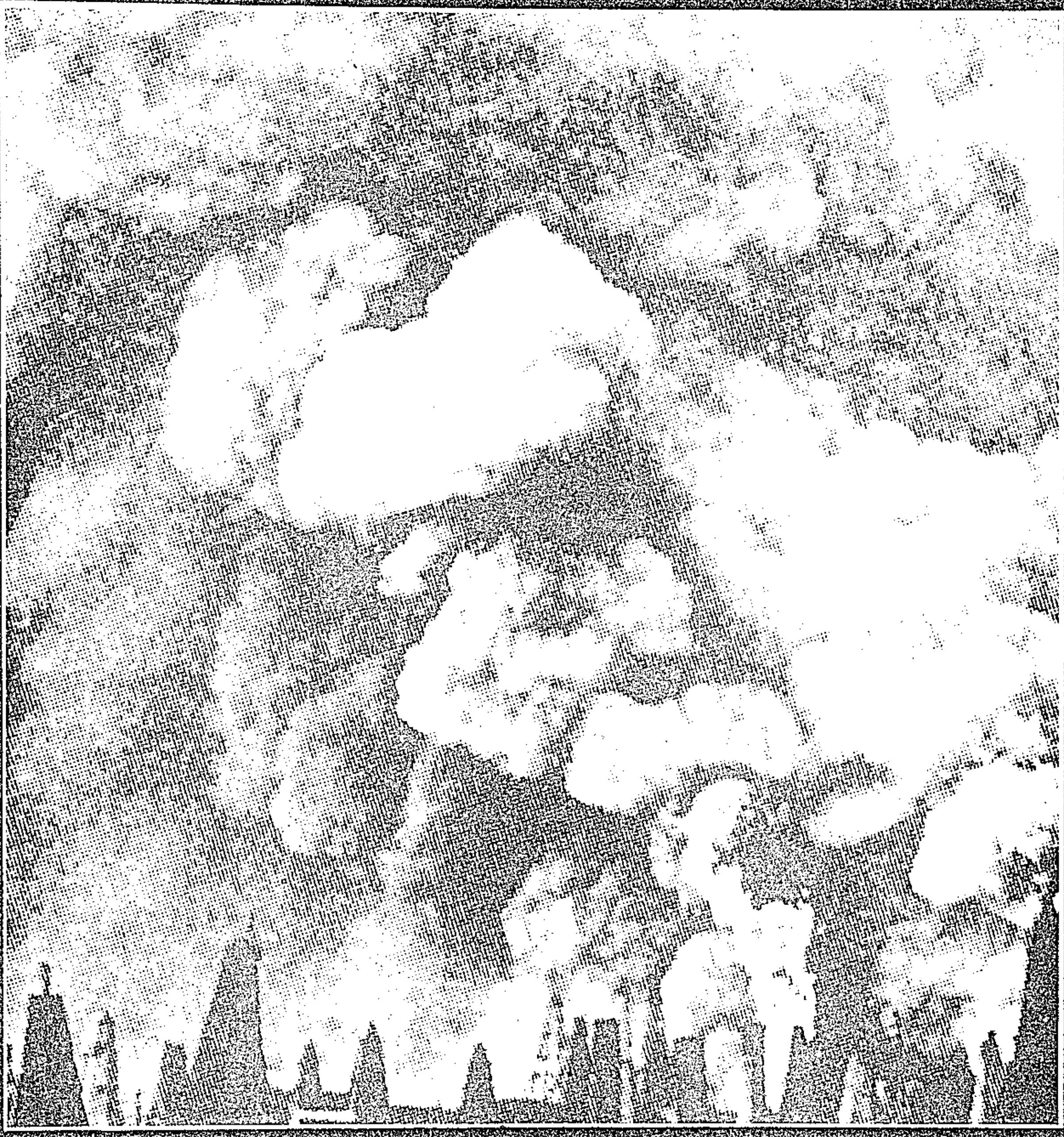
エジプトにおける環境問題の現状



JICA

環境問題研究会

平成４年３月

حالة تلوث البيئة في مصر

における環境問題の現状

発刊に当たって

「かけがえのない地球」をテーマに、地球が有限であることを、国連として初めて宣言した1972年の国連人間環境会議から、早や、20年が過ぎようとしています。この間、地球の温暖化やオゾン層の破壊といったことが取りざたされるようになり、環境問題は、益々グローバルな課題となっています。本年6月には、ブラジルにおいて、環境と開発に係わる国連会議が開催されることとなっていますが、ここでは、21世紀に向けた地球・地域・社会の在り方を「環境」と「開発」の側面から把え、環境問題を具体的にどのようにマネージメントしていくかについて検討がなされることとなっています。この様に、環境問題を地球規模で考えていくことは、誠に結構なことであるとは思いますが、地球規模の環境問題にしても、そのルーツは、各々の地域・社会にあることも忘れてはならないことだと考えています。

実際、当地に生活し、当地の環境条件にさらされて毎日を過ごしている我々にとって、身近な環境がどうなっているかは、切実な問題であるわけです。しかしながら、当地では、環境問題に係る、正確、且つ十分な情報が何時でも入手できるという状況ではなく、問題意識としては持ちつつも、十分な議論がなされないまま今日に至りました。

このような背景の下で、今般、環境問題に関心のある在留邦人有志により、「エジプトにおける環境問題の現状」が取りまとめられたことは、誠に時宜を得たものと思います。聞くところによりますと、環境問題に係る個人の知識、情報を持ち寄り、共有することから始め、適当な講師の選定、講演の実施を順次行ない、情報を取りまとめたとのことですが、この手法は、ネットワークを形成することによって成果が得られた、一つの例ではないかと思います。このような試みは、何もこのテーマに限らず種々考え得るもので、他のテーマで継続的に実施して行くことも良いのではないでしょうか。その場合には、当地の関係者をその輪に迎え入れることにより、更なる成果が期待できると共に、日本・エジプト両国の相互理解にもつながって行くと考えられます。

本研究会に参加された皆様方の御尽力を多とし、御挨拶とさせて頂きます。

平成4年3月

山田中正

山　田　中　正

エジプト駐箚特命全権大使

エジプトにおける環境問題の現状

－総括編－

目次

1．　はじめに

エジプトは、悠久なるナイルに抱かれて、その歴史と社会を発展させてきた。ナイルは偉大な存在であって、膨張する人口を支え、人間の諸活動に伴う環境負荷を飲み込み、消化し続けて来た。そのため、今まで、当国における環境問題に対する政府・国民の態度は、多くの開発途上国以上に無関心でありえた。しかし、近年、ナイルにおける水草の異常発生、カイロ市内の大気汚染等が顕著になるに至り、環境問題に対して、無関心であり得なくなってきている。

エジプト在住邦人の間でも、″最初に赴任した数年前は、住んでいるフラットからピラミッドを毎日眺めることが出来たが、最近では、霞に隠れて見えないことが多くなった″、あるいは、″「生水は飲まない方が良い。」と言われているが、上水の水質は実際のところどうなっているのか″という会話が交わされるようになってきている。環境問題は、我々の家族の健康管理にとっても避けては通れない問題である。

このような背景の下、当国における環境問題の現状を把握するため、在留法人有志で「エジプト環境問題研究会」（本編巻末・参考資料参照）を組織し、環境問題について体系的に調査を進めることとした。（エジプトでは、環境問題への取り組みの遅れと、独特なビューロクラシィ等によって、環境関連資料・データが全くないわけではないが、整合された資料がない。ついては、個人的な知見を基に情報を組織的に再編集する必要があり、研究会を組織した）。同研究会では、政府職員や著名な研究者等を講師として招聘し、水質・大気・廃棄物等、主要環境問題について、計8回に亘る講演会（本編巻末・参考資料参照）を開催すると共に、講師とのディスカッションを通じて、情報を収拾した。また、現地踏査、講師との再面談によるデータの補足も行なっている。

本報告書は、エジプトにおける環境問題の現状について、「エジプト環境問題研究会」として取りまとめたものであり、総括編及び資料編から構成されている。執筆は、同研究会のメンバーが、水質・大気・廃棄物といった各環境分野ごとに別れて行なった。官民集っての初めての試みでもあり、当国での環境データが不十分であること等により、その出来映えについては御批判もあろうが、今後の業務の参考、あるいは健康管理等、何がしかのお役に立てばと、敢えて報告書にまとめた次第である。

2. 環境行政のあらまし

当国の環境行政は、1982年内閣官房行政管理庁下に創設された環境庁が -Egyptian Environmen-tal Affairs Agency(EEAA)-、関係省庁間の調整と指導を行うこととなっている。また、環境対策の実施については、工場からの排水規制は工業省が、発電所からの排水規制は電力省が、下水処理施設からの排水規制は水資源省が、各々所管している。しかし、環境庁の権限の抽象性、指導力の不足、各省庁の環境対策に関する認識不足、環境対策を実施するに足る資金・技術の不足等々により、当国の環境基準・対策は、殆ど実施に移されていないのが現状である。

しかし、環境問題に関する関心の高まりを背景として、1991年4月、環境庁の機能強化を図るため、内閣官房長官を担当相に迎え、組織の格上げを行った他、土壌汚染・国土保全等、従来、その所管でなかった分野にまで、環境庁の権限を拡張した。現在、環境庁が中心となり、当国の環境保全に係るマスタープランを策定中である等、一応の進展が見られるものの、環境対策の実施という点では、今までのところめぼしい成果は現われていない。

(i) 水質

① 組織

水質保全に関する各省庁の所管事項については、必ずしも明確に定められていない部分もあるが、概略は、表-1の通りである。この内、水質のモニタリングや、調査・研究については、実質的に次の3機関で実施されている。

- Water Research Center (公共事業・水資源省)
- 保健省
- National Research Center (科学技術省)

② 法令

河川・湖沼・海域の水質に関し、達成すべき目標としての環境基準は定められていないが、各種事業所から、公共下水道への排水基準を定めた1962年法律第93号、及び、各種事業所等から公共水域への排水基準を定めた1982年法律第48号がある。

特に、環境保全の観点から、後者は、規制の対象を広げ、厳しい基準値を設定した他、排水が流入する水域の水質基準を設ける等(表-2に示す基準値以上の水域には排水が許可されないのが建前。従って、この基準が一種の「環境基準」とも考えられる)、意欲的なものであった。しかしながら、主要汚染源である国営企業の資金・技術力不足を考慮しないものであったため、実効は発揮されずに現在に至っている。

表－1　水質保全に関する各省庁の所管事項　　　　（○　重要な役割、△　補助的役割）

	モニタリング	研究	指導	規制許可	行政処分・処罰	役割・責任
水資源省	○	○		○		ナイル川の管理・監督及び潅漑 下水処理基準・法令の設定 ナイル航行の許認可
保険省	○	○				上水基準設定・検査・分析
工業省			○			産業排水改善対策
開発住宅省	△	△	○	○		上水検査・分析 生活排水基準の設定 傘下企業の産業排水規制
運輸省			△			ナイル航行船の排水規制
内務省					○	法令の執行
電力省			△			発電施設からの排水規制
観光省			△			ナイル観光船の許認可・調査・監督
科学技術庁		○				依頼に基ずく調査・分析
農業省			△			農薬の使用監督
環境庁	△	△	△	△		全般の企画・調整・調査

上水処理場を出る上水道の水質については、表－3に示すように、保健省基準が定められており、厳密に守られているが、実際の蛇口での水質については、供給者たる水道公社の所管外であり、配管・貯水槽における基準はない。

（2）　大気

大気に関する環境基準は、表－4に示すように、項目毎に複数の法令が定められている。また、事業場・自動車からの排ガス基準も存在する。これらの大気公害規制法令は、現状では殆ど機能していない。効果が発現できなかった原因としては、エジプトの企業の多くが公営企業であって、政府の直接経営化にあり、政府が予算を付けなかったという釈明になっている。今後、経済の主体が私企業中心になることによって、責任の対象が明確になり、対策が立てやすくなっていくものと考えられる。

表-2 The Codes, Standards and Specifications for the Discharge of Treated Liquid Effluents into the Waterways.

