.550	Kotsica Starch & Glucose	R.B.										
39	916.551	Kotsica Starch & Glucose	R.B										
40	939.600	El Nasser Glass Tube 1	R.B.	2		27		36		4.39		0.3	
41	939.605	El Nasser Glass Tube 2	R.B.										
42	939.610	El Nasser Glass Tube 3	R.B.										
43	939.615	El Nasser Glass Tube 4	R.B.										
44	939.620	El Nasser Glass Tube 5	R.B.										
45	947.900	Delta Cotton Kanater	R.B.	5		8		27		3.36		0.01	

L.B. = Left bank

R.B = Right bank

Annex (4)Wastewater Treatment Plants in Egypt

Wastewater Treatment Plants	Capacity 1000 m^{3}/day	Wastewater Treatment Plants	Capacity 1000 m^{3}/day	Wastewater Treatment Plants	Capacity 1000 m^{3}/day
Beheira		**Giza**		**Sharkiya**	
Shoubramant (2)	20	Monsha El Khanater (1)	10	Zagazig and Aslougy (2)	80
Mahmoudya (2)	12	Bohormos (1)	10	Zinclone (1)	20
Shoubra Kheet (3)	11.5	El Hewamdeya (1)	20	Mashtol El Souk (1)	10
Kafr El Dawar (3)	40	Badrasheen (1)	20	Derb Negm (1)	10
Kom Hamada (1)	10	*Total*	*60*	Kafr Sakr (1)	10
Mansheyat El Horeya (1)	20	**Kafr El Sheikh**		Wilad Sakr (1)	10
Damanhour(1)	50	Riad (1)	10	San El Hayan(1)	10
Abu El Matamir(1)	18	Kafr El Sheikh (1)	18.5	El Hessania (1)	10
Itay El Baroud(1)	10	Kelin (1)	10	Anshas El Raml(1)	10
El Delnagare (1)	10	Metobas (1)	10	Belbis(1)	20
Rohmaneya (1)	10	Balteern (1)	10	Menia El Kamh(1)	20
Berka Ghates (1)	10	El reyad (1)	10	Abou Keber(1)	20
Besnetway (1)	10	Desouk(1)	40	Faaous(1)	20
El Kom El Akhdar (1)	2	Beala (1)	20	Karayat(1)	20
Fazara (1)	2	Fewa (1)	20	El Kareen(1)	20
Edco(1)	20	Sedi Salim (1)	10	Hahia(1)	10
Hosh Esa (1)	20	El Hamo (1)	20	Saud(1)	10
Abou Homos (1)	20	*Total*	*178.5*	El-Aba Sa (1)	10
Total	*295.5*	**Qaliubiya**		*Total*	*320*
Dakahliya		Qalioub and Kalma (2)	95	**Gharbiya**	
Mansoura(2)	135	Kanater and Sawalha(2)	20	Tanta and Shoubra el Namla (2)	90
Atmida, Alboha and Senfa (2)	10	Kafr Shoukr (1)	10	Semanod and kafr el Sarem (2)	12
Damas (1)	2	Qalioub & East of Kanater (1)	140	Kafr Zayeat(1)	120
Aga(1)	10	Shebeen El Kanater (1)	18	El Mahalla El Kobra(1)	90
Kom El Nour(1)	10	Tokh (1)	16	Mabthoway(1)	10
Itmeda(1)	10	Banha (1)	70	Clotour(1)	10
Temi el Amdid(1)	2	Kharke (1)	18	Bethbeen(1)	10
Meet el Karme (1)	2	Meet Kerana (1)	2	Mahalet Marsoom(1)	
Bark El Ezz (1)	2	Kaha (1)	10	Mahla Zeyed(1)	2
Batra (1)	20	Seryakous (1)	10	Saft Torab and Hayatem(1)	10
El Gamolya (1)	20	*Total*	*409*	Berma(1)	2

Annex (4) Continue..

Wastewater Treatment Plants	Capacity 1000 m^{3}/day	Wastewater Treatment Plants	Capacity 1000 m^{3}/day	Wastewater Treatment Plants	Capacity 1000 m^{3}/day
Manzalla (1)	20	**Minya**		Shenrak(1)	2
Dakernes (1)	20	Menia (2)	60	Zefta(1)	20
Sembelawen (1)	20	El Ferrya (1)	40	Basioon(1)	20
Belkes (1)	20	El-Adwa (1)	2	Mahal Rouh & Shebeen El Kom(1)	10
Gamasa (1)	40	Der Mawas(1)	10	El Farsia(1)	10
Talkha (1)	20	Samaloot(1)	20	*Total*	*418*
Matareya (1)	40	Bani Mazar(1)	20	**Fayoum**	
Menia El Nasr (1)	20	Malawi(1)	40	Fayoum (2)	40
Sherbeen (1)	20	Matay(1)	10	Obshwai (1)	20
Massara (1)	20	Magaga(1)	20	Tatoon "Vedmin" (1)	10
Mit-Salsil (1)	10	*Total*	*222*	Atsa (1)	10
Demna (1)	10	**Menoufia**		Mattertars (1)	2
Bani-Abeed (1)	10	Quesna and begeem (2)	20	Tamia (1)	10
Olyla (1)	10	Ahebeen el Kom (2)	10	Kasr Rashwan (1)	10
Total	*503*	Mienof(2)	40	El-Agameen (1)	10
Damietta		Cluesna (1)	10	*Total*	*112*
Kafr Saad (1)	20	El Santa (1)	20	**Beni Suef**	
Izba El Borg (1)	20	Samadon (1)	10	Naser (2)	20
Farascor (1)	20	Telya (1)	10	Beni Suef (2)	34
El Horani (1)	2	Meet Bare (1)	10	Smasta	10
El Zarqa (1)	20	Shamaand Tomai (1)	10	Ahnasia	10
El Mohamedya (1)	2	Berke El Saba(1)	20	El Fashn (1)	20
El Naseria (1)	2	Ashmoun(1)	20	Baba (1)	20
Total	*86*	Tela(1)	20	*Total*	*114*
Ismailia		El Shaouhada(1)	20	**Alexandria**	
Ismailia(3)	90	Betarovn(1)	20	East Alexandria (4)	410
El Tal El Kibeer (1)	10	Sentris(1)	10	West Alexandria (4)	284
Abou Khalifa (1)	10	Ganzoun(1)	10	*Total*	*694*
El Kantara Gharb (1)	10	Total	*260*	**Port Said**	
Total	*120*	**North Sinai**		Port said (2)	150
Assuit		Arish(3)	2	*Total*	*150*
Assuit (2)	160	*Total*	*2*	**Suez**	
Total	*160*	**Sohag**		Suez (2)	200
Aswan		Sohag (3)	8.5	*Total*	*200*
Aswan (2)	35	*Total*	*8.5*	**Cairo**	
Total	*35*	**Qena**		El Berka (3)	600
Luxor		Qena (3)	8.5	El Gabel el Asfar (3)	1000
Luxor and Village of Tarek(2)	*26*	*Total*	*8.5*	Shubra el Kheima (3)	600
Total	*26*	**South Sinai**		Zenein (3)	400
Matrouh		Sharm el Sheikh (2)	5	Abou Rawash (3)	350
Marsa Matrouh (2)	25	*Total*	*5*	Tebeen (3)	30
Total	*25*			*Total*	*2980*
Total 7,392,000 m3 /day					

Annex (5)Incidence rate of Typhoid and Paratyphoid/100,000 individuals in 1998

Governorate	Rate	Governorate	Rate
New Valley	37.79	Suez	35.11
Assiout	30.3	Menoufia	24.1
Kalioubia	22.62	Sharkia	21.27
Beheira	19.79	Minia	18.14
Sohag	16.97	Fayoum	11.8
Qena	9.47	North Sinai	9.03
Alexandria	7.78	Cairo	7.35
Ismailia	7.07	Beni Suef	5.62
Gharbia	4.02	Dakahlia	3.27
Damietta	2.85	Kafr El Sheikh	2.85
Giza	2.72	Port Said	2.27
Red Sea	1.24	Matrouh	0.89
Aswan	0.8	Luxor	0.27
South Sinai	-		

Incidence rate of Viral Hepatitis/100,000 individuals in 1998

overnorate	Rate	Governorate	Rate
New Valley	184.2	Port Said	47.88
Alexandria	47.87	Luxor	45.8
Aswan	38.6	Damietta	34.3
Matrouh	33.03	Giza	29.9
Minia	28.5	Menoufia	28.2
Assiout	27.6	Suez	26.3
Qena	25.5	Fayoum	22.3
Gharbia	22.06	Beheira	19.4
Kafr El Sheikh	15.3	Cairo	14.4
Kalioubia	13.9	Sohag	13.7
Beni Suef	12.9	Red Sea	12.9
Ismailia	12.5	Dakahlia	8.9
North Sinai	6.7	Sharkia	5.8
South Sinai	-		

Source: Anwar, W.A(1999) Environmental Assessment and Human Health in Egypt.

Incidence rate of poliomyelitis/100,000 children in 1998

Governorate	Rate	Governorate	Rate
Fayoum	0.72	Minia	0.71
Beni Suef	0.39	Alexandria	-
Assiout	0.08	Aswan	-
Beheira	-	Cairo	0.1
Dakahlia	-	Damietta	-
Gharbia	-	Giza	0.35
Ismailia	0.41	Kafr El Sheikh	-
Kalioubia	-	Qena	-
Luxor	-	Matrouh	-
Menoufia	-	New Valley	-
North Sinai	-	Port Said	-
Red Sea	-	Sharkia	0.12
Sohag	0.39	South Sinai	-
Suez	-		

Incidence rate of Measles /100,000 children in 1998

Governorate	Rate	Governorate	Rate
New Valley	465.3	Luxor	142.1
Suez	76.8	Red Sea	50.0
Menoufia	25.5	Aswan	23.3
North Sinai	19.7	Damietta	15.5
Ismailia	13.9	Assiout	13.5
Matrouh	12.7	Giza	10.4
Kalioubia	9.9	Qena	9.46
Port Said	7.7	Minia	4.7
Alexandria	4.5	Beni Suef	3.07
Cairo	2.9	Beheira	1.47
Sharkia	1.4	Fayoum	1.13
Dakahlia	1.08	Sohag	0.9
Gharbia	0.58	Kafr El Sheikh	-
South Sinai	-		

Incidence rate of Diphtheria /100,000 individuals in 1998

Governorate	Rate	Governorate	Rate
Luxor	1.31	Qena	0.03
Sohag	0.03	Alexandria	-
Minia	-	Aswan	-
Beheira	-	Cairo	-
Dakahlia	-	Damietta	-
Gharbia	-	Giza	-
Ismailia	-	Kafr El Sheikh	-
Kalioubia	-	Assiout	-
Fayoum	-	Matrouh	-
Menoufia	-	New Valley	-
North Sinai	-	Port Said	-
Red Sea	-	Sharkia	-
Beni Suef	-	South Sinai	-
Suez	-		

Incidence rate of Meningitis /100,000 individuals in 1998

Governorate	Rate	Governorate	Rate
Qena	1.99	Minia	1.89
Aswan	1.79	Gharbia	1.5
Sohag	1.24	Port Said	1.03
Kafr El Sheikh	0.9	Giza	0.6
Fayoum	0.6	Luxor	0.54
Damietta	0.5	Beni Suef	0.5
Ismailia	0.4	Kalioubia	0.4
Cairo	0.37	Alexandria	0.35
Beheira	0.2	Menoufia	0.2
Assiout	0.1	Sharkia	0.04
Dakahlia	-	Matrouh	-
New Valley	-	North Sinai	-
Red Sea	-	South Sinai	-
Suez	-		

