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**POLLUTION SOURCES IN THE NILE AND THEIR
ENVIRONMENTAL IMPACTS**

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Abstract

Over the past decades , the natural quality of water sources has been altered by the impact of various human activities and water uses.

In Egypt, the Nile River which is considered as the main water source is still a recipient of most of the wastewater discharged by industrial effluents and several agriculture drains contains mixed wastes (sewage and industrial). These wastes includes a variety of pollutants which have considerable potential effect on both water ecosystem and human health. Monitoring of these pollutant is the first step for the improvement and protection of the Nile River . The Nile Research Institute designed a monitoring program includes collection and analysis of samples from 35 stations along the Nile River from Aswan to the Mediterranean Sea and from all points sources of pollution discharge their wastes into the Nile. The most important pollutant in these wastes are heavy metals, organic matters, inorganic compounds and micro organism causing disease.

This paper includes a review of the main pollution sources on the Nile River and their environmental impacts.

Sources of pollution along Nile River

The River Nile is subject to a variety of pollutants such as Industrial, agricultural and municipal wastewater

(1) Industrial Pollutants

There are many factories discharging their wastes directly into Nile River . The Nile Research Institute recorded about 39 industrial point sources located along Nile River . The main categories of these industries are sugar, oil, chemicals, fertilizers and metals industries . These industrial wastes include a variety of pollutant like heavy metals and organic compounds which are harmful to human and causes a variety of disease and also have atoxic effect on aquatic life.

Figure (1) shows the location of industrial effluent points along the river

(2) Agricultural wastewater

The Nile Research Institute recorded about 72 agricultural drain which discharge their wastes directly into Nile River .

Figure (2) shows the location of agricultural drains along the Nile.

Most of these drains are loaded with nutrients (e.g. nitrate and phosphate) pesticides (e.g. herbicides, and insecticides), suspended solids, salts ... etc. Which is the result of agriculture activities. The pesticides, especially those resistant to hydrolyze, are accumulated in the food chain and finally have a carcinogenic effect on human.

The increase of phosphates and Nitrates in water leads to excessive growth of aquatic plants to levels that would result in undesirable effects and limit the use of water .

(3) Municipal Waste water

These wastes are discharging into the River from a variety of sources like agricultural drains, some industrial wastes and tourist ship.

The most harmful pollutant found in these waters are detergents, Grease and oil, suspended solids, salts, bacteria and viruses.

The most harmful effect of detergents is the formation of foam which prevent oxygen to transfer and dissolution in the water which badly affect aquatic life.

The presence of bacteria and viruses in water causes a variety of diseases.

Water quality Monitoring program of Nile Research Institute.

The Nile Research Institute has carried out a monitoring program for the Nile River since 1976. This program was implemented with cooperation of the Ministry of Health (MOH) from 1976 to 1986.

The main objective of this program was to evaluate the quality of water in the River Nile and determine the effects of pollutants on its water quality for different uses.

Current water quality Monitoring program.

In 1991 the Nile Research Institute (NRI) started a modified monitoring program. The main objectives of this program are:-

- To serve a general reference for water quality condition in the whole river.
- To detect stream standard violations and maintain effluent standard.
- To determine the quantitative seasonal variation in the river and the point sources of pollution

Sample locations :-

The sampling locations in this program were reduced to 35 sites along the River Nile and its two branches. From these sites, thirteen sites were considered as a major sites or macrolocations.

The remaining 22 sites were considered as minor sites or microlocations in order to fill the gaps between the major sites and to present different stages along the river.

In addition to the 35 sampling sites, all of the pollution sources located along the River Nile were also sampled. Figure (3) shows the sampling locations along the river..

Sampling Frequency

The sampling frequencies were planned to occur in three stages as follows:-

- 1- Short term (one year) twice a year for all the thirty-five river sites and the major point sources of pollution
- 2- Medium Term (two year)
Four times a year for all the thirty-five river sites and the major point sources of pollution.
- 3- Long term (Three year and above)
In addition to the medium term work, special studies could be done for specific zones, certain drains, or modeling purpose and bottom sediments.

The Program Parameters

parameters planned to be measured according to the NRI water quality monitoring program are :-

1- **In situ measurements :-**

Dissolved oxygen, PH value - temperature, Conductivity total alkalinity, turbidity and velocity of water.

2- **Lab. measurements**

Ammonia, Nitrate, Nitrite, Kjeldahl-N, orthophosphate, total phosphate, Biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids, total dissolved solids, oil and Grease, surfactants, phenols, chloride, sulfate, carbonate, Bicarbonate, calcium, magnesium, sodium, potassium.

Heavy metals (copper, iron, chromium, ...) pesticides, total coliform, fecal coliform, Algal counts and chlorophyll II.

Most of these analysis were carried out by NRI water quality lab.

Water quality Monitoring program for Lake Nasser

The NRI designed water quality monitoring program for collecting sampling from 13 site at the Sudanese part of the lake (about 150 km.) and 14 sites at Egyptian part of the lake (about 350 km.).