First: Discharge to Fresh Surface Water Bodies

Art 60: The fresh water bodies in which it is permitted to discharge treated industrial liquid effluents mus remain within the following (quality)standards and specifications.

Parameter	*Standards & Specifications* (mg/liter unless otherwise noted)
Color	Not to exceed 100 degrees
Total Solids	500
Temparature	5 ℃ above normal
Dissolved Oxygen	Not less than 5
PH	Within the range 7-8.5
Biochemical Oxygen Demand	Not to exceed 6
Chemical Oxygen Demand	Not to exceed 10
Organic Nitrogen	Not to exceed 1
Ammonia	Not to exceed 0.5
Oils and Grease	Not to exceed 0.1
Total Alkalinity	Within the range 20-150
Sulphate	Not to exceed 200
Mercury Compounds	Not to exceed 0.001
Iron	Not to exceed 1
Manganese	Not to exceed 0.5
Copper	Not to exceed 1
Zinc	Not to exceed 1
Synthetic Detergents	Not to exceed 0.5
Nitrate	Not more than 45
Fluorides	Not to exceed 0.5
Phenol	Not to exceed 0.02
Arsenic	Not to exceed 0.05
Cadmium	Not to exceed 0.01
Chromium	Not to exceed 0.05
Cyanide	Not to exceed 0.1
Lead	Not to exceed 0.05
Selenium	Not to exceed 0.01

表-3 Water Quality Standards

A. Chemical Standards

Parameter	Drinking Water Standards*
PH Value	6.5-9.2
Color (PT.Co.scale)	50
Taste	Acceptable
Odor	Acceptable
Turbidity "Jackson Units"	5
Total Dissolved Solids	1500
Total Hardness ($CaCo_3$)	500
Calcium	200
Magnesium	150
Nitrates	45
Floride	0.8
Chloride	600
Sulfate	400
Iron	1
Manganese	0.5
Copper	1.5
Lead	0.1
Zinc	15

Units = mg/l unless otherwise indicated

* Maximum allowable limits

B. Bacteriological Standards

* Throughout any year, 95% of samples ahould not contain any total californium organisms in 100 ml.
* No sample should contain fecal californium in 100 ml.
* No sample should contain more than 10 total californium in 100 ml.
* Total californium sholud not be detectable in 100 ml at any two consecutive samples.

表-4　法令と所管省

所管	規制	法令
Ministry of Health	大都市圏の交通公害による大気汚染の規制	Decree 470/1971,240/1979.
Ministry of Development, Housing, Utilities and New Communities	Furnance，chimney，stacksを規制	Decree 380/1975.
	産業地区における環境基準を規定	Law 3/1982, Decree 600/82.
Ministry of Industry	工場排気を規制	Decree 380/1982.
Ministry of Interior	自動車排ガスを規制	Law 66/1972, 210/80, 20/83. Decree 291/1974, 407/83. (分子は法令番号、分母は発令年度)

(3)　廃棄物

エジプトでは、公設市場や道路の廃棄物の清掃・下水汚泥の処理は知事の責務であるが、これら以外の廃棄物処理に関する公的制度は存在しない。そのため、個人契約をベースとして、「ワヒス」・「ザッバリーン」とよばれる民間業者が、主として、一般廃棄物処理を一手に引き受けている。これら民間業者は、契約者から委託金(という名目の心付け)を徴収するとともに、回収した廃棄物の中から有価物を選別し、生活収入を得ている。この結果、回収された廃棄物の再利用率は非常に高い。このシステムを支えているのは、極めて安価な労働力である。しかしカイロ大都市における急激な人口膨張は、現行システムの処理限界を超える廃棄物を発生させており、あふれた廃棄物は、運河や道路へ投棄され、放置される結果となっている。このことは都市の美観を損なうとともに、住民の生活環境の劣化にも大きく影響している。公的制度の根拠となる法令としては、1947年法律第62号、1967年法律第38号、及び、1983年大統領令第284号がある。

3.　環境の現況及びその課題

(1)　水質

①　ナイル水系の水利用と水質の現状

・ナイルの水利用

人口の増加、産業の発展と共に、ナイルの水需要は着実に増え続けており、一方流入量はほぼ横ばいにある。その結果、1990年のナイルの水の実利用率は、表-5に示すように、77%に達したものと推測される。また、残りの水量も、船舶航行・堤防保全・発電の為の、最低必要量と考えられている。分野別利用では、農業用が大半を占めているが、表-6に示すように、今後更に、農業・民生・産業用の需要の伸びが予測されている。

表-5 Use of River Nile Water (Million M³)

Year	Discharge from Aswan	Drainage Water to Sea	Fresh Water to Sea	Total Flow to Sea	Actual Net Used
1984/85	56,300	14,100	4,600	18,700	37,600
1985/86	55,500	13,900	3,200	17,000	38,500
1986/87	55,300	13,000	3,700	16,700	38,600
1987/88	52,900	11,900	2,700	14,600	38,300
1988/89	53,300	10,600	2,800	13,400	40,000
1989/90	54,000	10,600	1,800	12,500	41,500

Note: Actual Net Used = Discharge from Aswan - Total Flow to Sea

Water Flow to Sea should be included into Actual Gross Used.

表-6 National Water Balance for Year 1989/90 and 2000

(Million M³)

	1989/90	2000	Balance
Water from Aswan	54,000	55,300	1,300
Agriculture	36,600	38,800	2,200
Drainage to Sea	10,500	9,900	- 600
Nonrecoverable Consumption	3,100	4,200	1,100
Evaporation	2,000	2,100	100
Navigaiton	1,800	300	-1,500

・　水質の現状

ナイル水系に係わる体系的な水質調査は、1976年に始めて実施された。その後は間歇的に実施され、現在に至っている。これらの調査の内、1976~86年について取りまとめたレポート、及び、1991年の調査結果についてのレポートがある。調査地点、分析方法などの相違によるのか、両者(共に水資源省作成)には一貫性が見られない部分もあるが、両者に現われたナイル水系の水質動向は、以下の通りである。

図-1は、ナイル川沿い各地点の水質指標を(主要10項目を指標化したもので、前述「環境規準」への適合度を表している。数値が大きい程、水質がよい)、1977年と'86年で比較したもので、この間、水質が悪化している状況を良く表している。

図-2に示す1984~86年調査のBOD データでも、その間、ナイル流域のどの地点をとっても明らかに悪化の方向にあり、産業・農業・生活排水が、その原因になっていると考えられている。ただし、調査データはナイル本流に限定されており、支流及び排水路でのデータは全く不十分であり、詳細は不明であるが、特にデルタ地域内のナイルの水質が、極度に悪化した状況は容易に想像できる。更に、汚染の状況は、浮遊物の増加、捕獲魚量の減少、河川の悪臭などの事例により、容易にその進行が推測される。

長期間にわたり、定期的に分析してきた日本とは単純に比較できないが、ナイル本流の1986年 BOD データの平均は約9mg/l(都市周辺で突出して14に達する地域があるが、これは工場排水による影響)であり、これからすると、70年代後半の多摩川や大和川など、日本の代表的都市河川の状況に近く、相当汚染されていると言える。

一方、1991年7月に、34地点でサンプリングした結果によれば、BOD は、0.4~4.7mg/l となっており、図-2に比して小さくなっている(データと実体感覚の不整合については、別に検討を要する)。水質の実体については、長期間の、継続的・定期的観測により始めて明らかにしうるものであり、実体の把握については、今しばらくの期間を要するものと思われるが、水質の維持・改善のための対策が殆ど実行に移されていないことから、日々、悪化しているのは確実である。

② 産業、農業排水

ナイル川へ直接排出する工場の排水口近傍、あるいは生活排水・工業排水と一緒になってナイルに流れ込む排水口近傍での水質については、全国的な調査が一度だけ行われている。これにより、排水の水質が極めて悪いことや、業種別の負荷量が明らかになっている。例