Prevalence rate of Schistosomiasis /100 individual in 1998

Governorate	Haematobium	Mansoni
Giza	2.6	0.3
Assiout	6.04	-
Beni Suef	3.4	-
Alexandria	0.43	7.56
Minia	4.4	-
Aswan	2.31	-
Beheira	0.07	11.2
Dakahlia	0.13	7.61
Damietta	0.01	5.54
Gharbia	0.18	4.6
Fayoum	7.3	-
Ismailia	1.15	8.32
Kafr El Sheikh	0.72	12.6
Kalioubia	1.42	2.7
Qena	4.93	-
Menoufia	2.76	7.08
Port Said	0.29	2
Sharkia	0.31	5.82
Sohag	4.84	-
Suez	4.17	3.21

Annex 6

River Nile Water Quality date for all Governorates of Egypt
Source :MOHP'S 2003

ASWAN

Table (1) River Nile water quality at Aswan sampling site

Parameter	Temperatur	DO	H_2S	pH	EC	NH_3	NO_2	NO3	Chlorides	Total Hardness	Ca Hardness	Ca
January	25.00	5.94	0.00	14.20	259.73	0.00	0.00	0.00	16.55	105.82	65.82	
February	25.00	5.92	0.00	7.82	266.55	0.00	0.00	0.00	16.18	110.00	68.73	27.49
March	25.00	5.69	0.00	7.82	258.36	0.00	0.00	0.00	17.55	109.09	69.09	27.64
April	25.00	5.93	0.00	7.81	250.73	0.00	0.00	0.00	16.91	105.91	65.91	26.36
May	28.00	6.29	0.00	7.77	266.45	0.00	0.00	0.00	16.18	109.45	68.73	27.49
June	25.00	5.68	0.00	7.82	262.82	0.00	0.00	0.00	16.36	109.09	67.64	27.05
July	27.00	5.65	0.00	7.77	262.00	0.00	0.00	0.00	17.82	105.00	65.45	26.18
August	27.00	5.65	0.00	7.77	262.00	0.00	0.00	0.00	18.18	104.55	64.00	25.60
September	28.00	5.85	0.00	7.78	265.36	0.00	0.00	0.00	16.91	108.91	68.91	27.56
October	27.00	5.95	0.00	7.85	266.00	0.00	0.00	0.00	16.00	107.27	65.82	26.33
November	25.00	5.71	0.00	7.83	266.55	0.00	0.00	0.00	17.09	110.36	69.82	27.93
December	25.00	5.58	0.00	7.82	260.18	0.00	0.00	0.00	18.45	104.73	64.73	25.89

Table (1) Continue

Date	Mg Hardness	Mg	Total Alkalinity	Iron	Mn	Sulphate	Phosphate	Silicate	BOD	COD	T.D.S	SS	Fluorides	Oil &Grease	COD Limits	BOD Limits
Jan.	40.00	9.60	124.91	0.00	0.00	0.00	0.00	10.00	4.25	8.05	177.09	25.64	0.37	0.00	10.00	6.00
Feb.	41.27	9.91	119.64	0.00	0.00	0.00	0.00	10.00	4.84	8.99	166.45	33.27	0.40	0.00	10.00	6.00
Mar.	40.00	9.60	125.73	0.00	0.00	0.00	0.00	12.27	5.11	9.49	164.18	23.27	0.40	0.00	10.00	6.00
Apr.	40.00	9.60	113.27	0.00	0.00	0.00	0.00	9.64	5.36	9.73	168.18	21.09	0.40	0.00	10.00	6.00
May	40.73	9.77	125.73	0.00	0.00	21.00	0.10	10.00	5.45	9.33	165.82	27.45	0.40	0.00	10.00	6.00
Jun.	41.45	9.95	129.82	0.00	0.00	20.18	0.00	10.00	5.42	10.03	165.55	24.64	0.40	0.00	10.00	6.00
Jul.	39.55	9.49	111.09	0.00	0.00	21.18	0.00	10.00	4.93	9.50	154.64	20.36	0.40	0.00	10.00	6.00
Aug.	40.55	9.73	111.82	0.00	0.00	21.91	0.00	9.09	5.83	9.64	170.90	28.91	0.40	0.00	10.00	6.00
Sep.	40.00	9.60	122.36	0.00	0.00	20.64	0.00	6.82	5.78	9.22	168.00	27.82	0.40	0.00	10.00	6.00
Oct.	41.45	9.95	128.73	0.00	0.00	20.00	0.00	5.91	5.79	9.19	158.18	27.73	0.40	0.00	10.00	6.00
Nov.	40.55	9.73	117.73	0.00	0.00	20.18	0.00	7.50	5.70	9.75	165.45	28.09	0.40	0.00	10.00	6.00
Dec.	40.00	9.60	126.00	0.00	0.00	22.00	0.00	7.05	4.30	9.15	173.18	27.82	0.35	0.00	10.00	6.00

Table (1a) Heavy metals in the River Nile at Aswan site

Date	Silver (Ag)	Arsenic (As)	Aluminum (Al)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Selenium (Se)	Tin (Sn)	Zinc (Zn)
March	0.0093	0.0133	0.0806	0.0090	0.0066	0.0220	0.0005	0.0281	0.0127	0.0057	0.0158	0.0412
October	0.0317	0.0282	0.0319	0.0038	0.0260	0.0498	0.0003	0.0391	0.0352	0.0025	0.0176	0.1523

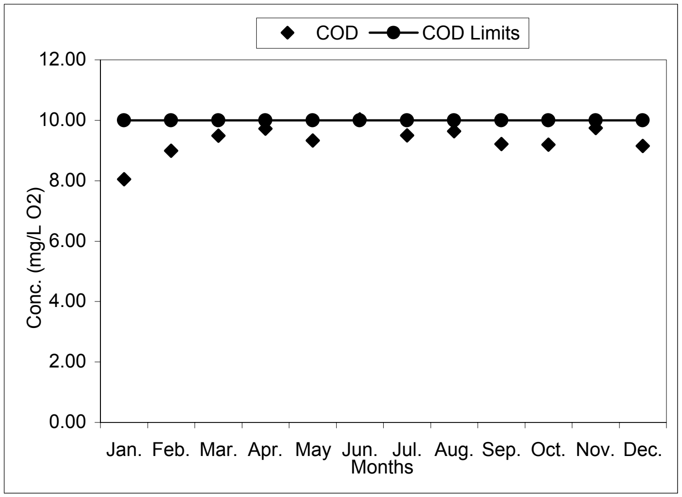

Figure (1) Variation in COD values at Aswan site

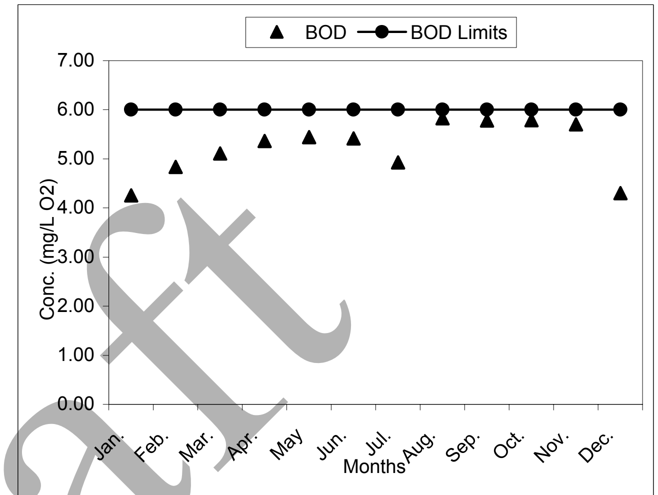

Figure (1a) Variation in BOD values at Aswan site

Souhag

Table (2) River Nile water quality at Souhag sampling site

Parameter	Temp	DO	H_2S	pH	EC	NH_3	NO_2	NO_3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
January	19.14	6.39	0.10	7.22	313.86	0.00	0.00	0.00	10.36	103.57	60.00	43.57	24.00
February	18.00	8.09	0.10	7.20	302.50	0.00	0.00	0.00	10.00	104.38	61.88	42.50	24.75
March	20.53	8.50	0.10	7.13	258.00	0.00	0.00	0.00	10.00	98.67	58.67	40.00	23.47
April	22.80	8.33	0.10	7.17	283.53	0.00	0.00	0.00	10.33	104.67	58.67	46.00	23.47
May	25.00	7.53	0.10	7.13	288.00	0.00	0.00	0.00	10.00	106.67	62.00	44.67	24.80
June	25.93	8.32	0.10	7.14	271.33	0.00	0.00	0.00	10.00	98.67	58.67	40.00	23.47
July	27.07	7.72	0.10	7.17	264.00	0.00	0.00	0.00	10.53	105.33	60.00	45.33	24.00
August	26.33	7.50	0.10	7.08	274.00	0.00	0.00	0.00	11.87	110.67	64.00	46.67	25.60
September	24.80	7.57	0.10	7.12	266.67	0.00	0.00	0.00	12.67	125.33	69.33	56.00	27.73
October	24.40	8.70	0.10	7.17	293.33	0.00	0.00	0.00	12.67	120.67	67.33	53.33	26.93
November	21.53	8.27	0.10	7.10	272.67	0.00	0.00	0.00	12.00	116.67	66.00	50.67	26.40
December	19.20	9.07	0.10	7.12	272.00	0.00	0.00	0.00	10.27	117.33	65.33	52.00	26.13

Table (2) Continue

	Mg	Total Alkalinity	Iron	Mn	Phosphate	Silicate	BOD	COD	TDS	COD Limits	BOD Limits
Jan.	10.56	124.00	0.01	0.00	0.02	10.00	2.93	11.73	209.40	10.00	6.00
Feb.	10.20	121.25	0.05	0.00	0.02	10.81	2.84	11.75	201.25	10.00	6.00
Mar.	9.60	114.67	0.01	0.00	0.02	10.27	3.03	11.40	180.80	10.00	6.00
Apr.	11.04	123.33	0.00	0.00	0.02	10.33	2.83	12.60	187.47	10.00	6.00
May	10.72	125.33	0.00	0.00	0.02	10.67	2.50	11.93	189.40	10.00	6.00
Jun.	9.60	114.67	0.01	0.00	0.02	10.27	3.03	11.40	179.87	10.00	6.00
Jul.	10.88	126.67	0.00	0.00	0.03	10.00	2.47	11.87	173.93	10.00	6.00
Aug.	11.20	133.33	0.00	0.00	0.02	10.00	2.83	11.20	182.33	10.00	6.00
Sep.	13.44	134.00	0.00	0.00	0.02	10.00	2.90	11.47	182.60	10.00	6.00
Oct.	12.80	135.33	0.00	0.00	0.02	10.00	3.43	11.00	195.27	10.00	6.00
Nov.	12.16	138.00	0.00	0.00	0.02	10.00	2.73	12.20	181.80	10.00	6.00
Dec.	12.48	136.67	0.00	0.00	0.03	10.00	2.70	12.13	180.00	10.00	6.00

Table (2a) Heavy metals in the River Nile at Souhag site

Date	Silver (Ag)	Arsenic (As)	Aluminum (Al)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Selenium (Se)	Tin (Sn)	Zinc (Zn)
Jan.2003	0.0000	0.0247	0.0000	0.0026	0.0000	0.0265	0.0000	0.0000	0.0209	0.0061	0.0000	0.0531
Oct.2003	0.0114	0.0270	0.0471	0.0020	0.0024	0.0929	0.0001	0.0306	0.0282	0.0026	0.0329	0.1335