The program also includes especial studies for eutrophication and thermal stratification of the lake.

Figure (4) shows the sampling location in Lake Nasser.

Water quality status in the River

In order to describe the general water quality status of the River Nile some recent water quality data collected during June 1998 will be presented.

(1) Organic matter

BOD and COD were measured as indicator of the organic load along the River Nile during June 1998. Fig (5)

The Result of these measurements showed that the BOD ranged between 1.2 to 3.2 mg/l which indicate high quality of the water of the River Nile because the standard value of the BOD according to law 48 doesn't exceed (6) mg/l.

also the results of the COD showed a good quality in water of the River Nile in the area extended between Aswan high Dam and Assuit because its value was found less than the standard value (10 mg/l).

but the area from Assuit to Cairo showed a higher COD values than the standard value this indicate that the organic pollutants increased in this area.

(2) Load of bacteria

Measuring of total coliform and fecal coliform as indicator of sewage pollution showed that its concentration lies in intermediate category according to the standards for surface water used for potable water abstractions (50 and 5000 for total coliforms, 20 and 2000 for fecal coliforms.) fig.5

(3) Total dissolved salts (TDS) and total suspended solid (TSS)

The concentration of TDS Ranged between 160 to 200 mg/l and the TSS also Ranged between 10 to 24 mg/l which indicate a good water quality in the River . Fig. (6)

(4) Heavy metals (Iron and Copper)

The results of Iron and copper concentration along the River Nile showed that their concentration Ranged between 0.01 to 0.03 mg/l and 0.01 to 0.02 mg/l respectively. (Fig. 6)

These values are within the standard level of law 48 (Iron and copper not exceed (1 mg/l))

(5) Nutrients

The Result of nitrate concentration showed that it Ranged between 2.5 to 6 mg/l This value is less than the standard value of law 48 (Not exceed 45 mg/l).

The phosphate concentration along the River Nile Ranged between 0.04 to 0.14 mg/l . This value are very low and showed a good water quality. Fig. 7

INSTITUTIONAL FRAMEWORK

The ministries and governmental agencies in Egypt that are currently responsible for and involved in the administration of water quality and pollution control are :-

Ministry of Environment

- Environmental Affairs Agency

The Ministry of Public Works and Water Resources

- * Irrigation Department
- * Drainage Department
- * Mechanical and Electrical Power Department
- * National Water Research Center

Ministry of Health

- * Environmental Health Department
- * Central Laboratories
- * Environmental and Occupation Health Center
- * Vector and Snail Department

Ministry of Industry

- * General Organization for Industrialization

Ministry of Housing, New Communities Construction and Public Utilities

- * Greater Cairo General Organization for Sanitary Drainage
- * Greater Cairo General Organization for Water Utility
- * Alexandria General Organization for Sanitary Drainage
- * Alexandria General Organization for Water Supply
- * National Organization for Potable Water and Sanitary Drainage

Ministry of Agriculture and Land Reclamation

- * Agriculture Research Center
- * General Authority for Fish Resources Development

Ministry of Transportation

- * River Transportation Authority

Ministry of Interior

- * Surface Water Police Department

Ministry of Electricity and Power Production

- * Power Stations Authority

Ministry of Tourism

- * Inspection Department

Academic and Research Institutions

- * National Research Center (NRC), High Institute of Public Health (HIPH), and interested Departments in Universities.

LEGAL FRAME WORK

To control water pollution and the pollution effects resulting from different sources, the following laws have been issued.(3)

a) Law No. 93 of 1962

The relevant environmental and public health aspects of water bodies including the River Nile, the irrigation canals, and the agricultural drains were dealt with legally for the first time in the Decree from the president of the United Arab Republic within law No. 93 of 1962 in relation to wastewater disposal. This Implementary was in Section II of the Executive Regulations which dealt with watercourses and wastewater Disposal. Item 10 which stated that " When applying the items of this law, the following are considered as watercourses :

- 1- The Nile River and its creeks (rayahs), inlets, and tributaries,
- 2- the feeders, main canals with their main as well as subsidiary side channels,
- 3- farm ditches or farrows, and the like,
- 4- agricultural drains and its feeder submarines,
- 5- lakes and seas, and
- 6- ponds, marches and swamps and other similar water bodies."

Disposal of polluted and/or contaminated wastewater in addition to the required analyses were managed in the associated Executive Regulation No. 649 of Law No. 93 of 1962 related to wastewater disposal.