図-1 Water Quality Index (WQI) for 1977/1986

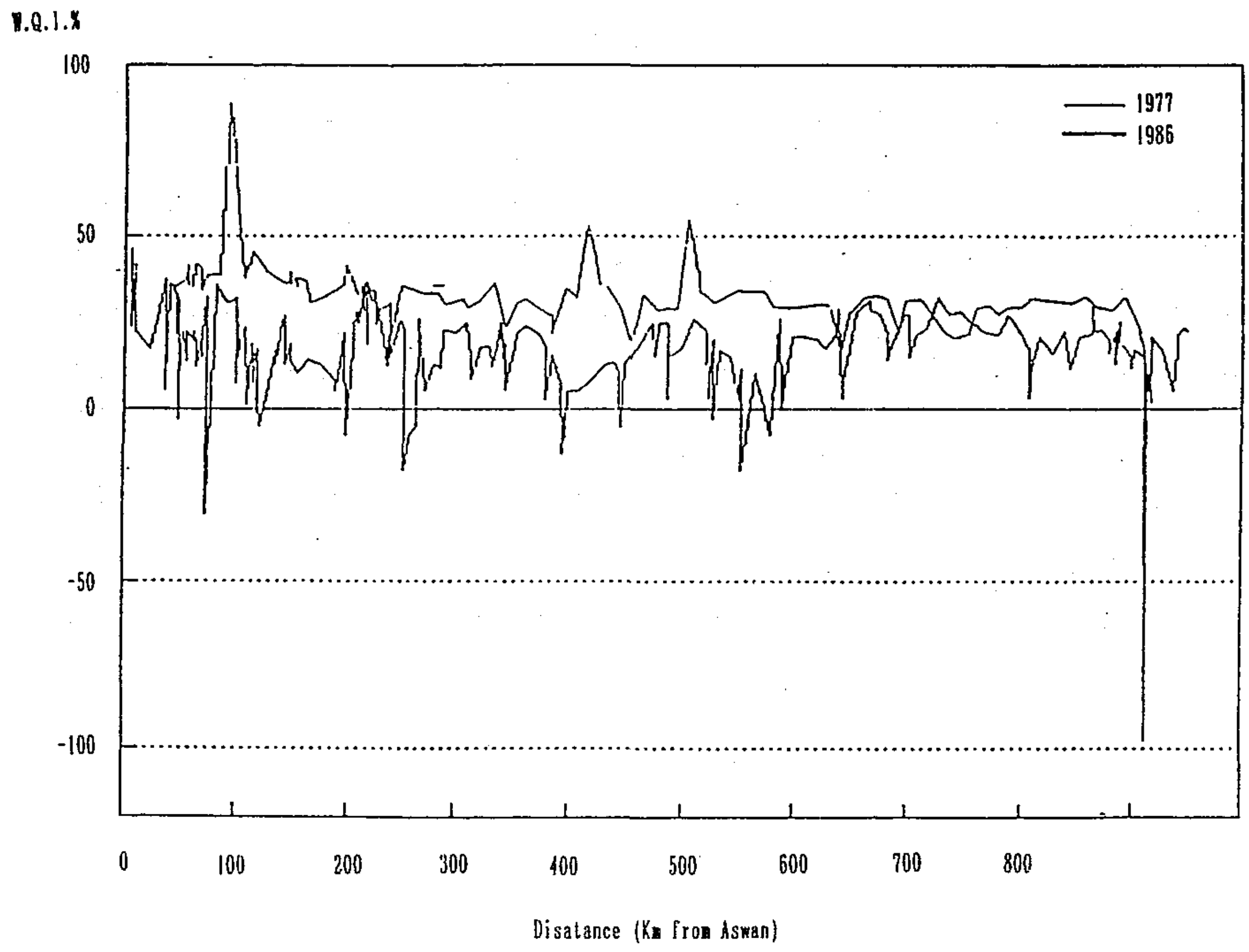
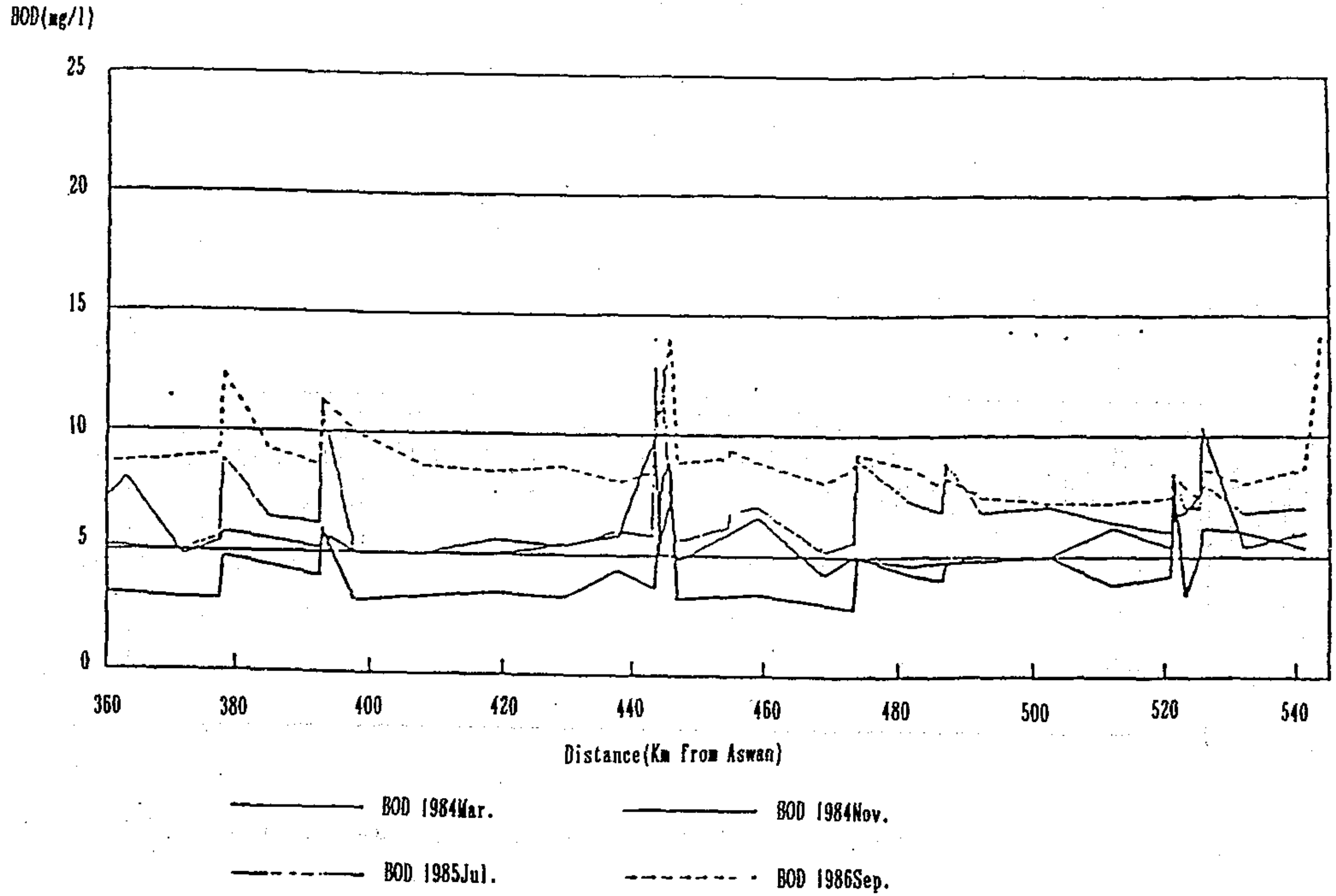


図-2 BOD Concentration in the River Nile
Reach3-Nag Hammadi to Assuit '84'85'88



えば、図-3は、排水口の上流、排出地点、及び、下流での水質調査結果を示しており、BOD ・COD とも、排出地点における値が飛び抜けて高いことが判る。これは、現在、工場からの排水が、なんらの処理もされずにそのまま排出されているためであり、”沈殿池による簡単な前処理を施すだけでも、かなりの効果が期待できる”、という見方をする研究者もいる。また、図-4は、業種別のBOD ・COD の負荷量で、主要産業の一つである繊維関連業種の負荷量が最も大きいことを表している。

③ 湖沼、海域

自然湖であるマリュート・マンザラといった、ナイルデルタに位置する湖の一部では、常に悪臭が発生しているなど、水質の悪化は明らかである。前者は、アレキサンドリア工業地帯に隣接しており、過去に比して漁獲量が80% 減少したとの報告もある。又、流入水路の流域を含めれば、400~500万人の生活排水・農業排水が流入する後者では、1950年より一貫して、低級魚であるティラピアの漁獲量が増加している。一方、高級魚の減少が続いている。

海域における環境問題としては、都市活動・産業活動に伴う廃油や、海上油井や船舶からの廃油による汚染が、特に問題となっている。石油汚染は、海洋生物・レクリエーションを中心とする観光と、冷却水を必要とする産業活動に多大なる影響を与えることから、石油省が、石油汚染対策センターを地中海1ヶ所、紅海側に2ヶ所設けるなどの対策を進めている。

湖沼・海域のいずれにしても、環境対策を立案・実施していくに必要なデータは殆どなく、モニタリングシステムの整備、人材の育成といった基礎的な体制の整備が望まれる。

なお、現在のところ、地中海側の富栄養化の問題は、マンザラ湖外域を除いてあまり顕在化していないが、当国の人口、経済の伸びと共に、将来には問題化することが懸念される。

④ 上下水道

上水道の普及率は70% であり、大小併せて350 以上の河川水処理施設がある。更に、3,500 以上の地下水処理施設があり、表-7に示すように、1992年には、一日当たり12百万立方米以上の供給が可能となる予定である。