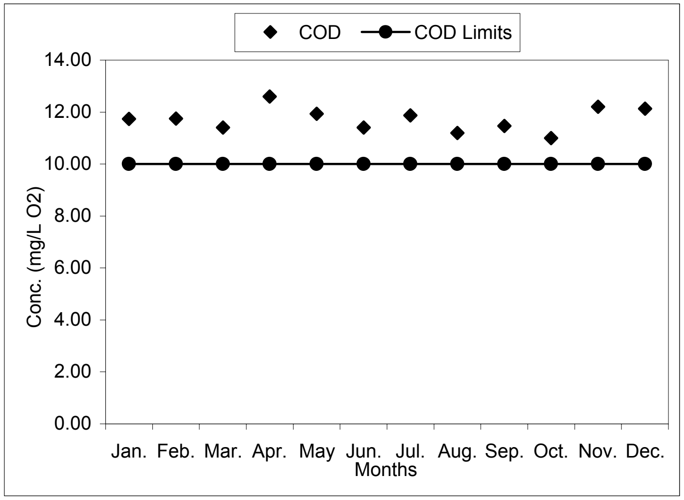

Figure (2) Variation in COD values at Souhag site

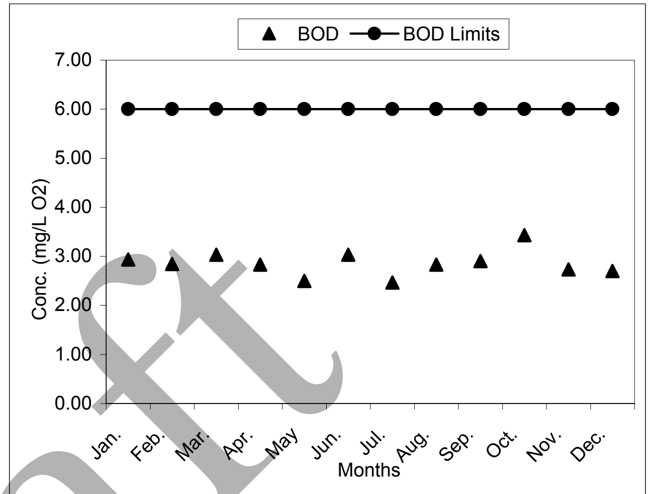

Figure (2a) Variation in BOD values at Souhag site

Asuot

Table (3) River Nile water quality at Asuot sampling site

Parameter	Temp	DO	H_2S	pH	EC	NH_3	NO_2	NO_3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
January	18.9	8.0	0.0	7.7	258.4	0.2	0.1	0.0	28.4	165.3	92.6	72.6	37.1
February	18.9	8.2	0.0	7.8	250.8	0.3	0.1	0.0	22.5	161.2	87.1	74.2	34.8
March	19.1	7.1	0.0	7.8	198.8	0.2	0.1	0.0	17.2	142.8	75.8	66.9	30.3
April	23.3	7.3	0.0	7.6	209.1	0.3	0.0	0.0	15.3	142.9	83.6	59.3	33.5
May	25.6	6.8	0.0	7.3	267.7	0.2	0.0	0.0	22.5	133.2	67.7	65.5	27.1
June	28.3	7.6	0.0	7.7	267.8	0.3	0.3	0.0	10.6	126.2	65.8	60.3	26.3
July	29.9	7.0	0.0	7.5	267.4	0.1	0.1	0.0	13.5	133.7	77.7	56.0	31.1
August	31.5	6.9	0.0	7.5	298.5	0.2	0.0	0.0	12.2	138.6	83.5	55.1	33.4
September	30.9	7.0	0.0	7.5	412.2	0.2	0.0	0.0	15.1	152.5	85.1	66.6	34.0
October	28.6	7.3	0.0	7.7	318.5	0.2	0.0	0.0	21.6	175.4	89.3	86.1	35.7
November	22.1	9.1	0.0	7.7	298.6	0.4	0.0	0.0	17.2	160.2	95.4	64.8	38.2
December	17.5	8.9	0.0	8.5	273.3	0.7	0.1	0.0	16.9	148.6	90.3	58.3	36.1

Table (3) Continue

Parameter	Mg	Total Alkalinity	Iron	Mn	Sulphates	Phosphates	Silicates	BOD	COD	TDS	SS	Na	K.	F	Oil & Grease	COD Limits
Jan.	17.4	140.8	0.2	0.0	34.3	0.1	26.3	2.7	7.8	173.1	29.7	34.0	5.4	0.8	0.3	10.00
Feb.	17.8	137.1	0.1	0.0	27.8	0.2	24.8	2.1	6.4	165.4	28.4	22.0	5.5	1.0	0.1	10.00
Mar.	16.2	132.2	0.1	0.0	22.9	0.1	25.9	2.0	6.9	137.8	29.6	19.9	5.1	0.9	0.1	10.00
Apr.	14.2	135.9	0.0	0.0	26.8	0.1	26.3	2.9	7.9	144.6	30.2	23.2	5.3	0.6	0.2	10.00
May	15.7	130.2	0.2	0.0	26.2	0.3	25.6	2.1	7.5	185.3	29.5	20.2	5.7	0.9	6.1	10.00
Jun.	14.5	127.7	0.1	0.8	18.7	0.2	5.3	1.9	7.6	194.5	29.9	16.1	4.9	0.3	0.0	10.00
Jul.	13.4	123.9	0.4	0.0	18.5	0.2	4.4	2.6	7.5	196.5	29.9	17.8	5.1	0.4	0.0	10.00
Aug.	13.2	125.2	0.0	0.0	19.8	0.1	6.3	2.3	7.5	196.3	29.7	17.1	4.8	0.4	0.0	10.00
Sep.	16.0	133.3	0.3	0.0	29.7	1.5	4.0	2.9	9.1	296.3	31.0	17.8	5.5	6.0	0.2	10.00
Oct.	20.8	146.0	0.3	0.0	31.2	1.5	2.9	2.7	8.1	235.1	30.4	20.6	3.5	2.6	0.0	10.00
Nov.	15.5	143.8	0.2	0.0	27.1	0.5	3.7	3.1	8.4	206.0	30.6	19.5	5.1	2.0	0.0	10.00
Dec.	14.0	124.8	0.1	0.0	24.2	0.3	1.5	2.2	6.5	201.4	31.1	20.8	5.4	2.3	0.0	10.00

Table (3a) Heavy metals in the River Nile at Asuot site

Date	Silver (Ag)	Arsenic (As)	Aluminum (Al)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Selenium (Se)	Tin (Sn)	Zinc (Zn)
Mar. 2003	0.0000	0.0100	0.0000	0.0040	0.0000	0.0200	0.0000	0.0000	0.0193	0.0061	0.0000	0.0793
Jul. 2003	0.0331	0.0128	0.0161	0.0129	0.1210	0.0652	0.0016	0.0240	0.0356	0.0088	0.0324	0.1180
Oct. 2003	0.0389	0.0189	0.0291	0.0190	0.0732	0.1086	0.0040	0.0443	0.0868	0.0095	0.0259	0.1764

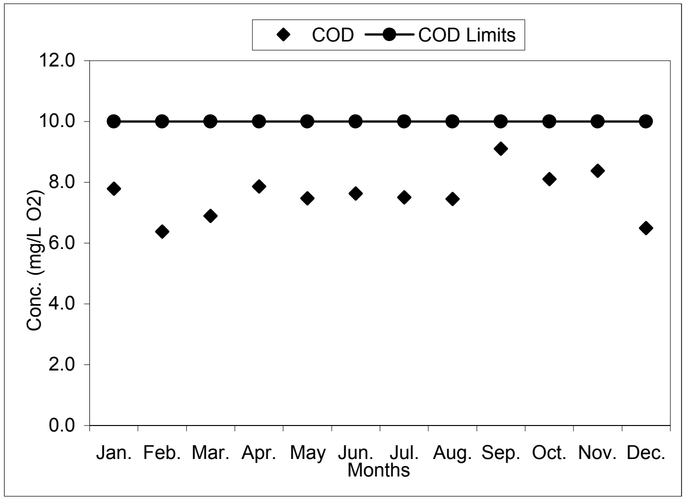

Figure (3) Variation in COD values at Asuot site

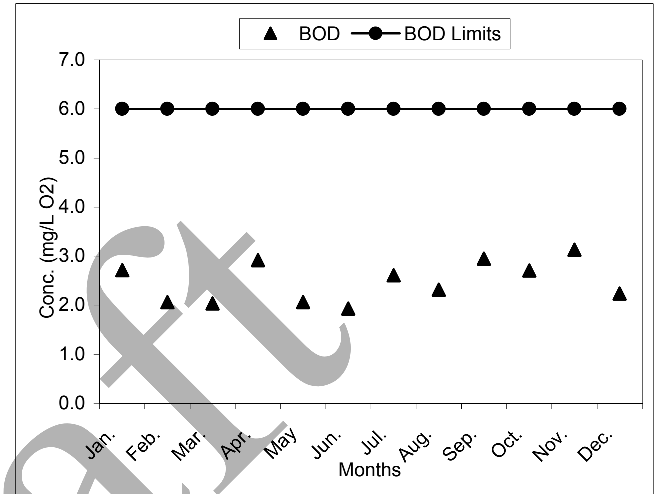

Figure (3a) Variation in BOD values at Asuot site

El-Menia

Table (4) River Nile water quality at El-Menia sampling site

Parameter	Temp	DO	H_2S	pH	EC	NH_3	NO_2	NO_3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
January	17.5	7.8	0.0	7.9	242.2	0.0	0.0	0.0	12.7	116.5	72.3	44.2	28.9
February	17.6	7.8	0.1	7.8	244.6	0.0	0.0	0.0	12.8	120.5	70.9	49.5	28.4
March	17.4	7.7	0.1	7.9	249.2	0.0	0.0	0.0	12.7	120.5	76.6	43.8	30.6
April	18.5	7.8	0.2	7.9	243.8	0.0	0.0	0.0	12.6	120.8	70.8	50.0	28.3
May	26.2	7.1	0.0	7.9	261.5	0.0	0.0	0.0	15.1	118.5	73.1	45.8	28.3
June	26.9	6.9	0.0	7.8	250.9	0.0	0.0	0.0	15.7	119.3	73.4	45.9	29.4
July	21.2	7.4	0.0	7.9	243.7	0.0	0.0	0.0	12.8	113.1	68.5	44.6	27.4
August	21.1	7.1	0.0	7.9	237.7	0.0	0.0	0.0	13.0	115.5	69.2	45.5	27.7
September													
October	20.7	7.6	0.3	7.6	246.2	0.0	0.0	0.0	12.8	117.5	72.6	44.9	29.0
November	20.2	7.6	0.3	7.7	239.2	0.0	0.0	0.0	13.3	117.0	73.3	43.7	29.3
December	19.4	7.7	0.0	7.8	278.2	0.0	0.0	0.0	12.7	119.1	77.7	41.4	31.1