However, implementation of this law was shouldered by the Ministry of Housing and the Ministry of Local Affairs. Both Ministries were mainly interested in wastewater disposal into sewers and sewer connections while disposal into water bodies was out of their sphere of interest since such water bodies do not belong technically to any of them. Disposal of industrial and human wastes continued to be done into the river, canals and drains without implementation of any positive measures.

b) Law No. 38 of 1967

In 1967 Law No. 38 to cover the Public Cleansing Aspects was issued. It stated in Item No. 4, paragraph "A" that bathing or washing of utensils, clothes, vegetables and / or other similar objects in public fountains and / or streams is prohibited unless done in places specified for these purposes.

c) Law No. 74 of 1971

The pollution aspects of the River Nile and its branches and drains were dealt with also in the Irrigation and Drainage Law No. 74 for 1971 in Item No. 10. It stated that private canals and drains should be cleared and cleaned from all kinds of weeds, otherwise the owners of these private water bodies would be subjected to a fine ranging from LE 5 to LE 20 according to Item No. 74. Also Item No. 69 stated that throwing dead animals or any other material harmful to health or producing offensive odors in canals and / or drains is prohibited. Violators would be subjected to a fine ranging from LE 5 to LE 30 according to Item No.75 of the same law.

d) Ministerial Decree 380 of 1982

Ministerial Decree 380 of 1982 was issued by the Ministry of Industry to ensure industries operate and maintain pollution control equipment to meet environmental standards.

LAW NO. 48 OF 1982 AND DISCUSSION

By the early eighties and with the aggravation of water quality status in the water bodies to the extent that the dissolved oxygen in some drains reached very low values most of the time, as well as the inability of the associated ministries to carry out any effective role, as legally required, it became necessary to remove such responsibility from both Ministries of Housing and Local Affairs and render it to the Ministry of Public Works and Water Resources to whom the whole water bodies directly and technically belong. This was done in order to protect the River Nile, its canals, and drains from pollution and contamination. Therefore, Law No. 48 needed to be issued in 1982.

In this law the control of pollution and/or contamination of the River Nile, its canals, and the agricultural drains was assigned to the relevant authority, which is the Ministry of Public Works and Water Resources, as defined in Law No. 48 for 1982. The relevant Executive Regulations were issued under No. 8 of 1983.

According to Item 17 of the law, the Minister of Irrigation issued the Implementary Regulations, with respect to the protection of the River Nile and its water courses from pollution.

These regulations are divided into eight chapters as follows:

- Chapter 1 provides the definitions of different relevant water bodies.
- Chapter 2 deals with permits and licensing of wastewater disposal into water bodies.
- Chapter 3 deals with control of licensing measures.
- Chapter 4 deals with floating houses and mobile units.
- Chapter 5 deals with sampling and analysis measurements.
- Chapter 6 deals with specifications and standard

Recommendations:-

The Nile River is main source of water for Egyptian people. Therefore its water quality should be preserved and measures for pollution control is to be administered. This can be accomplished through .

- Support and strengthen all organization and institutions responsible for pollution control of the river.

the role of these organization in the pollution control of the river water is as follows :

- Monitoring the water quality of the River and point sources of pollution to assess compliance of the discharges to the law of pollution control.
- Enforcing of the law by prosecuting the violators and preventing the cause of pollution by shutting down the sources of pollution.

The support and strengthening could be in terms of :

- *- Provide the necessary equipment and facilities to perform their duties efficiently .
- *- Recrivate capable staff and/or train existing staff
- *- Provide financial support for the organization and incentives to the individuals.

2- Promote environmental public awareness :

this is to be accomplished through media and educational organizations NGO'S , political parties local authorities .. etc should be strongly involved . Public awareness to pollution control should involve policy and decision makers as well as the public at large.

- Chemical fertilizers which are discharged to the river whether through agriculture drains or as a diffuse should be minimized. A series of practices must be designed to decrease the availability of excess nutrient through improvements in timing, application rates and location selection for fertilizer placement. It also involves fertilizer- type selection, crop - variety selection.
- Use advanced technologies to eliminate most of the pollutants during processing instead of using very expensive treatment plants for wastewater. This might require the optimal use of raw material in order to reduce the volume of wastes.

INTRODUCTION

The Nile is recognized as the longest river in the world. Within Egypt, it is the main source of irrigation, industrial and domestic water. It is also used as a cheap means of transportation, a source of fish, and recently, for hydropower generation. Naturally, it has been, and still is, a recipient of most of the wastewater's of Egypt (El Moattassem, 1990).

The construction of the High Aswan Dam (HAD) has caused changes in hydrologic conditions of the River Nile. The control of the river flow has increased the level of pollution as compared to the pre-HAD when annual flooding flushed the river channel and washed away pollutant residual. Further more, the impoundment of water in the reservoir has caused changes in water quality with respect to its physical, chemical and biological properties (El Gohary, 1937).

Egyptian industrialization in its modern state, started in the early sixties. Industrial plants are concentrated in north and south Cairo, Alexandria and the Nile Delta. The main source of industrial pollution upstream of Cairo is the old industrial plants in Upper Egypt such as sugar, edible oil, soap, distillation, etc.

Since the HAD has been completed, water is released according to the country's requirement, while the rest of it is stored in the reservoir. This controlled water release, in conjunction with the continuous increase in industrial and agricultural discharges, significantly affects the water quality of the river.

The Egyptian government has recognized the dangers of pollution and has issued a series of laws for pollution control, such as law 93 of 1962 regarding liquid waste disposal and Law 48 of 1982 regarding protection of the River Nile and waterways against pollution.