図-3 Impact of El-Sail Drain on the Water Quality of the River

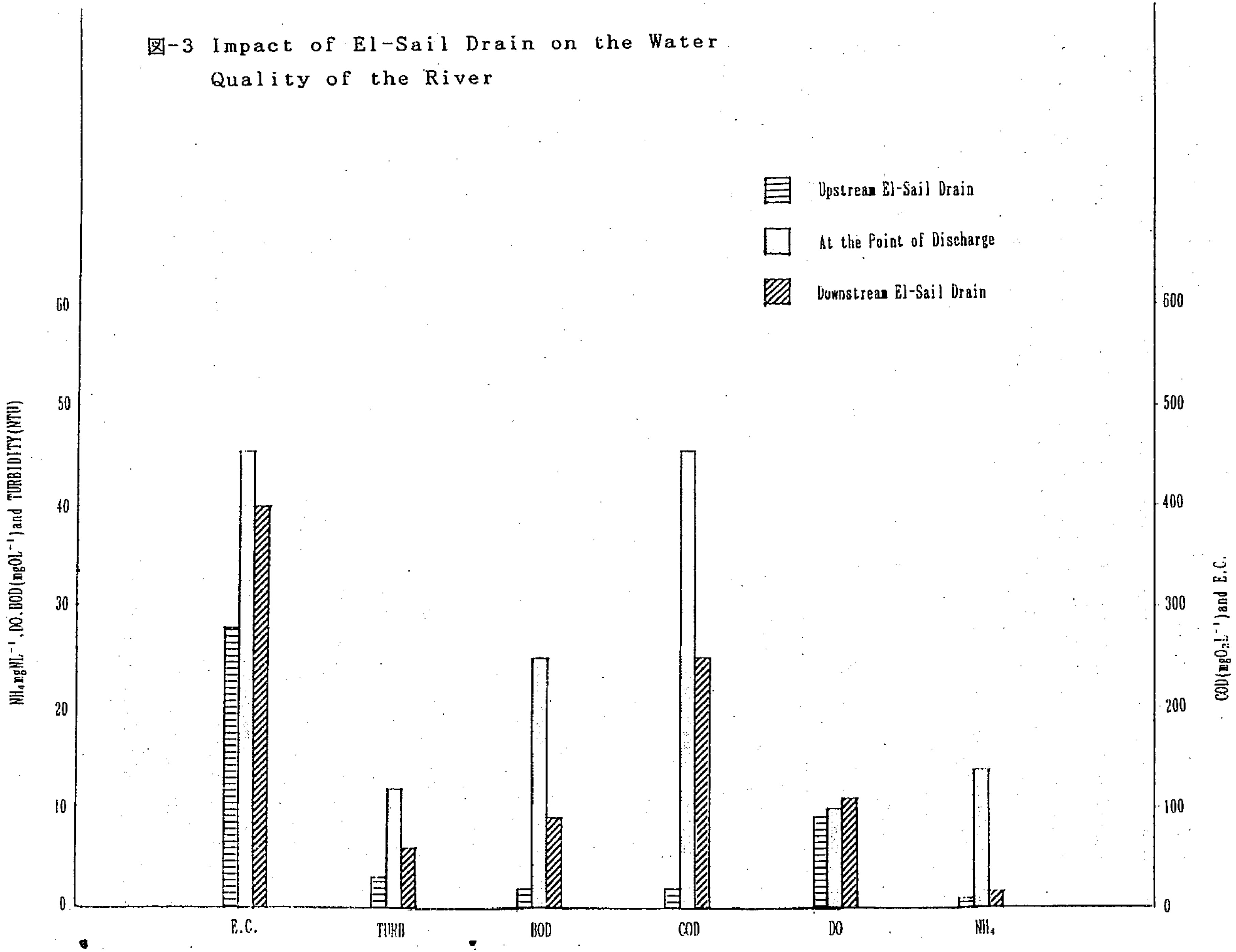


図-4 Loads of Pollution Contributed from Different Industrial Sectors

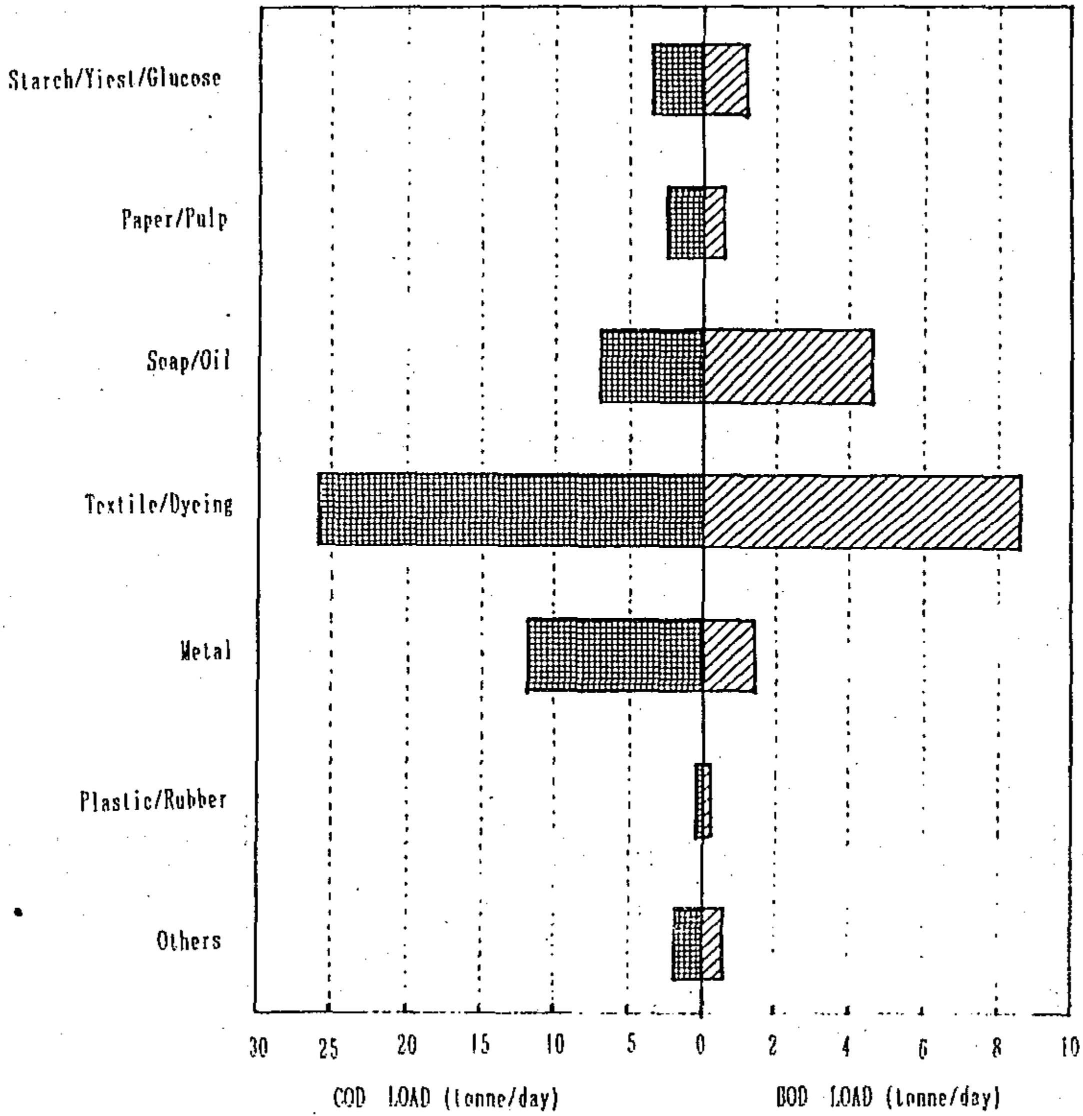


表-7 Development of Potable Water Supply Capacity

(Thousand M³ Per Day)

	1952	1977	1987	1989	1992
Cairo	340	2,100	3,200	3,650	4,800
Alexandris	190	716	1,500	1,886	2,026
Governorates	995	2,277	3,672	3,830	5,423
Total	1,525	5,093	8,372	9,366	12,349

下水道の普及率は、表-8に示すように、30％であり、その内約半数が最終処理を経て、残りの半数が未処理のまま排出されていると推測される。下水処理能力は大幅に改善されてきているが、まだまだ不足の状況である。産業排水の処理については、排出者責任が法律により定められているが、遵守はされていない。公共処理場の絶対数の不足もさることながら、排出責任者の負担による汚水処理の欠如は大きな問題となっている。個別住宅においても浄化槽の設置事例は殆ど無い。

表-8 Development of Sanitary Drainage (Thousand M³ Per Day)

	1952	1977	1987	1989	1992
Cairo	340	1,200	2,100	2,370	3,300
Alexandria	5	200	750	900	1,000
Governorates	82	239	450	500	2,682
Total	427	1,639	3,300	3,770	6,982

⑤ 課題

以上の水質環境の現況を考慮し、水質環境の保全を行って行くための課題を整理すれば次の通りである。

1 法規制と行政－ 排出責任の明確化と規制の段階的実施。

2 検査・管理体制－ 質量共の充実。

3 検査項目の拡充－ 先端技術・機器の導入。

4 産業排水処理－ 産業の指導及び資金・技術援助。

5 下水処理の充実－ 処理場の拡大。

6 教育－ 研修の制度的・継続的取組。

(2) 大気

全国的な調査はないが、カイロ市内の調査は表-9に示されている。これで見ると、日本の大気質規制の上限数値の約3～5 倍に悪化している。特に、カイロ周辺の既成工業地帯の大気質悪化が目立つ。自動車排ガスがこれを加速させている。この結果として、大都市圏児童の肺疾患罹病率は、図-5に示すように、農村地域の2～3 倍に達しているし、交通警官の

血液中の鉛量は、非常に高いという報告がある。調査データについては、調査地点の広域性、調査の継続性に乏しく、最近のデータが不足している。

表－9　エジプトにおける大気汚染規制値と、汚染の状況

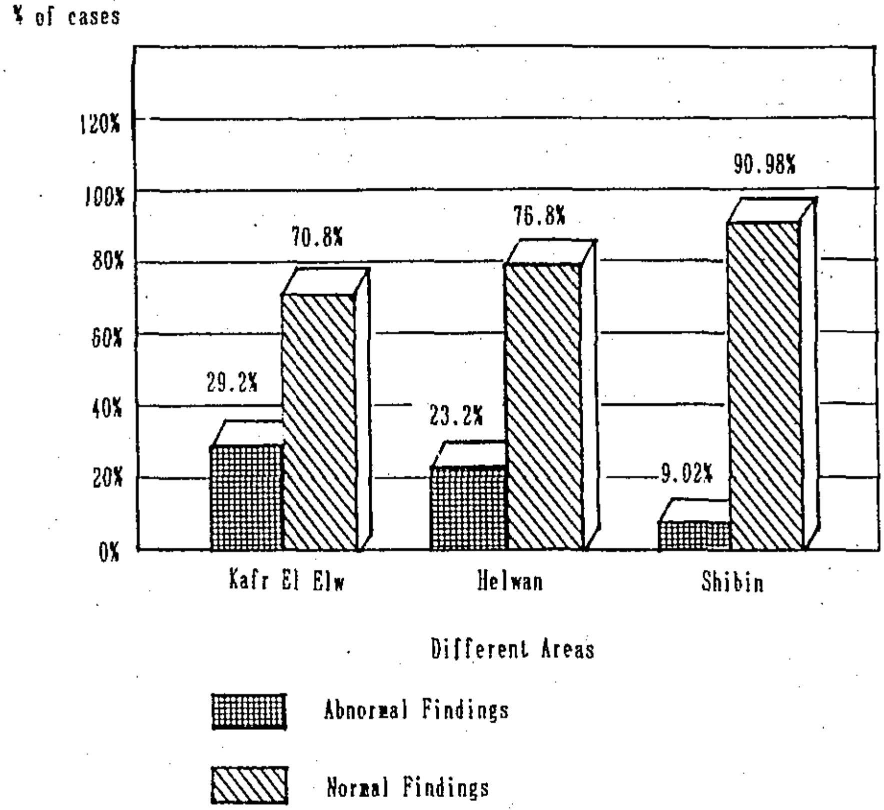
Item/Unit	Egyptian Standard	Data Obtained			Japanese Standard
		Cairo	Helwan	Shobra	
SO_2/ppm	(< 60 micro gm/m³) Annual	0.06-0.13 1983/1984			< 0.04 Daily average
CO_2/ppm	< 2.5 Daily	20 1978			< 10 Daily average
Suspended Particular Material mg/m²	0.15	0.6-0.7 1988	0.838 1988	0.567 1983	< 0.100 Daily average
NO_2/ppm	< 0.1	0.38 1979			< 0.04-0.06 Daily average
Smoke Concentration mg/m³	WHO < 40	43-139 1988		195 1978	
Photochemical Oxidents/ppm		0.1 more 1979			< 0.04-0.06 Hourly value
Lead mg/m³	< 0.014 Daily	0.5-4.9 1983			
Dust fall (residential) (industrial)	(< 20 t/mil²/month) (< 40 t/mil²/month)	57 1983	144 1978	46 1983	< 20t/km²/month < 20g/m²/month

主要大気汚染源について概述すると以下の通りである。

① セメント工場

工業地帯の大気質悪化のうち、もっとも顕著な事例は、カイロ近郊の工業地帯・ヘルワン地区のセメント工場から排出される排気公害である。エジプトのセメント生産量は、現在13

図-5　Results of Clinical Examinaiton of Chest among schoolchildren in the different studied Areas



百万トン/年の水準にあるが、この生産の大部分が、ヘルワン地区の3工場の生産によっている。この3工場によるダスト排気は、500トン/日と推定されている。表-9に示す、ヘルワン地区の、高いsuspended particlesの観測値は、主に、セメント工場の排気から来ている。この問題の是正については、すでにドイツの援助を中心として、事態改善に取り組まれている。

② 火力発電所

現在のエジプトの発電能力は、約12,500MWである。このうち、3,000MWがカイロを中心に立地しており、その内1,900MWは重油による発電となっていて、かつ排ガス対策が取られていない。表-9に示すSO_2/CO_2/NO_2の高観測値は1978~84年のものであって、その後、85年に、Shobura地区で、1,200MWの発電所が稼働したことを考えると、現況はさらに悪化していることに間違いはない。電力政策としては、石油はできるだけ輸出に回し、ガス源への転換を進めている。

③ 自動車

表-9に示すCO_2/NO_xの観測値は、1978/79の数値であって、当時の自動車台数は全国で0.8百万台であった。91年の全エジプトの自動車保有台数は2.2百万台、その内0.9百万台がカイロに集中していて、自動車の排ガス規制が実行されていない状況では、さらに悪化していることは容易に想像できる。また、研究者によれば、カイロ大都市圏を走っている自動車のうち、車齢21年以上のものが23%、11年以上のものが67%ということであった。