Table (4) Continue

Parameter	Mg	Total Alkalinity	Iron	Mn	Sulphates	Phosphates	Silicates	BOD	COD	TDS	SS	F	Oil & Grease	COD Limits	BOD Limits
Jan.	10.6	116.2	0.0	0.0	21.4	0.0	0.2	4.7	6.9	169.9	13.0	0.9	1.4	10.00	6.00
Feb.	11.9	116.5	0.0	0.0	23.0	0.0	0.2	5.0	8.7	170.5	13.1	0.6	0.3	10.00	6.00
Mar.	10.5	117.8	0.0	0.0	22.2	1.1	0.1	5.2	8.7	173.7	13.5	1.7	1.1	10.00	6.00
Apr.	12.0	113.1	0.0	0.0	21.1	0.0	0.2	4.9	9.3	172.8	13.2	0.6	1.3	10.00	6.00
May	11.0	116.5	0.0	0.0	21.5	0.0	0.1	5.0	8.0	189.2	30.2	0.0	1.1	10.00	6.00
Jun.	11.0	116.9	0.0	0.0	21.8	0.0	0.1	5.1	7.9	189.2	17.8	0.0	0.0	10.00	6.00
Jul.	10.7	118.4	0.0	0.0	21.8	0.0	2.5	4.6	6.5	166.5	12.5	0.1	0.0	10.00	6.00
Aug.	10.9	115.5	0.0	0.0	21.9	0.0	1.6	4.3	6.9	167.7	12.8	0.0	0.1	10.00	6.00
Sep.														10.00	6.00
Oct.	10.8	104.0	0.0	0.0	21.7	0.1	0.2	5.2	7.7	113.7	13.2	0.2	0.5	10.00	6.00
Nov.	10.5	113.1	0.0	0.0	22.5	0.1	0.1	5.3	7.9	122.0	13.3	0.1	1.0	10.00	6.00
Dec.	9.9	113.5	0.0	0.0	22.3	0.1	0.2	5.7	8.8	173.5	13.9	0.8	0.5	10.00	6.00

Table (4a) Heavy metals in the River Nile at El-Menia site

Date	Silver (Ag)	Arsenic (As)	Aluminum (Al)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Selenium (Se)	Tin (Sn)	Zinc (Zn)
Jan. 2003		0.0123		0.0080		0.0276			0.0191	0.0057		0.0294
June2003	0.0225	0.0162	0.0725	0.0077	0.0100	0.0541	0.0008	0.0607	0.0320	0.0071	0.0335	0.0788
Dec.2003	0.0160	0.0163	0.0446	0.0086	0.0138	0.0600	0.0013	0.0389	0.0333	0.0058	0.0268	0.1142

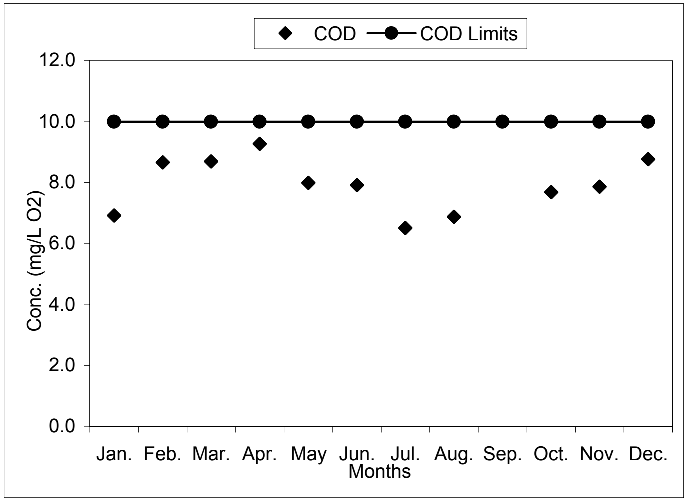

Figure (4) Variation in COD values at El-Menia site

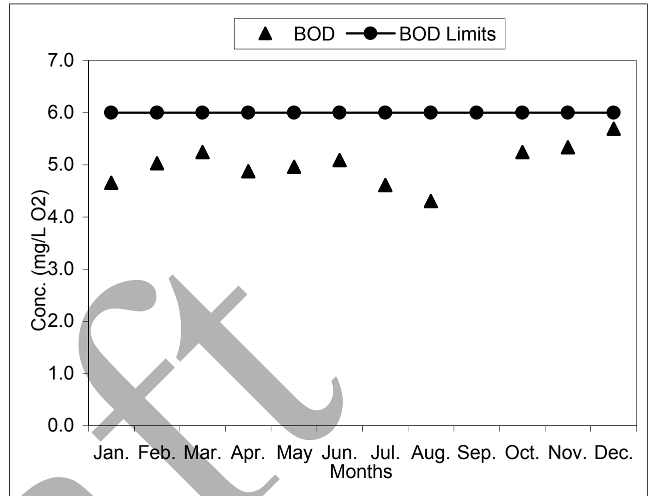

Figure (4a) Variation in BOD values at El-Menia site

Bani-Sweif

Table (5) River Nile water quality at Bani-Sweif sampling site

Parameter	Temp	DO	H_2S	PH	EC	NH_3	NO_2	NO_3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
January	19.0	6.1	0.3	8.3	658.5	0.0	0.0	0.0	23.2	186.5	100.5	86.0	40.2
February	16.3	5.7	0.2	7.9	533.3	0.0	0.3	0.0	40.0	156.3	64.0	92.3	25.6
March	18.5	5.7	0.2	8.0	516.0	0.0	0.0	0.0	34.5	143.0	69.5	73.5	27.8
April	25.0	5.7	0.2	8.1	461.0	0.0	0.0	0.0	18.0	120.0	74.0	46.0	29.6
May	27.7	5.5	0.2	8.0	606.0	0.0	0.5	0.0	32.3	136.0	68.0	68.0	27.2
June	30.0	5.7	0.3	8.0	490.8	0.0	0.0	0.0	24.5	130.5	60.5	70.0	24.2
July	30.2	5.4	0.3	8.0	510.0	0.0	0.0	0.0	21.7	121.3	62.0	59.3	24.8
August	29.7	5.4	0.2	8.0	633.5	0.0	0.7	0.0	30.7	143.7	57.7	86.0	23.1
September	29.0	5.6	0.2	8.1	502.0	0.0	0.0	0.0	24.2	123.0	70.0	53.0	28.0
October	24.0	5.7	0.2	8.1	492.2	0.0	0.0	0.0	30.3	135.3	71.3	64.0	28.5
November	23.3	5.4	0.3	8.0	634.5	0.0	0.0	0.0	44.0	181.0	101.7	79.3	40.7
December	19.3	9.2	0.1	8.2	485.5	0.0	0.0	0.0	33.3	147.3	87.7	59.7	35.1

Table (5) Continue

Parameter	Mg	Total Alkalinity	Iron	Mn	Phosphate	BOD	COD	DS	SS	F	Oil & Grease	COD Limits	BOD Limits
Jan.	20.6	171.5	0.0	0.0	0.2	0.5	6.6	188.8	38.3	0.4	0.0	10.00	6.00
Feb.	22.2	152.0	0.1	0.0	0.2	1.8	10.4			0.4	0.0	10.00	6.00
Mar.	17.6	142.5	0.4	0.0	0.2	1.7	6.4			0.4	0.0	10.00	6.00
Apr.	11.0	138.7	0.3	0.0	0.2	2.4	7.1	187.3	37.3	0.4	0.0	10.00	6.00
May	16.3	149.3	0.2	0.0	0.2	1.7	9.6	200.2	53.7	0.4	0.0	10.00	6.00
Jun.	16.8	132.0	0.6	0.0	0.2	1.7	8.0	213.0	39.8	0.4	0.0	10.00	6.00
Jul.	14.2	128.7	0.3	0.0	0.2	1.0	7.5	194.0	42.5	0.4	0.0	10.00	6.00
Aug.	20.6	156.7	0.4	0.0	0.1	1.0	8.3	221.5	59.8	0.4	0.0	10.00	6.00
Sep.	12.7	140.0	0.4		0.1	1.3	7.5	234.3	50.5	0.4	0.0	10.00	6.00
Oct.	15.4	142.7	0.7		0.1	1.0	8.6	249.3	99.3	0.4		10.00	6.00
Nov.	19.0	168.0	0.5	0.0	0.1	2.1	9.8	326.7	56.8	0.4	0.0	10.00	6.00
Dec.	14.3	145.7	0.5	0.0	0.0	3.7		235.7	59.5	0.4		10.00	6.00

Table (5a) Heavy metals in the River Nile at Bani-Sweif site

Date	Silver (Ag)	Arsenic (As)	Aluminum (Al)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Selenium (Se)	Tin (Sn)	Zinc (Zn)
Apr. 2003	0.0300	0.0130	0.0273	0.0035	0.0148	0.0185	0.0006	0.0045	0.0175	0.0053	0.0150	0.0420
Aug. 2003	0.0135	0.0138	0.0133	0.0032	0.0125	0.0165	0.0005	0.0128	0.0183	0.0065	0.0100	0.0548
Nov. 2003	0.0276	0.0209	0.0390	0.0096	0.0269	0.0583	0.0013	0.0251	0.0413	0.0081	0.0188	0.1074

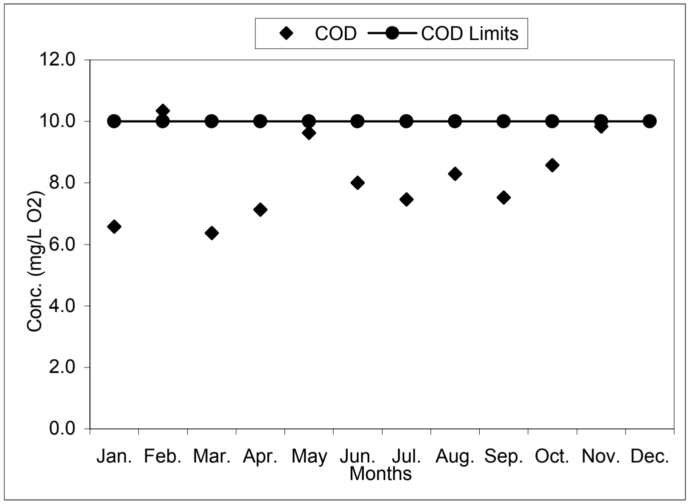

Figure (5) Variation in COD values at Bani-Sweif site

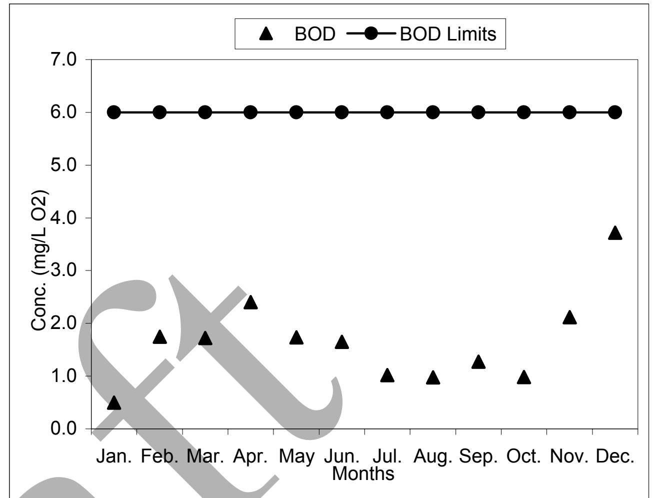

Figure (5a) Variation in BOD values at Bani-Sweif site

Greater Cairo

Table (6) River Nile water quality at Greater Cairo sampling site

Parameter	Temp	DO	H_2S	pH	EC	NH_3	NO_2	NO_3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
January	17.0	6.8	0.0	7.3	375.2	0.0	0.0	0.0	0.0	133.9	126.9	74.4	29.6
February	18.4	6.3	0.0	7.5	348.4	0.0	0.0	0.0	0.0	130.1	122.6	70.9	28.4
March	19.6	6.5	0.0	7.2	390.7	0.0	0.0	0.0	0.0	135.3	125.2	68.4	27.4
April	23.2	6.7	0.0	7.1	388.3	0.0	0.0	0.0	0.0	148.4	125.5	70.5	28.2
May	25.7	7.0	0.0	7.1	354.5	0.0	0.0	0.0	0.0	133.1	124.1	73.3	29.3
June	28.1	6.8	0.0	7.1	313.7	0.0	0.0	0.0	0.0	126.7	119.4	72.5	28.9
July	28.0	6.7	0.0	7.7	309.1	0.0	0.0	0.0	0.0	123.9	123.3	74.8	29.9
August	29.6	6.8	0.0	7.7	292.9	0.0	0.0	0.0	0.0	136.1	133.8	76.4	30.5
September	28.0	6.0	0.0	7.6	392.2	0.0	0.0	0.0	0.0	158.4	155.9	83.6	33.4
October	26.0	6.4	0.0	8.2	407.3	0.0	0.0	0.0	0.0	173.4	164.8	90.2	36.1
November	24.0	6.4	0.0	8.2	399.0	0.0	0.0	0.0	0.0	157.9	138.9	87.4	35.0
December	18.6	6.2	0.0	7.5	505.8	0.0	0.0	0.0	0.0	190.6	169.3	80.4	32.2