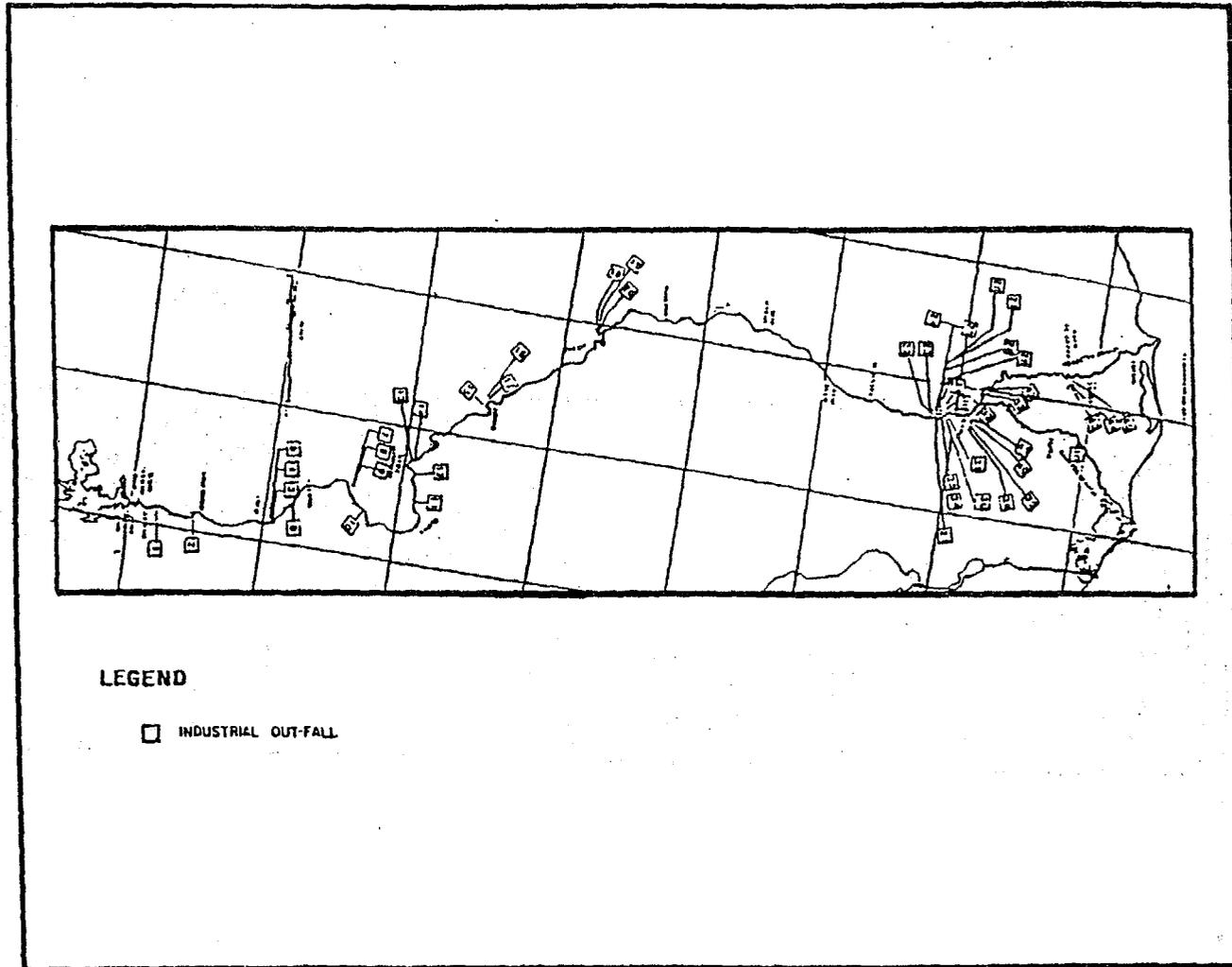


Figure: 1 - Industrial Sources of Pollution Entering the River Nile