上記の他、主要汚染源としての製鉄工場などの排煙があるが、具体的なデータがない。

以上を踏まえ、大気環境の保全を行っていくための課題を整理すれば、次のとおりである。まず第一に、エジプト政府自体がアクションプランを作ること、このうち、環境行政に直接かかわるものとしては、

環境規準の設定、法規制の整備。

研究・教育体制の整備。

Monitoring StationによるSource Inventory, Training, 国民意識の昂揚。

自動車・発電所・工場(特にセメント・製鉄工場)の排ガス規制。

産業政策・運輸交通政策の整備。

工場再配置、公共輸送の充実と積極的利用、道路交通管制システムの導入。

財政政策に関するものとしては

汚染排除対策に対する税制優遇。

その他、Heavy Oilのnatural gasへの転換、ガソリンの鉛量削減、等がある。

(3) 廃棄物

① 発生量

カイロ大都市圏における一般廃棄物の発生量については諸説あるが、6000~8000t/日と見られる。カイロ大都市圏の人口規模を考慮すれば、0.5Kg/人/日程度と考えられる。また、農村部では、0.2Kg/人/日程度である(因みに、日本では、1Kg/人/日で、米国では、3Kg/人/日)。

この内、未回収分は、900~2800tと見られ、大きな問題となっている。

② 回収、処理システム

一般廃棄物の回収、処理システムは、図-6に示すように、かつ、2.(3)で述べたように、民間業者(総てコプト教徒であり、当国では、イスラム教徒は一般廃棄物の回収に従事しない)が中心となって収集しているもので、中高所得者が多く住む地域では機能しているが、低所得者の多い地域では有価物が殆どないため、回収業者は回ってこないのが現状である。このため、未回収廃棄物は、道路、運河等へ投棄、放置されることとなる。

回収した廃棄物は、磁石及び人力により篩分けられた後、売却あるいはコンポスト(混合肥料)にされ再利用される。全体の10%がコンポストに、50~60%が資源としてリサイクルされる(カイロ大都市圏には、コンポストプラントは、4ケ所ある)。また、売却するほど価値はないが、可燃性の物は業者直営の(中級以下の品質の)焼き物工場の燃料となり、真っ黒な煙をもうもうとカイロ上空に撒き散らすこととなる。残りの、石、煉瓦等が最終的に投棄される。業者によれば、投棄する場所は指定されているとのことである。とは言え、無認可で砂漠道路の横に廃棄物の山が放置されていることも事実である(これが一般廃棄物なのか産業廃棄物なのか明らかではないので、一般廃棄物の回収業者の仕業かどうかも不明)。

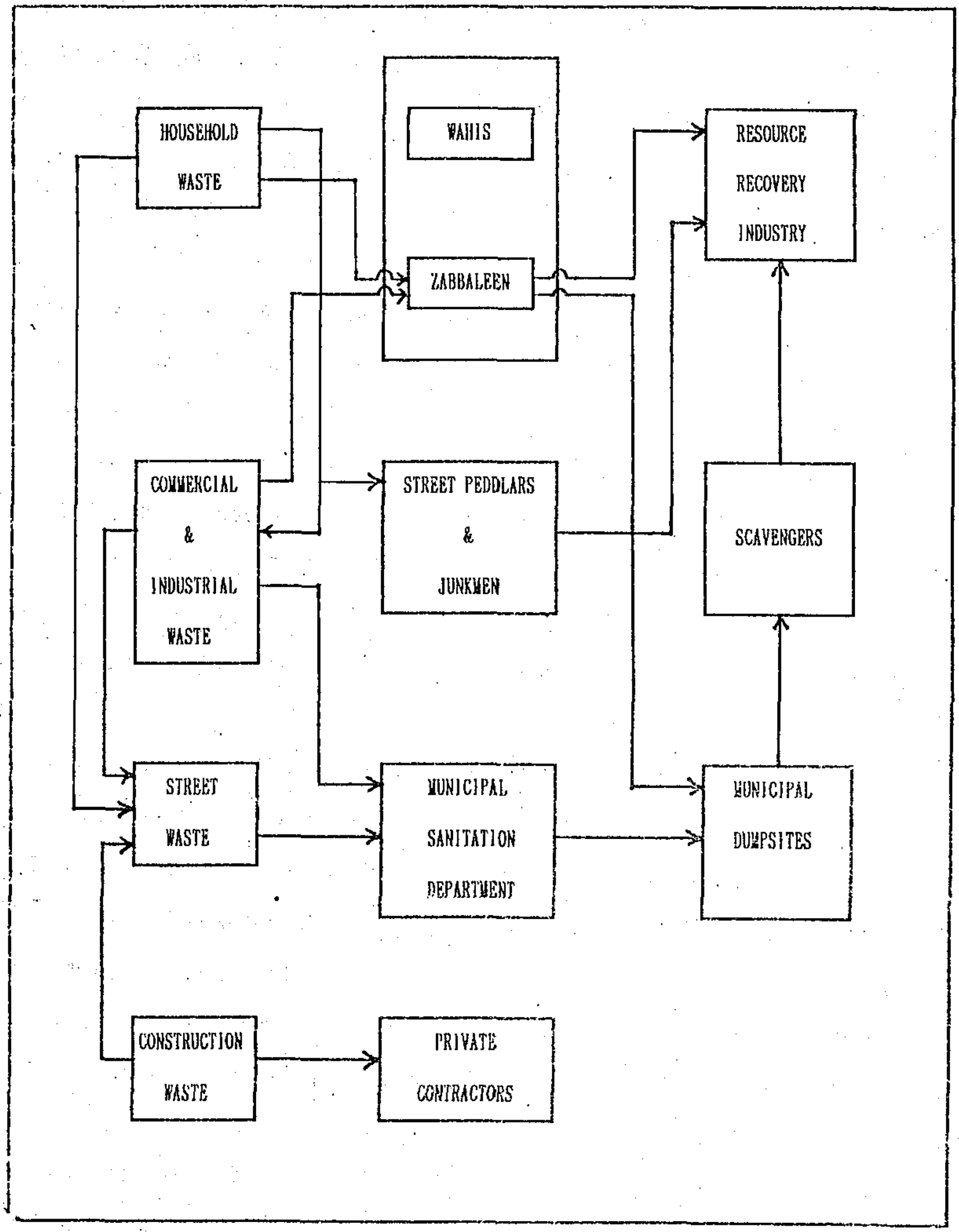
③ 課題

以上を踏まえ、一般廃棄物処理を円滑に行っていくための課題を整理すれば、次の通りである。

- 民間回収業者にとりインセンティブのない、低所得者の多い地域における公的回収システムの整備(相応の受益者負担の導入も考慮)。
- 民間回収業者の近代化、効率化。
- 公的システムと民間業者との連係の強化。
- 不法投棄に対する規制の強化。
- 廃棄物問題・街の美化・衛生に関する教育・広報。

以上、一般廃棄物を中心に述べたが、東京都区内の場合、産業廃棄物の発生量は、一般廃棄物をの約5倍(1987年)であり、その処理・処分がカイロにおいても問題となる可能性もあり、産業廃棄物・建設残土等、一般廃棄物以外の廃棄物についても注目しておく必要があると考えられる。

図-6 Flow of Waste Materials (From Sources to Disposal Points)



4．　あとがき

「エジプトの環境はどうなっているのか。」という疑問のもとに、当国の環境を、データとして具体的に把握しようと試みて来た。十分に満足の行くものではないが、環境問題の現状について、おぼろげながら理解出来たと考えている。水質・大気・廃棄物と言った（古典的）環境問題の現状は、極めて憂慮すべき状況にあると判断される。また、各環境分野に共通しているのは、人材、機材の不足等による、体系的なモニタリング体制の未整備、法規制は存在するが、何等実施に移されていないという構造的問題であった。

環境問題は、現在の社会が持つ生産、消費構造の変革が求められる、極めて複合的な問題であり、個別の問題を解決するに足る技術を上乗せしてしまっては、世界全体がそのコスト負担にたえかねる問題である。この立場から、環境保全を進める上での主要課題を挙げれば、まず第一に、石油の大量消費とCO_2ガスの発生や、フロンガスの利用とオゾン層の破壊といった、先進国がイニシアティブを発揮すべき課題がある。第二には、自動車の普及と都市大気環境の悪化や、都市効率の低下に代表される、先進国・開発途上国に共通する課題がある。第三には、開発途上国に見られる環境保全、改善に係る負担能力の欠如である。これらの内、第一番目の課題については、本報告の範囲外であり、二番目、三番目の課題について、当国の環境現況を参照しながら、更に見解を述べれば、以下の通りである。

二番目の課題は、公秩序意識の薄さから来るものであって、先進国・途上国を問わず、政府が、その国民と領土に責任を持つことで、解決していかなければならない問題である。当国の例で言うならば、農薬・肥料の過剰消費から来るナイルの汚染、ひいてはマンザラ湖の汚染、地中海水域への汚染拡大に見られる事例は、エジプト自体が解決していかなければならない問題であると考える。この問題の背後には、人口圧力の増大、消費の無秩序化、排出者負担の原則の確立の難しさといった、公害にまつわる固有の問題があるが、これは、地球の上に住む人間が、先進国・途上国を問わず、その解決を担っていかなければならない問題である。

三番目の課題は、基本的には、貧しさから来るものである。公害問題の中には、都市衛生とかの、衣食足って礼節を知る範疇に属する、言いかえれば、所得の向上によって解決していく問題がある。改めて、国間貧富の格差の分布を眺めてみると、貧富の格差は、工業生産機能の分布の偏りと密接に結び付いていると言える。先進国に偏りすぎている工業生産機能は、改めてその移転を考える時期に来ている。生産機能を移転するに当たっては、先進国の

もつ現在の技術水準が、移転に適合する技術であるとは限らない。日本では過去のものとなった技術が、途上国にとって適合性の高い場合が多い。また、技術の体系全体を見直しをしている必要もある。カイロ市で発生する生活ゴミが、収集過程の再利用選別を通じて、あるいは、アレキサンドリアの生ゴミが肥料に再生化することによって有価値ゴミとなり、コスト償却ができていることは大切にする必要がある。排出者負担の原則を確立すれば、排出量の低下も考えられる。また、排出源の地方移転が進めば、規準と照らして公害処理技術も、安価化・低価格化の道をたどる可能性もある。巨大・高価格処理技術だけが、対応策ではあるまい。

最後に、本研究会のためにご協力頂いたエジプトの関係者に深甚の謝意を表して、この報告を終えることとしたい。

参考資料－1．　エジプト環境問題研究会名簿

メンバー	企業名
井 川 恵 亮	アラブ 大 塚
五十嵐 徹	日 本 航 空
遠 藤 幾 勇	日 商 岩 井
遠 藤 昌 男	J I C A
緒 方 仁	五 洋 建 設
小 川 重 徳	O E C F
小野川 繁 澄	J I C A
栗 田 敬 三	伊 藤 忠
小 林 頼 和	三 井 物 産
小 松 秀 人	兼 松
曽 我 裕	丸 紅
店 田 廣 文	早稲田 大 学
田 口 正 之	大日本 土 木
谷 和 弘	三 菱 商 事
中 村 玲 子	中東経済研究所
Nabil Sehsah	P C I
平 田 修 一	ク ボ タ
山 口 幸 文	J E T R O
米 沢 勉	住 友 商 事

幹事

東 俊 夫	大 使 館
川 添 浩 正	J I C A

参考資料－２．　　講演会日程及び講師一覧

講演日	氏　名	所属先と講演題目
'91年10月20日	Dr.M.EL-Moattassem	Project Manager RMPO.
		River Nile Water Quality Monitoring.
27日	Dr.Mounirs.Neamatalla	President of EQI.
		Recycling of Solid Waste.
11月06日	Dr.Khaled Mostafa	Chairman of El Nasr Co.Utility & Construction.
		Drinking Water and Sewage Status in EGYPT.
17日	Prof.Fatma El Gohary	Prof. National Research Center.
		Status & Trend of Industrial Pollution Control.
12月01日	Prof.Dr.M.Nasralla	Prof. National Research Center.
		Air Pollution in EGYPT.
08日	Dr.Fikry I.Khalaf	Adviser of Port Said Governorate.
		The Environmental Deteroration of Lake Manzala.
15日	Dr.Saad Awad	Dupty Head of National Research Center.
		General Nature of the Air Pollution Problems.
'92年01月19日	Dr.Ahmed Sayed Mousry	Prof.National Research Center.
		Marine Pollution.