Table (6) Continue

Parameter	Mg Hardness	Mg	Iron	Mn	Sulphates	Chlorides	Silicates	BOD	COD	TDS	SS	Oil & Grease	Phenols	F	Cyanide	Na
Jan.	52.6	12.6	0.0	0.0	27.0	23.5	4.7	3.1	9.2	251.4	13.0	0.0	0.0	0.4		
Feb.	51.7	12.4	0.0	0.0	28.0	22.6	3.9	2.9	8.9	194.4	19.9	0.0	0.0	0.4		
Mar.	56.8	13.6	0.0	0.0	21.4	21.3	6.0	3.2	10.3	234.3	17.5	0.0	0.0	0.6		
Apr.	55.0	13.2	0.0	0.0	26.6	21.9	6.3	3.3	9.8	227.6	18.7	0.0	0.0	0.3		
May	50.8	12.2	0.0	0.0	24.7	17.1	5.6	3.6	9.7	232.8	24.3	0.0	0.0	0.4		
Jun.	46.9	11.3	0.0	0.0	24.1	16.6	5.2	4.0	9.1	196.4	18.1	0.0	0.0	0.4		
Jul.	48.5	11.6	0.0	0.0	26.0	15.1	3.9	5.7	8.6	202.2	17.7	0.0	0.0	0.3	0.0	19.8
Aug.	57.4	13.8	0.1	0.0	28.1	16.7	4.0	4.9	9.8	201.4	17.3	0.0	0.0	0.4	0.0	22.1
Sep.	72.3	17.4	0.1	0.0	28.5	22.8	4.2	6.0	11.1	260.8	20.7	0.0	0.0	0.3	0.0	28.9
Oct.	74.5	17.9	0.0	0.0	29.6	27.8	5.0	4.1	8.5	243.7	20.2	0.0	0.0	0.4	0.0	24.0
Nov.	51.4	12.3	0.0	0.0	30.4	26.2	4.3	3.8	14.2	238.6	17.9	0.0	0.0	0.4	0.0	24.0
Dec.	88.9	21.3	0.0	0.0	45.7	43.7	6.4	2.6	8.1	335.6	19.4	0.0	0.0	0.3	0.0	23.4

Table (6a) Heavy metals in the River Nile at Greater Cairo site

Date	Silver (Ag)	Arsenic (As)	Aluminum (Al)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Selenium (Se)	Tin (Sn)	Zinc (Zn)
January		0.0133		0.0047		0.0202			0.0199	0.0081		0.0469
February		0.0136		0.0068		0.0172			0.0163	0.0058		0.0394
March		0.0096		0.0059		0.0212			0.0162	0.0058		0.0425
April	0.0100	0.0116	0.0313	0.0062	0.0054	0.0174	0.0006	0.0096	0.0171	0.0064	0.0262	0.0456
May	0.0132	0.0122	0.0248	0.0070	0.0091	0.0387	0.0006	0.0187	0.0226	0.0057	0.0213	0.0628
June	0.0116	0.0157	0.0236	0.0048	0.0126	0.0266	0.0009	0.0198	0.0198	0.0056	0.0157	0.0691
July	0.0092	0.0100	0.0155	0.0039	0.0104	0.0203	0.0004	0.0127	0.0134	0.0050	0.0085	0.0557
August	0.0067	0.0063	0.0135	0.0042	0.0139	0.0201	0.0004	0.0103	0.0088	0.0037	0.0059	0.0755
September	0.0104	0.0055	0.0168	0.0016	0.0141	0.0198	0.0004	0.0134	0.0115	0.0048	0.0086	0.0728

October	0.0079	0.0087	0.0214	0.0021	0.0122	0.0212	0.0004	0.0147	0.0131	0.0046	0.0072	0.0679
November	0.0099	0.0177	0.0180	0.0018	0.0118	0.0416	0.0004	0.0136	0.0135	0.0054	0.0063	0.1130
December	0.0074	0.0104	0.0134	0.0018	0.0147	0.0496	0.0004	0.0148	0.0175	0.0050	0.0067	0.1234

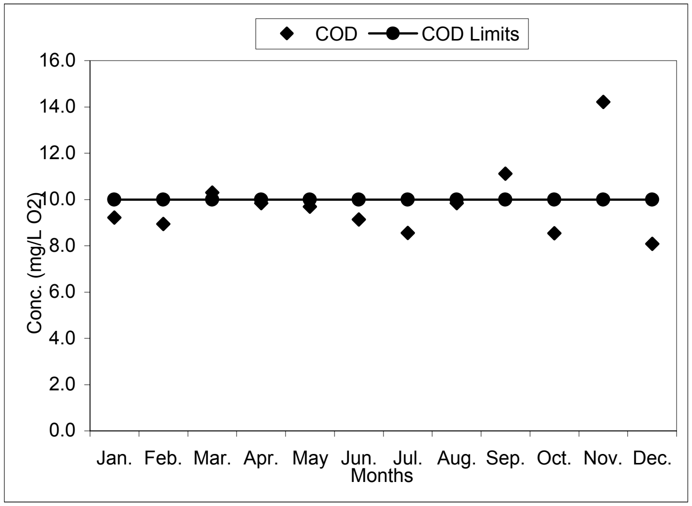

Figure (6) Variation in COD values at Greater Cairo site

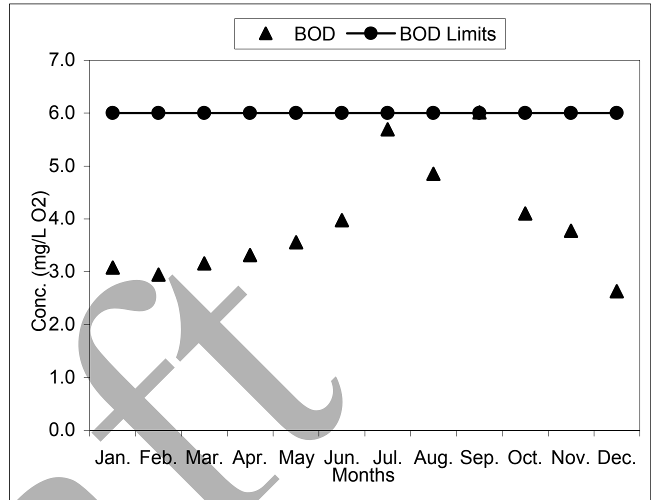

Figure (6a) Variation in BOD values at Greater Cairo site

El-Gharbia

Table (7) River Nile water quality at El-Gharbia sampling site

Parameter	Temp	DO	pH	EC	NH_3	NO_2	NO_3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
Jan.	18.2	6.9	8.0	567.9	0.2	0.2	0.1	45.7	223.3	129.3	94.0	51.7
Feb.	16.8	7.2	8.2	476.7	0.2	0.1	0.1	32.4	221.9	127.4	94.5	51.0
Mar.	17.6	7.4	8.2	485.8	0.2	0.2	0.0	38.3	214.6	121.5	93.1	48.6
Apr.	24.2	7.3	8.3	424.4	0.1	0.1	0.0	30.7	228.8	128.6	100.2	51.4
May	28.1	6.6	8.3	385.5	0.0	0.1	0.1	25.3	208.3	114.4	93.9	45.8
Jun.	29.6	5.8	7.7	357.4	0.0	0.1	0.0	21.5	188.0	103.8	84.3	41.5
Jul.	28.9	6.2	8.0	345.0	0.0	0.1	0.1	21.1	184.3	105.3	79.1	42.1
Aug.	30.1	6.7	8.3	367.5	0.1	0.1	0.1	22.7	201.5	117.8	83.7	47.1
Sep.	28.9	6.3	8.4	401.5	0.0	0.1	0.1	25.3	207.1	116.6	90.5	46.6
Oct.	26.7	5.6	8.0	477.0	0.1	0.2	0.1	34.2	165.3	95.9	69.4	38.4
Nov.	24.1	5.5	8.1	467.7	0.2	0.1	0.1	31.3	175.5	104.8	69.2	41.9
Dec.	19.1	6.9	8.1	530.7	0.1	0.1	0.1	40.4	180.2	103.9	76.3	44.1

Table (7) Continue

Parameter	Mg	Total Alkalinity	Iron	Mn	SO_4	Phosphate	Silicate	BOD	COD	TDS	SS	F	Oil & Grease	COD Limits	BOD Limits
Jan.	22.6	166.7	0.0	0.0	30.9	0.0	1.6	21.5	31.8	397.1	22.6	0.3	22.9	10.00	6.00
Feb.	22.7	149.6	0.0	0.0	26.1	0.0	1.1	11.9	17.3	333.0	18.7	0.3	17.4	10.00	6.00
Mar.	22.3	149.3	0.0	0.0	28.5	0.0	1.5	15.3	21.9	341.9	16.7	0.2	23.1	10.00	6.00
Apr.	24.0	147.1	0.1	0.0	27.2	0.0	1.8	14.4	20.3	301.0	16.6	0.3	23.9	10.00	6.00
May	22.5	134.1	0.0	0.0	27.7	0.0	2.9	14.4	19.7	272.4	20.8	0.4	18.9	10.00	6.00
Jun.	20.2	129.0	0.1	0.0	21.8	0.0	2.6	23.1	26.9	250.1	18.1	0.3	21.2	10.00	6.00
Jul.	19.0	132.9	0.0	0.0	20.1	0.0	2.3	18.6	26.5	241.2	18.9	0.2	18.2	10.00	6.00
Aug.	20.1	136.0	0.0	0.0	21.0	0.0	10.1	11.3	16.2	256.8	18.3	0.3	17.6	10.00	6.00
Sep.	21.7	145.3	0.1	0.0	22.4	0.0	1.9	13.5	19.7	280.6	20.7	0.3	18.6	10.00	6.00
Oct.	16.7	140.7	0.0	0.0	27.9	0.0	1.4	16.8	27.1	333.4	30.3	0.3	24.6	10.00	6.00
Nov.	16.6	141.3	0.0	0.0	28.5	0.0	1.4	9.1	16.0	327.3	26.3	0.2	17.3	10.00	6.00
Dec.	18.3	153.9	0.0	0.0	29.8	0.0	1.0	7.2	17.3	370.7	38.3	0.3		10.00	6.00

Table (7a) Heavy metals in the River Nile at El-Gharbia site

Date	Codmium (Cd)	Copper (Cu)	Chromium (Cr)	Laed (Pb)	Zinc (Zn)	Mercury (Hg)	Nickel (Ni)	Arsenic (As)	Selenium (Se)	Silver (Ag)	Aluminum (Al)	Tin (Sn)
Dec. 2003	0.0029	0.0653	0.0098	0.0248	0.0679	0.0009	0.025916667	0.0139	0.0071	0.0129	0.0490	0.038