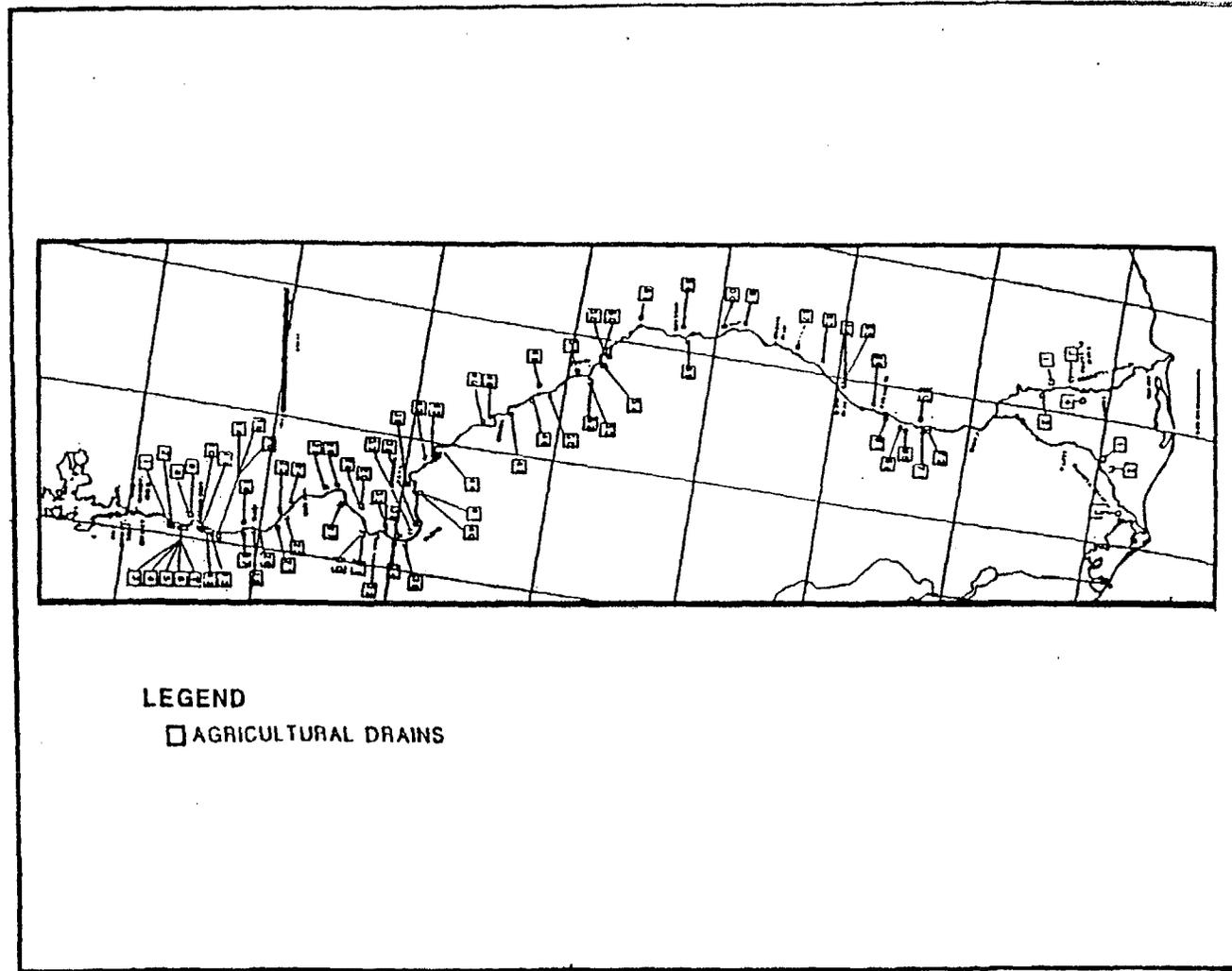


Figure: 2 - Agricultural Drains Entering the River Nile

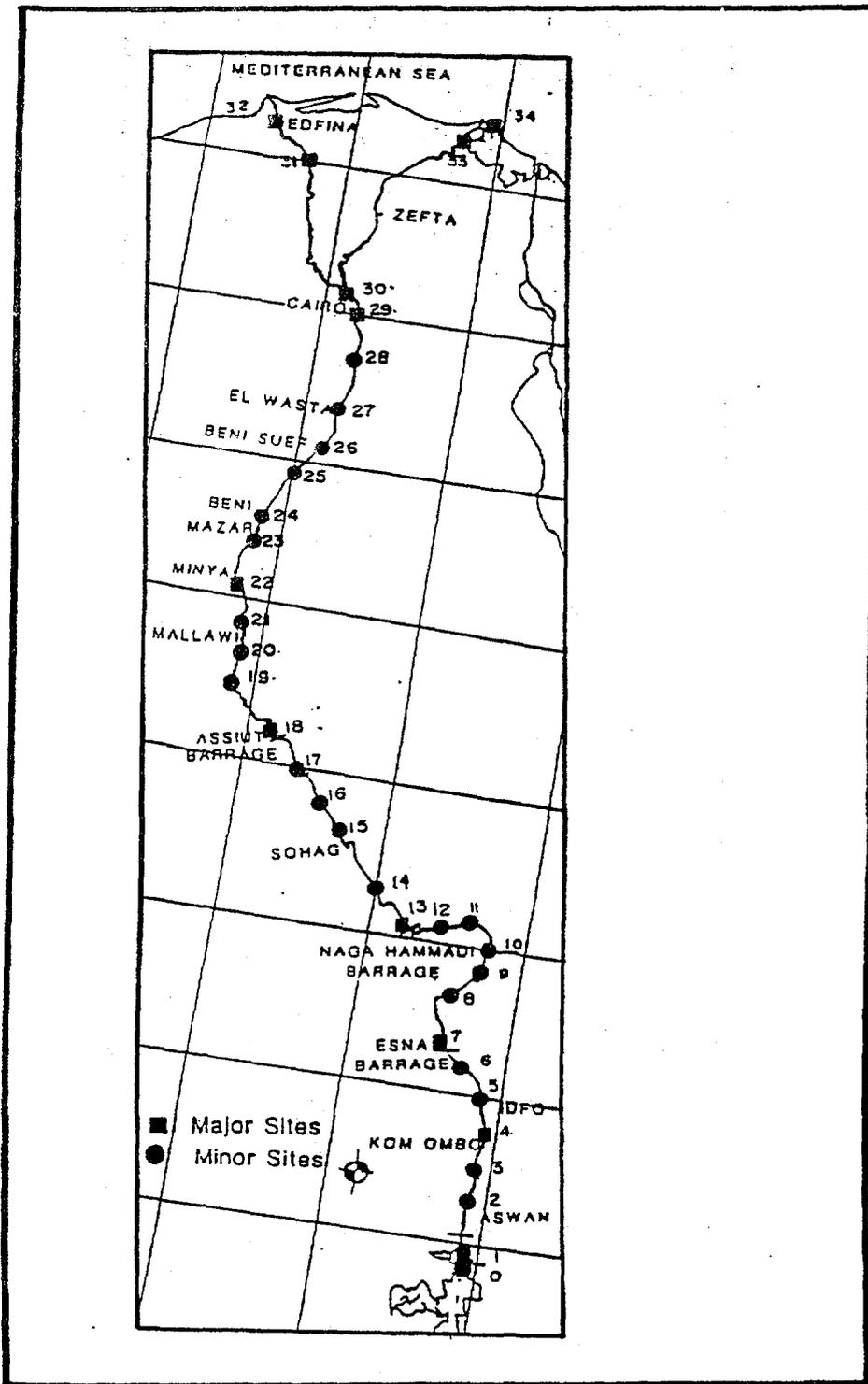