この他、研究会メンバーだけで、９月20日・27日・３月１日・８日・15日と、５回に亙る勉強会を行った。

参考資料－3．　環境問題に対する我が国の貢献実績

（1）無償

①　ギザ市・西オムラニア地区・上下水道整備（1988~89 年度）

（2）有償

①　大カイロ・水道改善事業（1976~83 年度）

②　カイロ・下水処理場・詳細設計事業（1984~85 年度）

（3）開発調査

①　カイロ大都市圏・上水道計画調査（1974~76 年度）

②　アレキサンドリア市・廃棄物収集処理計画調査（1983~85 年度）

③　シャルキア・下水道整備計画調査（1985~87 年度）

（4）研修

①　我が国で実施されている水質保全、環境モニタリング等、環境関係技術研修（20 コース）に、約20人／年のエジプト人が参加している。

（5）研究協力

①　乾燥地帯における保水剤開発に関する研究協力事業（グリーン・アース・プロジェクト）

内　　容　：保水剤の開発と、これを用いた砂漠の緑化

期　　間　：1988~92

実施機関　：（社）日本砂漠開発協会（通産省より委託）

参考資料－4．　－　環境問題に関するエジプト政府の対策、及び、各国からの協力の動向。
（90・91年のプレス記事。－出典の注記なき場合はGazetteから拾得）

エジプト　・環境問題の汎アラブ・センターをエジプトに考えたい－内閣官房－1/Apr.・91.

・工業相・農業相・内閣官房長官、アレキサンドリア・Maryut湖の汚染問題で協議。－06/May.

・アレキサンドリアで、公害問題の国際シンポジュームが開かれる。
High Institute for General Health in Alex.,UNED, IDO,IMF.－18/May.

・水のリサイクルの研究会が開かれる。
工業省、Abu Kiur Co. for Fertilizer & Chemical Industry. －26/May.

・エジプト沿岸の環境を守るための関係閣僚会議が開かれる。観光振興のため。－28/May.

・開発省、全国に160の汚水処理場を建設する予定。取りあえず、47基、26万トンを、LE.661mil. で契約。－20/Jun.

・海洋汚染防止体制が出来る。取りあえず、LE.9.8mil. の資金で運営。将来は罰金で運営。エジプト・マルセイユ・マルタで要員を訓練。
The Port & Lighthouse Authority in Alex.－17/Jul.

・エジプト海岸の環境調査始まる。
National Institute for Oceanology in Alex.－08/Jun.

・地中海の水位測定機構が整い観測に入る。温暖化に伴う水位上昇測定。
National Institute for Oceanology in Alex.－04/Jul.

・環境観測アラブ・センター設立。－内閣官房－04/Jul.

・砂漠化防止事業への援助をパリクラブへ要請。－09/Jul.

・スエズ運河庁、海洋汚染の罰則を強化。－10/Jul.

・開発省、Water & Sanitation計画に、LE.13bil. を投じると発表（何年計画かの記述がない）。この運営は地方公社に当たらせる。－14/Jul.

・核利用による、海水の淡水化の検討を開始。Atomic Energy Organization.-19/Jul.

・観光省が、フルガーダでゴミ処理施設を建設する。資金源は世銀と見られている。-19/Jul.

・国民議会、太陽熱利用による淡水化、水のリサイクルの必要を強調。-01/Aug.

・国民議会、Manzala湖の浄化に、LE.669mil. が必要と推定。-07/Aug.

・エジプトの環境問題の地図作成のため、観測点をネット・ワーク化する。National Council for Protection & Economic Affairs. -08/Aug.

・企業対象の省エネルギー会議が開かれる。-08/Aug.

・湖・工場の公害防止事業を始める。ヘルワンのセメント工場公害は、ドイツ資金、DM.0.98mil. を中心に実施。エジプト負担分は、Public Sector Authority Research Fund を使う。開発省・Scientific Research Academy が協力。-11/Aug.

・アレキサンドリア市街地内の工場移転の検討を始める。Egyptian Industries Federation.-12/Aug.

・湖公害防止事業が発足。Bousrulus・Idku・Maryut・Manzala湖が対象。平行して、企業公害防止プロジェクトが発足した。潅漑省。-13/Aug.

・工業省、水資源・エネルギーの再利用に関する研究に着手。-17/Aug.

・National Research Centerが、ナイルの水は工場排水で汚れていると発表。-24/Aug.

・アレキサンドリア大学、環境問題シンポジュームを開く。-09/Sep.

・都市化に伴う公害問題の検討を行ない、来年6月の世界環境会議に提出。- 内閣官房-23/Sep.

・トルコで開かれた環境問題会議にエジプト参加。-04/Sep.

・紅海州知事、海洋汚染防止について石油相・内閣官房長官と会合。26/Sep.

・水の有効利用と排水の多元利用について、国際シンポジュームをアレキサンドリアで開催。- 潅漑省-30/Sep.

・ヘルワンのInstitute of Mineral Studyで、国産の公害測定機器を

一式設置。順次、地方にも設定していく。－17/Oct.

・Manzala湖の汚染解決のための全体会議が開かれる。内閣官房府・EAA 主催。開発省、Suez Canal Univ.,Oceanological Institute 共催。流域全体に、3ヶ所の下水処理場を、LE.200mil. で造り、125 万トンの下水を処理する。カイロ周辺のYellow Mountain に、下水処理場を、LE.669mil. かけて造り、19万トンの下水を処理する。ポートサイード市の下水処理場の能力を、10万トン/日に上げる。－19/Oct.

・地球温暖化に伴う地中海水位の上昇が懸念されている。デルタ地帯も年間1.2mm沈下しており、地中海の水位が30~50mm上昇すると、デルタ地帯に影響をもたらす。－22/Oct.

・開発省、Arab Engineering Associationと共同して、セメント工場都市廃棄物の公害防除に取り組む。－27/Oct.

・海洋汚染監視機関を、石油省の元に、スエズ・アレキサンドリア・ラスガーレダの3ヶ所に、LE.9mil. を投じて設置する。－28/Oct.

・Manzala湖の汚染排除事業を、LE.3mil. で着工。内閣官房・農業省・資源省。－28/Oct.

・開発省、AOI と上下水処理施設製作の契約を結ぶ。－28/Oct.

・内閣官房・EAA，環境破壊に関する統一法を提唱。場合によって工場閉鎖。油投棄は$8万の罰金。－30/Oct.

・海洋漁業振興の国際シンポジュームが、アレキサンドリアで開かれる。海洋汚染防止が含まれている。－11/Nov.

・フルガーダの環境問題が明確になるまで、同地区には新しい石油採掘権を認めないと、石油相語る。－16/Nov.

・フルガーダに、海洋汚染監視機関を設置。運営費は観光省が負担する。－17/Nov.

・地方市町村で飲料水の水質が低下している。開発省・灌漑省、共同で問題処理に当たる。－26/Nov.

・開発省、Turah セメント工場にフィルターを付けて、公害防除に当たる。－30/Nov.

・石油相、アルメニアの石油化学工場に対して、クロールの増産を指示。地方水道の浄化のため。−03/Dec.

・潅漑省、首相指導の元に、ナイルの水の汚染防止にあたる。−07/Oct.

・カイロ市主要地点の景観改修が、文化相・カイロ州知事の手で始まる。−23/Dec.

・内閣官房・EAA，カイロ環境センターのために、300 フェダンの土地を提供。−23/Dec.

・都市ゴミの収集が組織化されて、従来の個人収集者のゴミ回収量が減っている。−29/Dec.

・大カイロ圏の下水道事業を、LE.3bil/500万トン・日の事業に格上げして、5ヶ年で実施する。−29/Dec.

アラブ環境相会議

・カイロで開催。クエイト油井火災、水質・砂漠化を検討。−28/Aug.・91.

・水質の監視、生態系の情報整備、水資源の確保・利用の合理化を議論することを決定。この問題に対する先進国の貢献を要求。−13/Sep.

・アラブ水利相、水の多次元利用の会議をカイロで開く。−23/Oct.

・ダマスカスで環境相会議を開く。−19/Dec.

地中海沿岸諸国環境相会議

・第7回会議をカイロで開催。−05/Oct.・91.

・イタリアの国際ライオンズ・クラブの提唱で、地中海・海洋汚染防止審判所が出来る。−04/Dec.

国連　・エジプトに環境センターの設置を決定。$5.5bil.を提供。砂漠化防止、河川水の保護、工業公害の防除。−06/Jun.・91.

世銀　・ヘルワン工業地帯の公害防止に、機器の無償提供を検討。−09/Jun.・91.

・ヘルワン工業地帯に、公害防止機器の購入を援助の見込。−10/Aug.

・エジプトの公害対策樹立のため、10月末に専門家を派遣する。-20/Oct.

・非漏水農業水路に$45mil.を援助。IDA も$74mil., ドイツDM50mil.,
オランダが$10.5mil., ベルギー がBF20mil. を提供。6ヶ年計画。
-29/Oct.-08/Nov.

・エジプトの公害現況図を作った。内閣官房、これを利用して、先進国からの援助を要請する資料とする。-25/Dec.

UNDP ・エジプトに生態系センターを設立。-08/Jun. ・91.

・エジプトに中東環境センターを造る。-13/Jul.

FAO ・農業における肥料・農薬の検討を始める。-08/Sep. ・91.

USAID ・Talkha セメント工場の廃熱利用の発電に、$12mil.を無償で提供。
-24/Aug. ・91.

・Abu Raswash の下水道処理施設に$52.2mil.の無償を提供。-24/Sep.

・ピラミッド周辺の下水道に、無償を提供。-03/Oct.

・運河沿い3都市の下水道整備に着手。$380mil.-04/Oct.

・スエズ運河地帯の三市で上下水道を整備。取りあえず、ポートサイード市から始める。-16/Oct.

オランダ ・今後5年間に、$150mil. を援助。この中に環境問題が入っている。
-MEED 30/Nov. ・90.