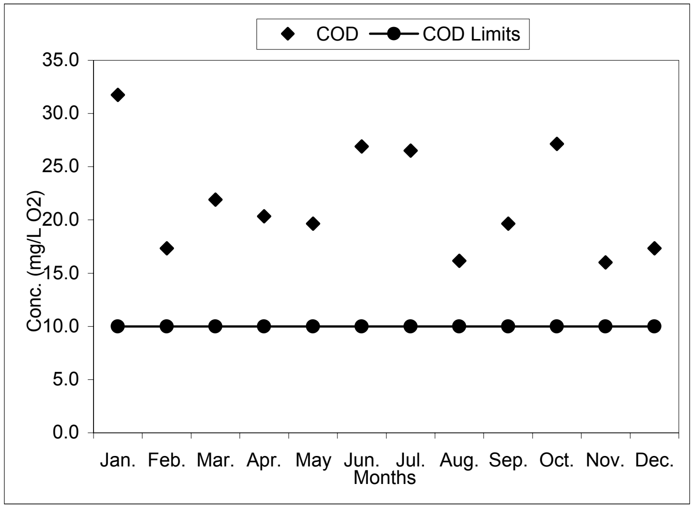

Figure (7) Variation in COD values at El-Gharbia site

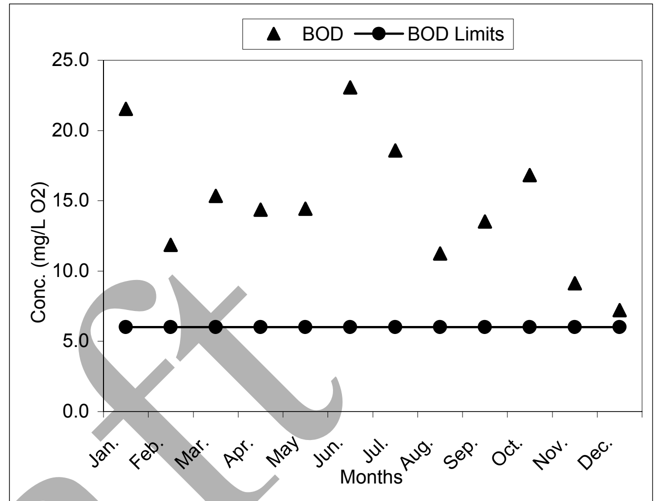

Figure (7a) Variation in BOD values at El-Gharbia site

El-Dakahleya

Table (8) River Nile water quality at El-Dakahleya sampling site

Parameter	Temp	DO	pH	EC	NH_3	NO_2	NO_3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
Jan.	17.60	7.40	7.34	482.60	0.13	0.01	0.35	45.60	168.40	94.00	74.40	37.60
Feb.	16.40	8.30	7.30	489.40	0.21	0.01	0.34	48.00	178.40	100.40	78.00	40.16
Mar.	16.80	8.08	7.52	406.00	0.18	0.01	0.25	36.40	146.00	81.20	64.80	32.48
Apr.	21.40	6.50	7.54	386.40	0.23	0.01	0.33	30.40	137.60	76.00	61.60	30.40
May	25.40	6.04	7.50	363.00	0.09	0.02	0.15	29.60	124.40	70.40	54.00	28.16
Jun.	29.20	5.44	7.50	353.60	0.14	0.04	0.25	18.00	104.40	58.40	46.00	23.36
Jul.	29.70	4.70	7.50	361.60	0.11	0.01	0.15	20.40	120.40	63.60	56.80	25.44
Aug.	29.31	4.91	7.46	365.88	0.16	0.01	0.13	23.25	119.75	67.50	52.25	27.00
Sep.	28.06	5.09	7.50	398.25	0.06	0.01	0.07	30.00	136.75	80.50	56.25	32.20
Oct.	27.94	5.69	7.53	427.00	0.10	0.01	0.07	36.25	149.00	79.50	69.50	31.80
Nov.	19.94	6.25	7.60	432.50	0.15	0.01	0.14	36.25	150.50	85.00	65.50	34.00
Dec.	16.14	6.76	7.49	514.57	0.32	0.04	0.06	53.71	182.29	106.00	76.29	42.40

Table (8) Continue

Parameter	Mg	Total Alkalinity	Iron	Mn	Phosphates	Silicates	BOD	COD	TDS	SS	F	Oil & Grease	COD Limits	BOD Limits
Jan.	17.86	177.20	0.00	0.00	0.10	3.10	2.18	7.52	301.60	21.20	0.37	0.00	10.00	6.00
Feb.	18.72	190.00	0.00	0.00	0.32	2.40	2.40	7.86	326.40	26.80	0.32	0.00	10.00	6.00
Mar.	15.55	164.00	0.00	0.00	0.23	3.06	2.10	7.64	272.00	27.60	0.26	0.00	10.00	6.00
Apr.	14.78	164.80	0.00	0.00	0.17	3.20	2.42	7.78	257.20	22.40	0.22	0.00	10.00	6.00
May	12.96	161.60	0.06	0.00	0.16	3.00	2.44	8.14	241.60	26.80	0.47	0.00	10.00	6.00
Jun.	11.04	154.00	0.06	0.00	0.16	4.20	3.10	10.44	232.00	29.20	0.33	0.00	10.00	6.00
Jul.	13.63	154.00	0.01	0.00	0.16	4.56	2.20	9.18	237.20	14.00	0.35	0.00	10.00	6.00
Aug.	12.54	149.00	0.00	0.00	0.22	4.26	2.46	8.41	239.50	11.00	0.37	0.00	10.00	6.00
Sep.	13.50	160.50	0.00	0.00	0.23	4.44	2.54	8.46	259.50	15.25	0.40	0.00	10.00	6.00
Oct.	16.68	170.25	0.01	0.00	0.11	2.50	2.91	8.85	278.75	9.75	0.33	0.00	10.00	6.00
Nov.	15.72	175.25	0.01	0.00	0.14	3.38	2.26	7.98	284.00	14.75	0.30	0.00	10.00	6.00
Dec.	18.66	191.75	0.00	0.00	0.18	3.06	2.73	8.59	339.00	23.50	0.33	0.00	10.00	6.00

Table (8a) Heavy metals in the River Nile at El-Dakahleya site

Date	Lead (Pb)	Copper (Cu)	Cadmium (Cd)	Chromium (Cr)	Zinc (Zn)	Arsenic (As)	Selenium (Se)	Nickel (Ni)	Silver (Ag)	Aluminum (Al)	Tin (Sn)	Mercury (Hg)
April 2003	0.0230	0.0144	0.0010	0.0044	0.0940	0.0330	0.0074	0.0424	0.0070	0.0430	0.0198	0.0064
Sep. 2003	0.0192	0.0128	0.0011	0.0027	0.1208	0.0134	0.00468	0.0452	0.0063	0.0316	0.0118	0.00094

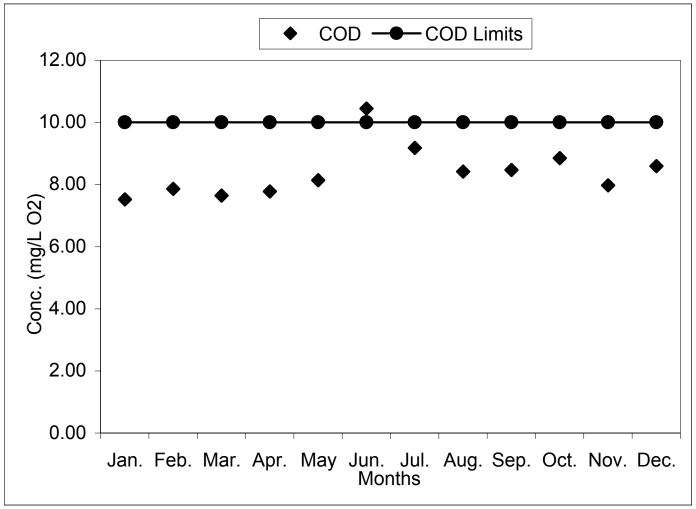

Figure (8) Variation in COD values at El-Dakahleya site

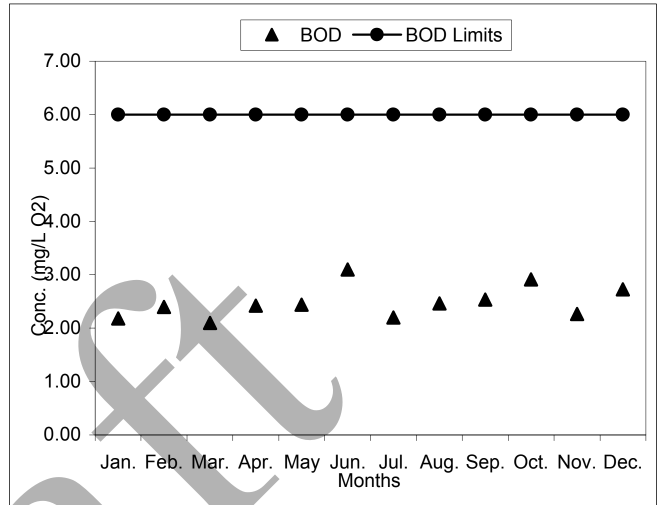

Figure (8a) Variation in BOD values at El-Dakahleya site

Damiatta

Table (9) River Nile water quality at Damiatta sampling site

Parameter	Temp.	DO	pH	EC	NH3	NO2	NO3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
Jan.	19.2	6.5	8.2	503.8	0.3	0.2	0.5	61.7	169.3	90.7	78.7	36.3
Feb.	14.8	6.9	7.7	469.7	0.4	0.1	0.5	56.6	166.6	86.6	80.0	34.6
Mar.												
Apr.	23.4	6.8	7.9	543.5	0.3	0.1	0.5	61.3	165.0	91.7	73.3	36.7
May	28.5	5.7	7.8	536.1	0.4	0.1	0.5	57.1	156.3	91.1	65.1	36.4
Jun.	28.6	5.6	7.8	386.5	0.3	0.1	0.4	36.7	146.7	78.3	68.3	31.3
Jul.	30.6	5.4	7.9	486.3	0.2	0.1	0.4	39.3	151.3	84.7	66.7	33.9
Aug.	32.9	5.3	7.8	484.7	0.3	0.1	0.5	51.4	172.3	93.7	78.6	37.5
Sep.	29.7	6.0	7.8	438.7	0.3	0.1	0.5	43.7	153.3	80.3	73.0	32.1
Oct.	24.4	6.5	7.9	336.0	0.3	0.1	0.5	57.7	166.7	93.3	73.3	37.3
Nov.	20.0	6.0	7.8	530.9	0.4	0.1	0.6	60.0	169.4	90.0	79.4	36.0
Dec.	18.1	6.5	7.9	457.7	0.3	0.1	0.5	67.7	178.3	104.0	74.3	41.6