Figure: 3 - Locations for Water Quality Sampling

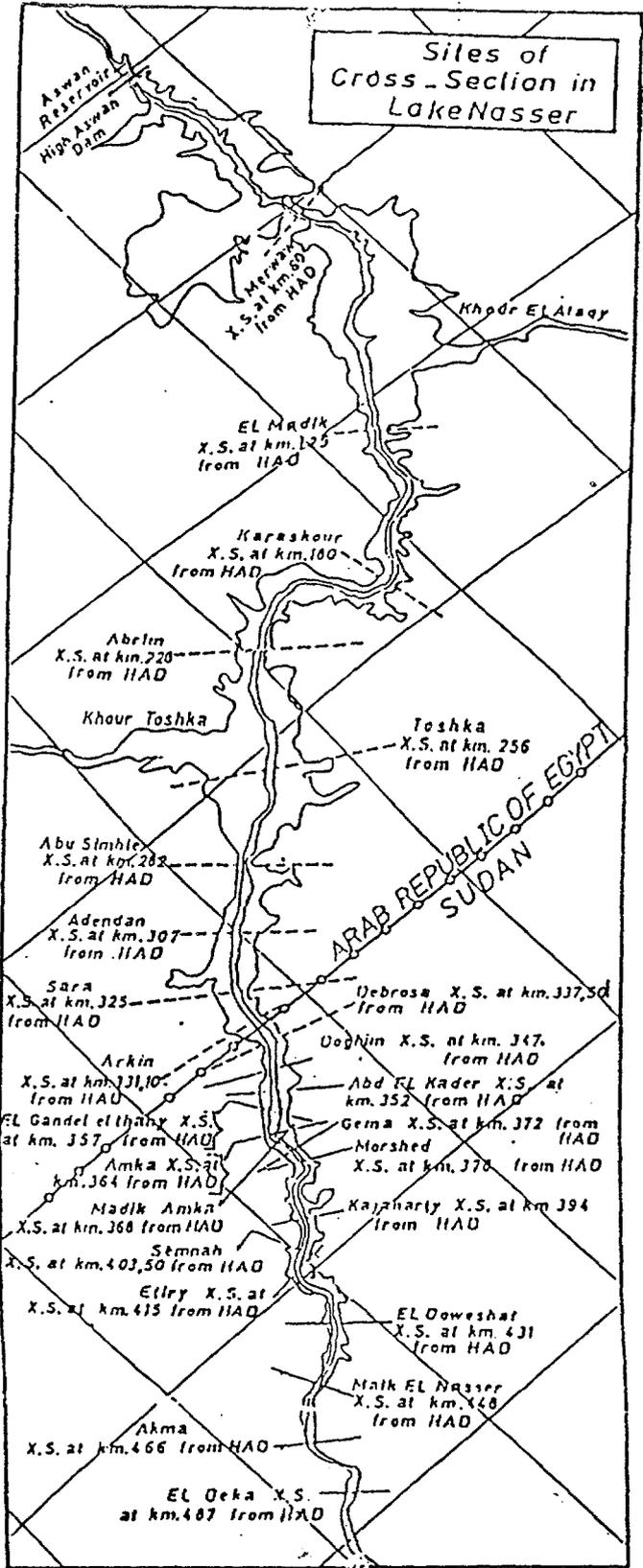
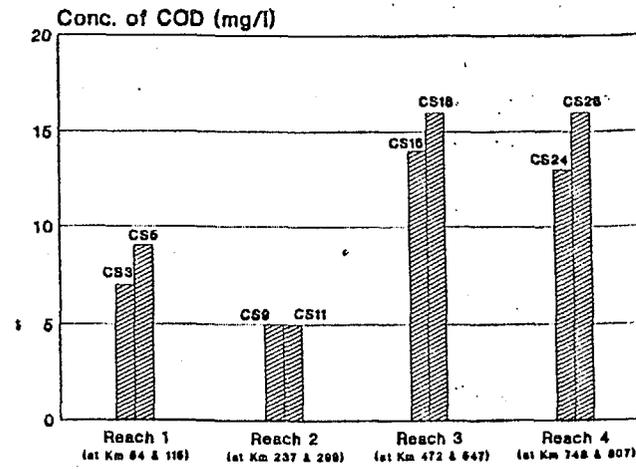