・専門家を派遣して、地中海沿岸とサイナイ半島の公害防止計画を作る。エジプト側は、Coastal Protection Agency が担当。-07/Dec.

・$4.5mil. の無償援助を提供。その中に、下水道処理水の再利用・ナイルの水の解析が入っている。-MEED 27/Dec.

デンマーク ・フルガーダの公害防止に$9mil. を提供。-28/May. ・91.

・水資源開発に、DK15mil.+$3mil. を提供。-28/May.

・DANIDAの幹部、エジプトの公害除去援助の打ち合わせに来訪。-19/Oct.
・DK150mil.の援助を提供。セメント工場の公害防止・Idfuの下水道整備が入っている。-05/Nov.

ノルウェー ・環境制御技術の移転について、無償援助を申し出。特に下水の再利用による魚養殖。-06/Jul.・91.

ベルギー ・環境問題に$10mil.を提供。10年グレース、30年償還。-03/Apr.・91.

カナダ ・ナイルの汚染に関する研究所を、$1mil.で設立。-29/Mar.・91.
・河川水質保護について、$10mil.を無償で提供。基礎調査と国際会議の費用。The Institute for Research of the High Dam.-26/Sep.
・カナダ商工会、経済交流に拡大協議に来訪。議題の中に、ナイル汚染防除、$7mil.がある。-17/Oct.

イギリス ・カイロ都市圏の下水道整備への援助を検討。-01/Jul.・91.
・下水の再利用による潅漑研究を、Suez Canal Univ.と共同で実施。LE.9万。-17/Aug.

フランス ・本年度援助、FF770mil.の中に、環境問題を含める。-25/Jun.・91.

ドイツ ・公害防止の専門家を派遣。情報センターを作る計画。-29/Nov.・90.
・エジプトの公害問題について協力を申し出。そのための財団を造る。-14/Dec.
・カフルエルシェイクの上下水道に、DM15mil.、セメント工場の公害防止に、世銀と協調して、DM20mil.を提供。-12/Sep.・91.
・北ライン州の環境相、10月下旬にエジプト訪問の予定。-17/Oct.
・エジプトと科学技術振興協定を結ぶ。ナイルの水質汚染対策、セメント工場の公害防除対策が入っている。-23/Oct.
・50市町村の下水道対策にDM220mil.を提供。60%は無償。残りはGBRの融

資。－13/Nov.

・ナイルの汚染監視体制強化に協力。灌漑省・開発省・科学技術省が関与。
－04/Dec.

クエイト　・AFESD が$35mil.を、水の循環体系に提供。－23/Sep.・91.

サウジ　・Kurimatからフルガーダまでの上水道・400Km に、$30mil.を提供。
－15/Dec.・91.

付属　資料

日本の基準

H4. 1. 19
環境研究会資料

Appendix 2. National Standards

1. Ambient Air Quality Standards

substance	Standard values	Measuring methods
Sulfur dioxide	Daily average of hourly values shall not exceed 0.04 ppm, and hourly values shall not exceed 0.1 ppm	Conductometric method
Carbon monoxide	Daily average of hourly values shall not exceed 10 ppm, and average of hourly values in eight consecutive hours shall not exceed 20 ppm	Nondispersive infra-red analyzer method
Suspended[1] particulate matter	Daily average of hourly values shall not exceed 0.10 mg/m³, and hourly values shall not exceed 0.20 mg/m³	Mass/concentration method based on filtration collection. Alternatively, the light-scattering method, the piezoelectric microbalance method, or the β-ray attenuation method yielding results linearly related to the values of the mass/concentration method.
Nitrogen[2] dioxide	Daily average of hourly values shall be within the range between 0.04 ppm and 0.06 ppm or below.	Colorimetry employing Saltzman reagent (with Saltzman's coefficient being 0.84)
Photochemical[3] oxidants	Hourly values shall not exceed 0.06 ppm	Absorptiometry using neutral potassium iodide solution, or coulometry

Notes : 1. Suspended particulate matter shall mean airborn paritcles of 10 microns or less in diameter.

2. a) In an area where the daily average of hourly values exceeds 0.06 ppm, efforts should be made to achieve the level of 0.06 ppm by 1985.

b) In an area where the daily average of hourly values is within the range between 0.04 ppm and 0.06 ppm, efforts should be made so that the ambient concentration be maintained around the present level within the range or does not significantly exceed the present level.

3. Photochemical oxidants are oxidizing substances such as ozone and peroxiacetyl nitrate produced by photochemical reactions (only those capable of isolating iodine from neutral potassium iodide, excluding nitrogen dioxide).

3. Environmental Water Quality Standards (Dec. 28, 1971, Amendments 1974, 1975, 1982, 1985)

(1) Standards related to the Protection of Human Health

Item	Standard values[1]
Cadmium	0.01 mg/ℓ or less
Cyanide	Not detectable
Organic phosphorus[2]	Not detectable
Lead	0.1 mg/ℓ or less
Chromium (hexavalent)	0.05 mg/ℓ or less
Arsenic	0.05 mg/ℓ or less
Total mercury	0.0005 mg/ℓ or less
Alkyl mercury	Not detectable
PCB	Not detectable

Notes: 1. Maximum values. But with regard to total mercury, standard value is based on the yearly average value.
2. Organic phosphorus includes parathion, methyl parathion, methyl demeton and E. P. N.
3. Standard value of total mercury shall be 0.001 mg/ℓ in case river water pollution is known to be caused by natural conditions.

(2) Standards related to the Coservation of the Living Environment

a. Rivers

Category	Item / Purposes of water use	Standard values[1]				
		pH	Biochemical Oxygen Demand (BOD)	Suspended Solids (SS)	Dissolved Oxygen (DO)	Number of Coliform Groups
AA	Water supply, class 1; conservation of natural environment, and uses listed in A—E	6.5—8.5	1 mg/ℓ or less	25 mg/ℓ or less	7.5 mg/ℓ or more	50 MPN/100mℓ or less
A	Water supply, class 2; fishery, class 1; bathing and uses listed in B—E	6.5—8.5	2 mg/ℓ or less	25 mg/ℓ or less	7.5 mg/ℓ or more	1,000 MPN/100mℓ or less
B	Water supply, class 3; fishery, class 2; and uses listed in C—E	6.5—8.5	3 mg/ℓ or less	25 mg/ℓ or less	5 mg/ℓ or more	5,000 MPN/100mℓ or less
C	Fishery, class 3; industrial water, class 1; and uses listed in D—E	6.5—8.5	5 mg/ℓ or less	50 mg/ℓ or less	5 mg/ℓ or more	—
D	Industrial water, class 2; agricultural water[2], and uses listed in E	6.0—8.5	8 mg/ℓ or less	100 mg/ℓ or less	2 mg/ℓ or more	—
E	Industrial water, class 3; conservation of the environment	6.0—8.5	10 mg/ℓ or less	Floating matter such as garbage should not be observed	2 mg/ℓ or more	—

Notes : 1. The standard value is based on the daily average value. The same applies to the standard values of lakes and coastal waters.
2. At the intake for agriculture, pH shall be between 6.0 and 7.5 and dissolved oxygen shall not be less than 5 mg/ℓ. The same applies to the standard values of lakes.
3. Conservation of natural environment : Conservation of scenic spots and other natural resources.
4. Water supply, class 1—Water treated by simple cleaning operation, such as filtration.
Water supply, class 2—Water treated by normal cleaning operation, such as sedimentation and filtration.
Water supply, class 3—Water treated through a highly sophisticated cleaning operation including pretreatment.
5. Fishery, class 1— For aquatic life, such as trout and bull trout inhabiting oligosaprobic water, and those of fishery class 2 and class 3.
Fishery, class 2— For aquatic life, such as fish of the salmon family and sweetfish inhabiting oligosaprobic water and those of fishery class 3.
Fishery, class 3— For aquatic life, such as carp and crucian carp inhabiting β-mesosaprobic water.
6. Industrial water, class 1—Water given normal cleaning treatment such as sedimentation.
Industrial water, class 2—Water given sophisticated treatment by chemicals.
Industrial water, class 3—Water given special cleaning treatment.
7. Conservation of the environment—Up to the limits at which no unpleasantness is caused to people in their daily life including a walk by the riverside, etc.

b. Lakes (natural lakes, and artificial reservoirs with 10 million cubic meters of water or above)

Category	Item / Purposes of water use	Standard values				
		pH	Chemical Oxygen Demand (COD)	Suspended[1)] Solids (SS)	Dissolved Oxygen (DO)	Number of Coliform Groups
AA	water supply, class 1; fishery, class 1; conservation of natural environment, and uses listed in A—C	6.5—8.5	1 mg/ℓ or less	1 mg/ℓ or less	7.5 mg/ℓ or more	50 MPN/100 mℓ or less
A	Water supply, classes 2 and 3; fishery, class 2; bathing, and uses listed in B—C	6.5—8.5	3 mg/ℓ or less	5 mg/ℓ or less	7.5 mg/ℓ or more	1,000 MPN/100 mℓ or less
B	Fishery, class 3; industrial water, class 1; agricultural water, and uses listed in C	6.5—8.5	5 mg/ℓ or less	15 mg/ℓ or less	5 mg/ℓ or more	—
C	Industrial water, class 2; conservation of the environment	6.0—8.5	8 mg/ℓ or less	Floating matter such as garbage shall not be observed	2 mg/ℓ or more	—

Notes: 1. With regard to fishery, classes 1, 2 and 3, the standard value for suspended solids shall not be applied for the time being.
2. See notes for rivers.
3. Fishery class 1— For aquatic life,such as salmon inhabiting oligotrophic lake type waters, and for those of fishery class 2 and 3.
Fishery class 2— For aquatic life, such as fish of the salmon group and sweet fish inhabiting oligotrophic lake type waters, and for those of fishery class 3.
Fishery class 3— For those aquatic life, such as carp and silver carp inhabiting eutrophic lake type waters.
4. Industrial water class 1— Water given normal treatment such as sedimentation.
Industrial water class 2— Water given sophisticated treatment such as chemical injection or special treatment.
5. Conservation of the environment—Up to the limits at which no unpleasantness is caused to the people in their daily lives including a walk along the shore.

c. Nitrogen and phosphorus in lakes and reservoirs

Category	Item / Purposes of water use	Standard velues	
		Total nitrogen[2]	Total phosphorus[3]
I	Conservation of natural environment, and uses listed in II—V	0.1 mg/ℓ or less	0.005 mg/ℓ or less
II	Water supply classes-1, 2 and 3 (excluding special types) fishery class 1, bathing ; and uses listed in III—V	0.2 mg/ℓ or less	0.01 mg/ℓ or less
III	Water supply class 3 (special types), and uses listed in IV—V	0.4 mg/ℓ or less	0.03 mg/ℓ or less
IV	Fishery class 2, and uses listed in V	0.6 mg/ℓ or less	0.05 mg/ℓ or less
V	Fishery class 3, industrial water ; agricultural water ; conservation of the living environment	1 mg/ℓ or less	0.1 mg/ℓ or less

Note : 1. Standard values are set in terms of annual averages.