Table (9) Continue

Parameter	Mg	Total Alkalinity	Iron	Mn	SO4	Phosphate	Silicate	COD	TDS	Oil&Grease	COD Limits	BOD Limits
Jan.	18.9	177.0	0.0	0.0	66.8	0.5	3.8	24.1	324.3	3.0	10.00	6.00
Feb.	19.2	172.6	0.0	0.0	52.1	0.7	4.6	22.2	362.9	7.4	10.00	6.00
Mar.											10.00	6.00
Apr.	17.2	171.7	0.0	0.0	46.3	0.6	4.7	21.3	322.7	0.0	10.00	6.00
May	15.6	160.3	0.0	0.0	46.3	0.9	4.8	25.9	364.3	13.4	10.00	6.00
Jun.	16.4	160.7	0.0	0.0	35.7	0.8	3.9	15.2	274.3	3.0	10.00	6.00
Jul.	16.0	166.7	0.0	0.0	43.0	0.7	4.3	15.9	296.3	3.3	10.00	6.00
Aug.	18.9	190.3	0.1	0.0	41.4	0.7	4.1	27.1	346.0	8.3	10.00	6.00
Sep.	17.5	171.0	0.1	0.0	43.5	0.7	4.6	19.6	309.0	0.0	10.00	6.00
Oct.	17.6	177.3	0.1	0.0	52.3	0.8	3.8	27.2	336.0	0.0	10.00	6.00
Nov.	19.1	175.4	0.0	0.0	54.0	1.0	4.5	30.1	354.9	0.0	10.00	6.00
Dec.	17.8	191.7	0.1	0.0	56.0	0.8	3.8	20.0	339.3	0.0	10.00	6.00

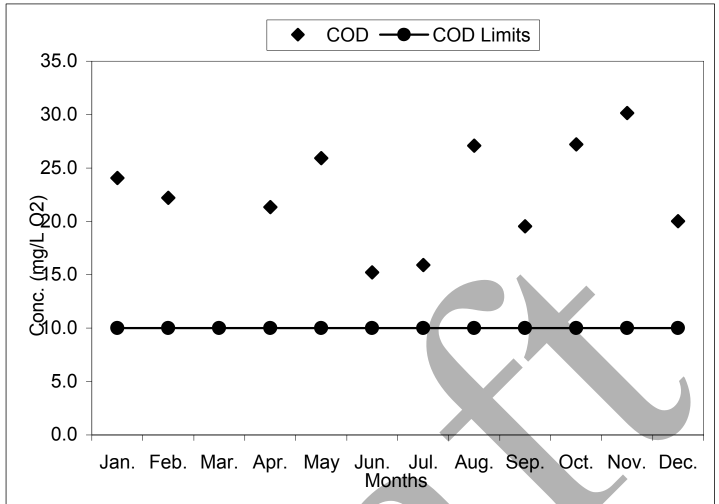

Figure (9) Variation in COD values at Damiatta site

Alexandria

Table (10) River Nile water quality at Alexandria sampling site

Parameter	DO	H2S	pH	EC	NH3	NO2	NO3	Chlorides	Total Hardness	Ca Hardness	Mg Hardness	Ca
Jan.	5.2	0.2	7.5	528.3	0.2	0.2	0.0	60.7	316.7	180.7	136.0	72.3
Feb.	5.8	0.2	7.3	391.7	0.2	0.0	0.0	50.0	252.7	128.0	124.7	51.2
Mar.	6.2	0.2	7.3	403.3	0.2	0.0	0.0	41.3	170.7	99.7	71.0	39.9
Apr.	5.7	0.2	7.7	421.0	0.3	0.0	0.0	46.2	187.0	100.0	87.0	40.0
May	3.7	0.2	8.3	456.7	0.6	1.7	0.0	44.7	169.3	90.7	78.7	36.3
Jun.	3.6	0.2	7.7	363.3	0.4	1.1	0.0	41.0	153.3	95.7	57.7	38.3
Jul.	4.8	0.2	8.0	427.5	0.2	1.9	0.0	51.7	154.0	79.7	74.3	31.9
Aug.	4.6	0.2	7.8	404.0	0.3	0.7	0.0	43.3	151.0	90.3	60.7	36.1
Sep.	5.9	0.1	7.7	491.7	0.2	0.7	0.0	43.7	154.7	81.0	73.7	32.4
Oct.	4.3	0.1	6.9	411.7	0.2	0.3	0.0	47.0	172.7	107.3	65.3	42.9
Nov.	4.7	0.1	7.3	470.0	0.2	0.8	0.0	58.7	198.0	102.0	96.0	40.8
Dec.	6.5	0.1	7.4	421.1	0.3	0.6	0.0	53.7	188.0	104.0	84.0	41.6

Table (10) Continue

Parameter	Mg	Total Alkalinity	Iron	Mn	Sulphates	Phosphate	Silicate	BOD	COD	TDS	SS	F	Oil&Grease	COD Limits	BOD Limits
Jan.	32.6	199.3	0.2	0.0	46.8	0.5	6.0	2.5	14.5	483.3	97.0	0.5	0.0	10.00	6.00
Feb.	29.9	157.3	0.2	0.0	45.3	0.3	4.0	1.8	12.2	404.7	78.3	0.5	0.0	10.00	6.00
Mar.	17.0	152.3	0.1	0.0	49.3	0.4	5.5	2.8	15.0	334.7	66.3	0.5	0.0	10.00	6.00
Apr.	20.9	157.7	0.1	0.0	50.0	0.3	5.5	2.4	14.0	347.0	56.3	0.7	0.0	10.00	6.00
May	18.9	144.7	0.2	0.0	81.3	0.3	3.5	2.8	23.8	339.7	53.3	0.7	0.0	10.00	6.00
Jun.	13.8	140.7	0.2	0.0	60.0	0.3	4.0	2.6	20.8	343.7	71.3	0.5	0.0	10.00	6.00
Jul.	17.8	137.7	0.2	0.0	59.2	0.4	6.0	2.5	22.7	330.8	63.5	0.5	0.0	10.00	6.00
Aug.	14.6	149.7	0.2	0.0	64.7	0.3	6.3	2.6	20.7	331.3	58.7	0.6	0.0	10.00	6.00
Sep.	17.7	155.3	0.3	0.0	63.0	0.3	6.2	3.3	17.2	327.0	54.0	0.5	0.0	10.00	6.00
Oct.	15.7	165.3	0.2	0.0	49.5	0.3	5.2	2.9	13.3	350.0	82.0	0.5	0.0	10.00	6.00
Nov.	23.0	176.0	0.2	0.0	65.0	65.0	4.5	2.9	16.0	368.7	70.3	0.4	0.0	10.00	6.00
Dec.	20.2	168.6	0.1	0.0	43.1	0.3	3.4	2.1	12.4	351.4	77.4	0.4	0.0	10.00	6.00

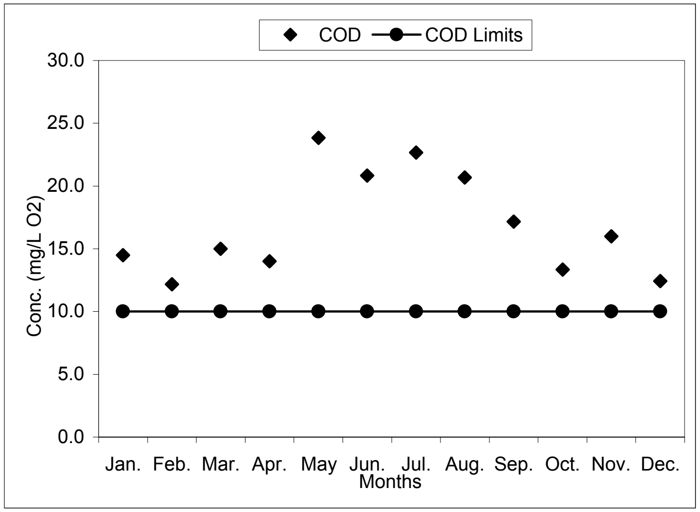

Figure (10) Variation in COD values at Alexandria site

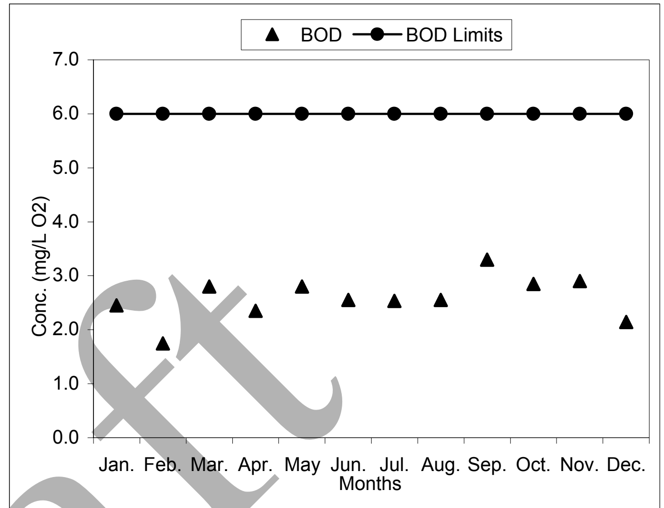

Figure (10a) Variation in BOD values at Alexandria site

Port-Saied

Table (11) River Nile water quality at Port-Saied sampling site

Parameter	Temp.	DO	H2S	pH	EC	NH3	NO2	NO3	Phosphate	Total Alkalinity	Total Hardness	Ca Hardness	Ca
Jan.													
Feb.	15.0	6.7	0.2	9.1	366.8	0.8	0.1	0.0	0.0	160.0	114.5	104.0	10.5
Mar.	19.5	7.6	0.3	8.4	371.5	0.4	0.0	0.0	0.5	172.5	165.5	102.0	63.5
Apr.	21.5	8.0	0.4	8.7	363.5	0.2	0.1	0.0	0.4	177.0	162.0	101.0	61.0
May	26.3	7.0	1.5	8.3	345.5	0.7	0.8	0.0	0.5	138.5	123.0	100.0	23.0
Jun.	30.1	6.0	0.9	8.8	299.5	0.2	0.0	0.0	0.6	162.5	175.0	99.0	76.0
Jul.	31.7	7.1	1.7	8.3	377.3	0.3	0.1	0.0	0.6	144.0	132.0	80.0	52.0
Aug.	28.1	5.0	2.2	8.3	387.0	0.2	0.1	0.0	0.5	151.5	114.5	83.5	31.0
Sep.	26.8	6.4	0.3	7.9	473.8	0.1	0.0	0.0	0.5	159.2	120.4	78.4	42.0
Oct.	23.8	6.4	0.2	7.9	461.8	0.2	0.0	0.0	0.5	169.6	126.4	85.2	41.2
Nov.	21.2	6.3	0.3	8.0	476.8	0.1	0.0	0.0	0.3	166.4	144.4	53.6	90.8
Dec.													