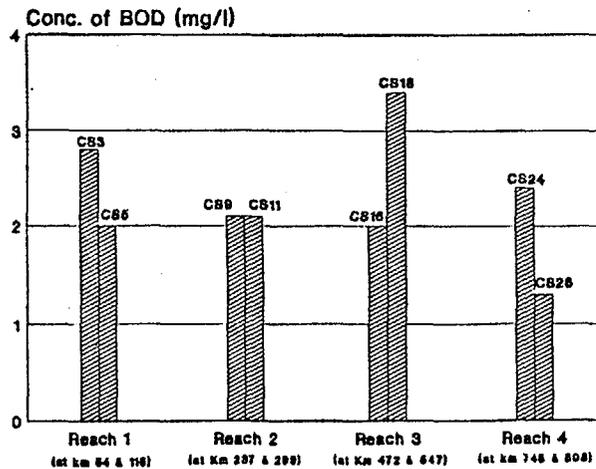
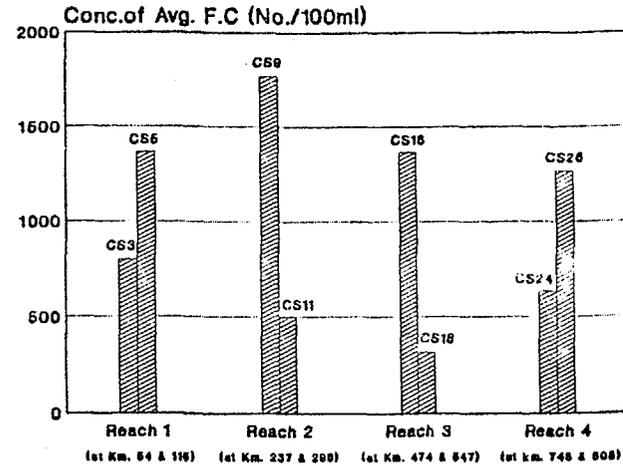
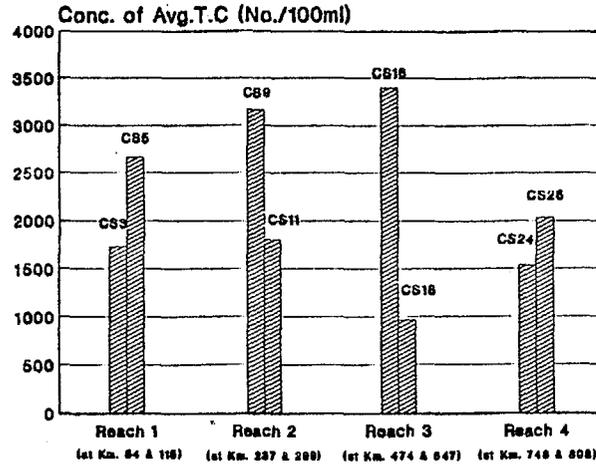


Figure 4. Sampling locations along Lake Nasser

Water Quality Status of River Nile During June 1998

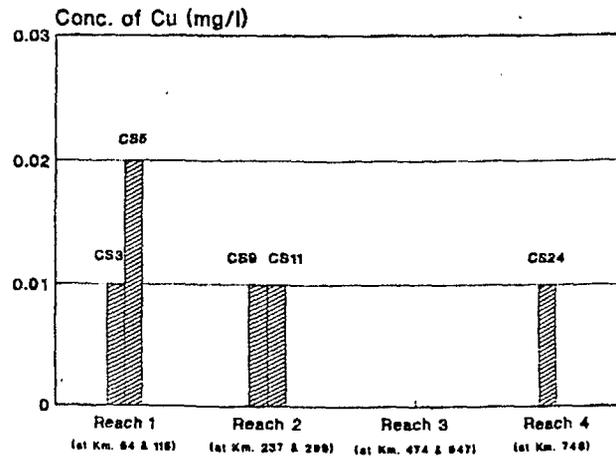
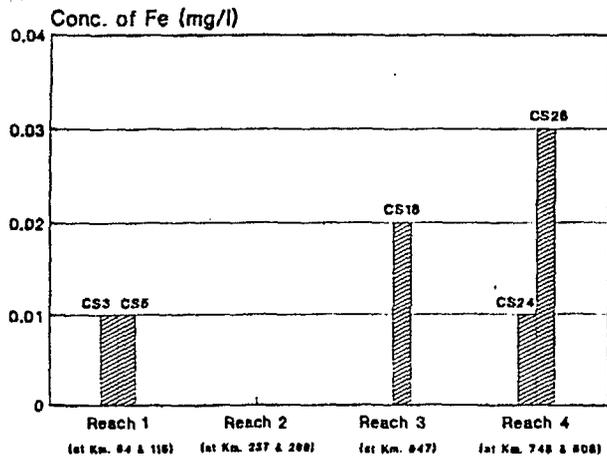
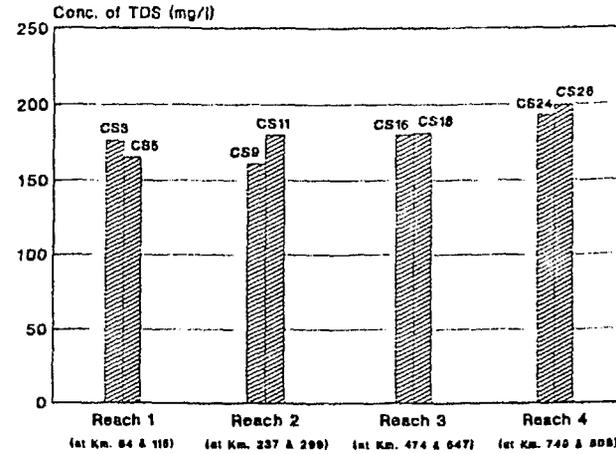
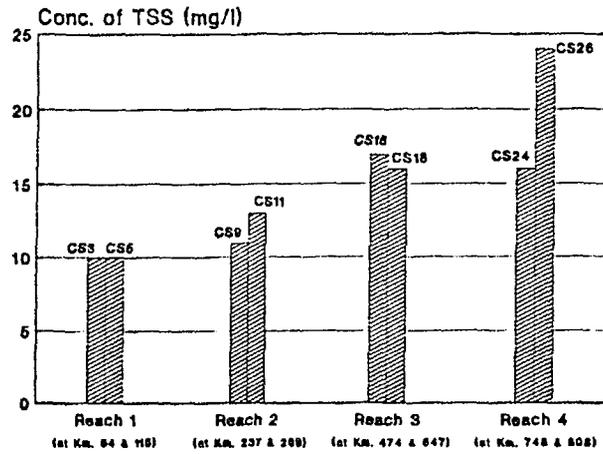


Fig(5)

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Water Quality Status of River Nile Sites During June 1998

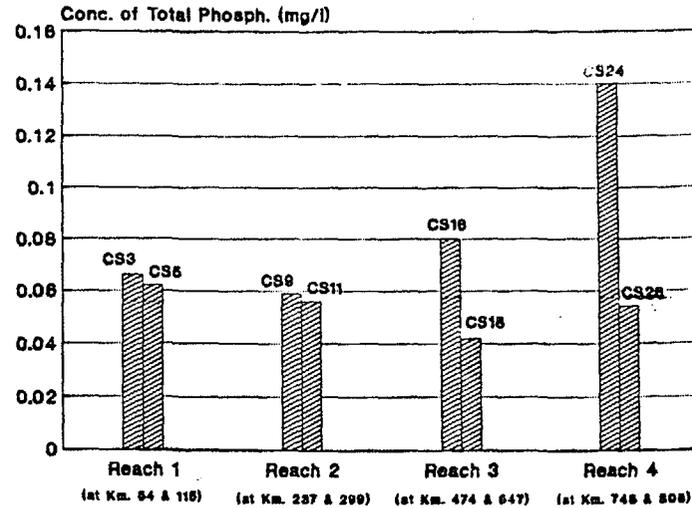
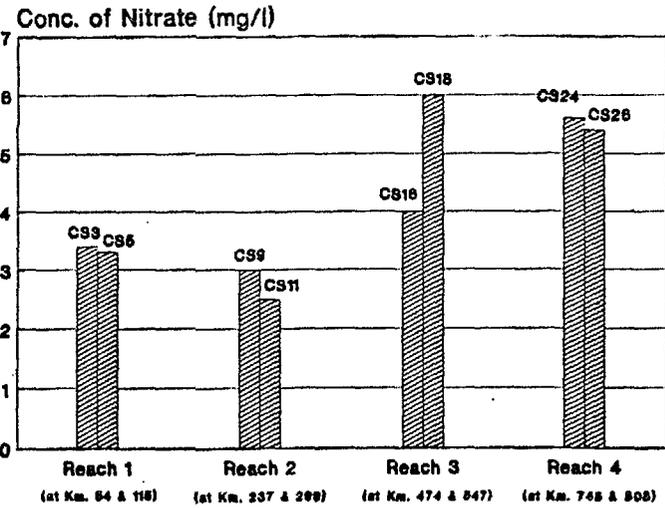
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Fig(6)

Water Quality Status of River Nile Sites During June 1998

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Fig(7)