Table (11) Continue

Parameter	Mg Hardness	Mg	Iron	Mn	Sulphates	Chlorides	Silicate	BOD	COD	TDS	SS	Oil&Grease	F	COD Limits	BOD Limits
Jan.														10.00	6.00
Feb.	41.6	2.5	0.1	0.0	41.0	30.0	11.0	1.5	20.5	256.5	26.5	0.0	0.3	10.00	6.00
Mar.	40.8	15.2	0.1	0.0	33.3	32.5	17.0	1.4	20.4	275.0	23.5	17.0	0.2	10.00	6.00
Apr.	40.4	14.6	0.1	0.0	33.5	28.0	13.5	2.0	6.1	257.0	47.8	4.0	0.1	10.00	6.00
May	40.0	5.5	0.2	0.0	38.5	23.0	16.0	1.9	14.1	283.5	22.0	7.5	0.5	10.00	6.00
Jun.	39.6	18.2	0.1	0.0	33.8	23.5	23.0	2.7	12.9	197.0	32.0	22.5	0.1	10.00	6.00
Jul.	32.0	12.4	0.1	0.0	29.8	30.0	29.0	1.4	7.0	251.4	19.8	12.4	0.9	10.00	6.00
Aug.	33.9	5.9	0.1	0.0	35.3	30.0	24.3	2.5	9.6	255.3	39.3	20.7	0.1	10.00	6.00
Sep.	31.4	10.1	0.5	0.0		37.2	24.0	4.0	14.0	290.0	15.4	21.2	0.3	10.00	6.00
Oct.	34.1	9.9	0.3	0.0		30.0	40.0	4.2	14.9	318.8	37.0	8.0	0.3	10.00	6.00
Nov.	21.4	21.8	0.3	0.0		40.0	20.6	3.7	19.0	244.8	25.6	16.8	0.3	10.00	6.00
Dec.														10.00	6.00

Table (11a) Heavy metals in the River Nile at Port-Saied site

Date	Silver (Ag)	Arsenic (As)	Aluminum (Al)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Selenium (Se)	Tin (Sn)	Zinc (Zn)
Mar. 2003		0.0085		0.0064		0.0160			0.0098	0.0053		0.0498
Jun-03	0.0028	0.0188	0.0648	0.0050	0.0095	0.0180	0.0007	0.0128	0.0145	0.0070	0.0948	0.0783
Nov. 2003	0.0096	0.0138	0.0364	0.0026	0.0084	0.0384	0.0005	0.0116	0.0174	0.0023	0.0176	0.1198

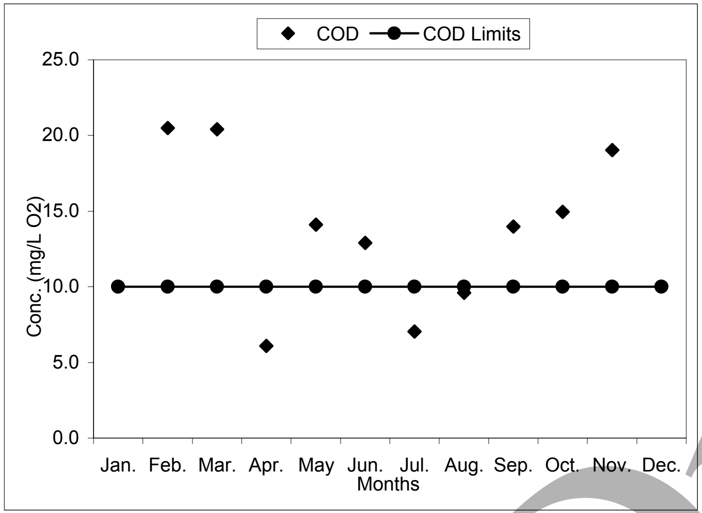

Figure (11) Variation in COD values at Port-Saied site

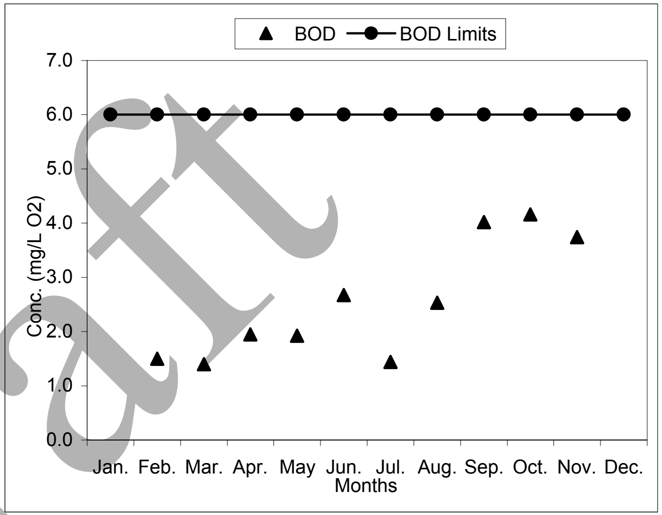

Figure (11a) Variation in BOD values at Port-Saied site

Annexe-7

Climatologically Data of Egypt

- Air Temperature (degree C)
- Relative Humidity (%)
- Precipitation(mm)
- Atmospheric Pressure (H.Pa)

Table (7. 1) Some Climatological Data of Egypt (Air Temperature, C°)

Stations	Jan		Feb		Mar		Apr		May		June		July		Aug		Sep		Oct		Nov		Dec	
	min	Max	min	Max	min	Max	min	Max	Min	Max	Min	Max	min	Max	min	Max	min	Max	min	Max	min	Max	min	Max
Rosetta	10	17.5	10	20	12.5	22.5	12.5	25	17.5	27.5	20	27.5	22.5	30	22.5	30	22.5	30	17.5	27.5	15	22.5	12.5	17.5
Damietta	10	17.5	10	20	12.5	20.5	12.5	25	17.5	27.5	20	27.5	22.5	30	22.5	30	22.5	30	17.5	27.5	12.5	22.5	12.5	17.5
Damnhour	7..5	17.5	7.5	20	10	22.5	12.5	25	17.5	32.5	17.5	27.5	22.5	30	20	30	17.5	30	17.5	27.5	12.5	22.5	10	17.5
El-Mansoura	7.5	17.5	7.5	20	10	22.5	12.5	25	15	32.5	17.5	32.5	20	32.5	20	32.5	17.5	32.5	17.5	27.5	12.5	22.5	10	20
Tanta	7.5	17.5	7.5	20	10	22.5	12.5	27.5	15	32.5	17.5	32.5	20	32.5	20	32.5	17.5	32.5	15	27.5	12.5	22.5	10	20
Quesna	7.5	17.5	7.5	22.5	10	22.5	12.5	27.5	15	32.5	17.5	32.5	20	32.5	22.5	32.5	17.5	32.5	15	27.5	12.5	22.5	7.5	20
Cairo	75	17.5	7.5	22.5	10	22.5	12.5	27.5	17.5	32.5	17.5	32.5	22.5	32.5	22.5	32.5	17.5	32.5	17.5	27.5	12.5	22.5	7.5	20
Giza	7.5	17.5	7.5	22.5	10	22.5	12.5	27.5	17.5	32.5	17.5	32.5	22.5	32.5	22.5	32.5	17.5	32.5	17.5	27.5	12.5	22.5	7.5	17.5
Bni sweef	7.5	17.5	7.5	22.5	10	22.5	12.5	30	17.5	32.5	17.5	35	20	37.5	20.0	32.5	17.5	32.5	17.5	30	12.5	22.5	7.5	22.5
Minya	2.5	17.5	7.5	22.5	10	27.5	12.5	30	17.5	37.5	17.5	35	22.5	37.5	22.5	37.5	17.5	32.5	17.5	30	12.5	27.5	7.5	22.5
Asyut	7.5	17.5	7.5	22.5	12.5	27.5	12.5	30	17.5	37.5	22.5	35	22.5	37.5	22.5	37.5	17.5	32.5	17.5	30	12.5	27.5	7.57.5	22.5
Sohag	7.5	22.5	7.5	22.5	12.5	27.5	17.5	30	17.5	37.5	22.5	35	22.5	37.5	22.5	37.5	22.5	37.5	17.5	30	12.5	27.5	7.5	22.5
Kena	7.5	22.5	7.5	25	12.5	27.5	17.5	35	22.5	37.5	22.5	42.5	22.5	40	22.5	40	22.5	37.5	17.5	35	12.5	27.5	7.5	22.5
Luxor	7.5	22.5	7.5	25	12.5	27.5	17.5	35	22.5	37.5	22.5	42.5	22.5	40	22.5	40	22.5	37.5	17.5	35	12.5	27.5	7.5	22.5
Aswan	7.5	22.5	7.5	25	12.5	30	17.5	35	22.5	37.5	22.5	42.5	25	40	22.5	40	25	37.5	20	35	12.5	27.5	12.5	22.5

Table (7.2) Some Climatological Data of Egypt, (Relative Humidity %)

Stations	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Rosetta	70	70	60	60	60	60	70	70	70	70	70	70
Damietta	70	70	60	70	70	70	70	70	70	70	70	70
Damnhour	70	60	60	60	60	60	60	70	70	70	60	70
El-Mansoura	70	60	60	60	60	50	60	70	70	60	60	70
Tanta	70	60	60	60	50	50	60	70	70	60	60	70
Quesna	70	60	60	60	50	50	60	70	60	60	60	70
Cairo	60	50	50	40	40	40	50	60	50	60	50	60
Giza	60	50	50	40	40	40	50	60	50	60	50	60
Bni sweef	60	50	40	40	30	40	40	50	50	50	50	60
Minya	60	50	40	40	30	30	40	50	50	50	50	60
Asyut	50	40	30	70	30	20	30	30	40	40	40	50
Sohag	50	50	40	30	30	30	30	40	40	40	50	50
Kena	50	40	30	20	30	20	20	30	30	30	40	50
Luxor	50	40	30	20	30	20	20	30	30	30	40	50
Aswan	40	30	20	10	20	10	20	20	30	30	30	40

Table (7.3) Some Climatological Data of Egypt, (precipitation, mm)

Stations	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Rosetta	50	25	15	5	1	0	0	0	1	10	25	50
Damietta	25	15	15	5	1	0	0	0	1	10	15	25
Damnhour	25	15	15	2	1	0	0	0	1	5	10	25
El-Mansoura	15	10	10	2	1	0	0	0	1	2	10	15
Tanta	15	5	10	2	1	0	0	0	1	2	5	15
Quesna	10	5	5	1	1	0	0	0	1	2	5	10
Cairo	10	5	5	1	1	0	0	0	1	2	5	10
Giza	10	5	1	1	1	0	0	0	1	2	5	10
Bni sweef	1	1	1	1	1	0	0	0	1	2	2	1
Minya	1	1	1	1	1	0	0	0	1	2	2	1
Asyut	1	1	1	1	1	0	0	0	1	2	2	1
Sohag	1	1	1	1	1	0	0	0	1	2	2	1
Kena	1	1	1	1	1	0	0	0	1	2	2	1
Luxor	1	1	1	1	1	0	0	0	1	2	2	1
Aswan	1	1	1	1	1	0	0	0	1	2	2	1

Table (7.4) Some Climatological Data of Egypt, Atmospheric pressure (H.Pa)

Stations	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Rosetta	1019	1016	1014	1012	1012	1010	1008	1008	1012	1014	1016	1016
Damietta	1019	1016	1014	1012	1012	1010	1008	1008	1012	1014	1018	1018
Damnhour	1018	1016	1014	1012	1012	1010	1008	1008	1012	1014	1016	1016
El-Mansoura	1019	1016	1014	1012	1012	1010	1008	1008	1012	1014	1018	1018
Tanta	1019	1016	1014	1012	1012	1010	1008	1008	1012	1014	1018	1016
Quesna	1019	1016	1014	1012	1012	1010	1008	1008	1012	1014	1018	1018
Cairo	1019	1016	1014	1012	1012	1010	1008	1008	1012	1014	1016	1018
Giza	1019	1016	1014	1012	1010	1010	1008	1008	1012	1014	1016	1018
Bni sweef	1019	1016	1014	1012	1010	1008	1006	1006	1010	1014	1016	1016
Minya	1019	1016	1014	1012	1010	1008	1006	1006	1010	1014	1016	1018
Asyut	1019	1016	1014	1012	1010	1008	1006	1006	1010	1012	1016	1018
Sohag	1019	1018	1014	1010	1010	1008	1006	1006	1010	1012	1014	1016
Kena	1019	1016	1012	1008	1010	1006	1004	1004	1008	1010	1014	1016
Luxor	1018	1016	1012	1008	1010	1006	1004	1004	1008	1010	1014	1016
Aswan	1018	1014	1012	1008	1010	1006	1004	1004	1008	1010	1014	1016