2. Standard values for total nitrogen are applicable to lakes and reservoirs where nitrogen is a causal factor of the growth of phytoplankton.
3. Standard values for total phosphorus are not applicable to agricultural water uses.
4. Conservation of natural environment—Conservation of scenic points and other natural resources.
5. Water supply class 1—Water treatment by simple cleaning operation such as filtration.
   Water supply class 2—Water treatment by normal cleaning operation such as sedimentation and filtration.
   Water supply class 3—Water treatment by sophisticated cleaning operation including pretreatment. ("special types" mean water treatments by special cleaning operation in which removal of smelling substances is possible.)
6. Fishery class 1—For aquatic life, such as fish of the salmon group and sweet fish, and for those of fishery class 2 and 3.
   Fishery class 2—For aquatic life, such as smelt and for those of fishery class 3.
   Fishery class 3—For aquatic life, such as carp and silver carp.
7. Conservation of the environment—Up to the limits at which no unpleasantness is caused to the people in their daily lives including a walk along the shore.

d. Coastal waters

Category	Item / Purposes of water use	Standard values				
		pH	Chemical Oxygen Demand (COD)	Dissolved Oxygen (DO)	Number of Coliform Groups[1]	N-hexane Extracts
A	Fishery, class 1 ; bathing ; conservation of natural environment, and uses listed in B—C	7.8—8.3	2 mg/ℓ or less	7.5 mg/ℓ or more	1,000 MPN/100 mℓ or less	Not detectable
B	Fishery, class 2 ; industrial water, and uses listed in C	7.8—8.3	3 mg/ℓ or less	5 mg/ℓ or more	—	Not detectable
C	Conservation of the environment	7.0—8.3	8 mg/ℓ or less	2 mg/ℓ or more	—	—

Notes : 1. With regard to the water quality of fishery, class 1 for cultivation of oysters, the number of coliform groups shall be less than 70 MPN/100 mℓ.

2. Conservation of natural environment—Conservation of scenic points and other natural resources.
3. Fishery, class 1—For aquatic life, such as red sea-bream, yellow tail, seaweed and for those of fishery class 2.
   Fishery, class 2—For aquatic life, such as gray mullet, laver, etc.
4. Conservation of the environment—Up to the limits at which no unpleasantness is caused to the people in their daily lives including a walk along the shore.

4. National Emission Standards

(1) Sulfur Oxides

a. Sulfur oxides emission standard

The emission standard for sulfur oxides which applies to a given sulfur oxides emitting facility may be calculated by inserting a value K, specified under Cabinet Order for the region that the facility is located, into the following equation :

$$q = K \times 10^{-3} \times He^2$$

Here, q is the hourly volume of sulfur oxides emitted (in unit of Nm^3) and He, effective height of stack, is the sum of actual height of stack and smoke ascent height. The value of K, which varies according to the region, inversely determines the degree of regulation. In other words, a reduction in K means stiffer control standard. The standard for sulfur oxides has hence been labeled the "K-value regulation."

The general emission standard for sulfur oxides (the K-value) was strengthened on September 28, 1976,and as a result all of Japan now controlled under sixteen K ranks ranging from 3.00 to 17.5.

b. Regulation on fuel

The regulation on fuel quality under the Article 15 of the Air Pollution Control Law was revised in September 1976. Asahikawa was added to the previous list of 14 areas (Tokyo, Osaka, etc.).

The regulation standards were upgraded to a sulfur content ranging from 0.5 to 1.2%.

Regulation of Sulfur Oxides Emission (K-value)

(a) General standards

	Area	K value
1	6 areas : Central Tokyo, Yokohama-kawasaki, Nagoya, Yokkaichi, Osaka-Sakai, Kobe-Amagasaki	3.0
2	21 areas : Chiba, Fuji, Kyoto, Himeji, Mizushima, Kitakyushu and others	3.5
3	1 area : Sapporo	4.0
4	4 areas : Hitachi, Kashima and others	4.5
5	3 areas : Toyama-Takaoka, Kure, Tōyo	5.0
6	9 areas : Annaka, Niigata, Okayama, Shimonoseki and others	6.0
7	3 areas : Tomakomai, Hachioji, Kasaoka	6.42
8	6 areas : Sendai, Fukui, Hiroshima and others	7.0
9	8 areas : Asahikawa, Utsunomiya, Mihara. Tokushima and others	8.0
10	8 areas : Akita, Kanazawa, Otsu, Fukuoka, Nagasaki and others	8.76
11	6 areas : Takasaki, Urawa, Narita, Naha and others	9.0
12	4 areas : Shizuoka, Sasebo and others	10.0
13	15 areas : Hakodate, Gifu, Takamatsu, Minamata and others	11.5
14	6 areas : Mishima, Kurume and others	13.0
15	20 areas : Aomori, Morioka, Yamagata, Nagano, Kagoshima and others	14.5
16	Others	17.5

(b) Special standards

6 areas :	Central Tokyo, Osaka-Sakai, Yokohama-Kawasaki, Kobe-Amagasaki, Yokkaichi, Nagoya	1.17
8 areas :	Chiba, Fuji, Himeji, Mizushima, Kitakyushu and others	1.75
14 areas :	Kashima, Toyama, Kyoto, Fukuyama, Ohmuta, Ōita and others	2.34

Note : Special standards are applied to newly constructed facilities only.

(2) Soot and Dust (Latest amendment, May 1982)

(Unit : g/Nm³)

Name of facility (excerpt)		Ordinary emission standard		Special emission standard		On
		Large scale	Small scale	Large scale	Small scale	
Boilers	Gas	0.05	0.10	0.03	0.05	5
	Oil	0.05 / 0.15	0.25 / 0.30	0.04 / 0.05	0.15 / 0.15	4
	Coal	0.10 / 0.20 / 0.30		0.05 / 0.10 / 0.15		6
Gas generating furnace		0.05		0.03		7
Blast furnace		0.05		0.03		Os
Cement kiln		0.10		0.05		10
Waste incinerator		0.15	0.50	0.08	0.15	12
Coke oven		0.15		0.10		7

Notes : 1. Prefectures may, by decree, set more stringent standards.

2. The gas emission rate of 40,000 Nm³/h is the criterion used for scale classification. However, heavy oil boilers and coal boilers are classified into four and three scales respectively. The criteria for the former ones are 200,000 Nm³/h, 40,000 Nm³/h, and 10,000 Nm³/h, and 200,000 Nm³/h and 40,000 Nm³/h are for the latter ones.

3. The emission concentration shall be converted through the following equation. (Except in the case of blast furnace)

$$C = \frac{21 - On}{21 - Os} Cs$$

C : Soot and dust emission concentration
On : Oxygen concentration in flue gas (set values in the above table)
Os : Actual oxygen concentration in flue gas
Cs : Actual soot and dust emission concentration

(3) Harmful Substances (June 22, 1971)

Substance	Facility	Standard value
Cadmium and its compound	Baking furnace and smelting furnace for manufacturing glass using cadmiun sulfide or cadmium carbonate as raw material	1.0 mg/Nm³
	Calcination furnace, sintering furnace, smelting furnace, converter and drying furnace for refining copper, lead or cadmium	
	Drying facility for manufacturing cadmium pigment, or cadmium carbonate	
Chlorine	Chlorine quick cooling facility for manufacturing chlorinated ethylene	30 mg/Nm³
	Dissolving tank for manufacturing ferric chloride	
	Reaction furnace for manufacturing activated carbon using zinc chloride	
	Reaction facility and absorbing facility for manufacturing chemical products	
Hydrogen chloride	Same as above	80mg/Nm³
	Waste incinerator	700 mg/Nm³
Fluorine, hydrogen fluoride, and silicon fluoride	Electrolytic furnace for smelting aluminium (Harmful substances are emitted from discharge outlet)	3.0 mg/Nm³
	Electrolytic furnace for smelting aluminium (Harmful substances are emitted from top)	1.0 mg/Nm³
	Baking furnace and smelting furnace for manufacturing glass using fluorite or sodium silicofluoride as raw material	10 mg/Nm³
	Reaction facility, concentrating facility and smelting furnace for manufacturing phosphoric acid	
	Condensing facility, absorbing facility and distilling facility for manufacturing phosphoric acid	
	Reaction facility, drying facility and baking furnace for manufacturing sodium tripoli-phosphate	
	Reaction furnace for manufacturing superphosphate of lime	15 mg/Nm³
	Baking furnace and open-hearth furnace for manufacturing phosphoric acid fertilizer	20 mg/Nm³
Lead and its compound	Calcination furnace, convertor, smelting furnace, and drying furnace for refining copper, lead, or zinc	10 mg/Nm³
	Sintering furnace and blast furnace for refining copper, lead or zinc	30 mg/Nm³
	Smelting furnace, etc. for secondary refining of lead, for manufacturing lead pipe, sheet, wire, lead storage battery or lead pigment	10 mg/Nm³
	Baking furnace and smelting furnace for manufacturing glass using lead oxides as raw materials	20 mg/Nm³

Note : Prefectures may, by decree, set more stringent standards.

(4) Nitrogen Oxides (as of Sept. 1983) (Abstract)

Type of facility		Stack gas volume (Unit : 1,000 Nm³/h)	Date of installation / On (%)	Standard value (ppm) before Aug. 9, 1973	after Aug. 10, 1973 before Dec. 9, 1975	after Dec. 10, 1975 before June 17, 1977	after June 18, 1977 before Aug. 9, 1979	after Aug. 10, 1979 before Sep. 9, 1983	after Sep. 10, 1983 before Mar. 31, 1987	after Apr. 1, 1987
Boiler	Gas firing	500 and above	5				60			
		100~500		130						
		40~100					100			
		10~ 40		150						
		5~ 10								
		less than 5		from Aug. 10, 1984 : 150						
	Solid material (including coal) firing	700 and above	6	400						200
		500~700		420			300			250
		200~500								
		40~200		450	350					
		5~ 40			380				350	
		less than 5		from Aug. 10, 1984 : 480			380			
	Liquid firing	500 and above	4				130			
		100~500		190	180					
		40~100					150			
		10~ 40		230						
		5~ 10		250						
		less than 5		from Aug. 10, 1984 : 250						
Sintering furnace (excluding pellet baking furnace)		100 and above	15	260				220		
		10~100		270						
		less than 10		300						
Calcination furnace			10	200				200		
Roasting furnace			14	250				220		
Blast furnace			15	120				100		
Metal melting furnace			12	200				180		

(contd.)

Type of facility	Stack gas volume (Unit : 1,000 Nm³/h)	Standard value (ppm)							
		Date of instal-ation / On (%)	before Aug. 9, 1973	after Aug. 10, 1973 before Dec. 9, 1975	after Dec. 10, 1975 before June 17, 1977	after June 18, 1977 before Aug. 9, 1979	after Aug. 10, 1979 before Sep. 9, 1983	after Sep. 10, 1983 before Mar. 31, 1987	after Apr. 1, 1987
Metal heating furnace	100 and above	11	160				100		
	40~100				150			130	
	10~ 40			170					
	5~10							150	
	less than 5			200				180	
Petroleum heating furnace	40 and above	6		170			100		
	10~ 40				150			130	
	5~ 10			180				150	
	less than 5			200				180	
Cement calcination furnace (excluding wet types)	100 and above	10		480				250	
	less than 100							350	
Baking furnace used for manufacturing refractories and fire bricks		18			450			400	
Melting furnace used for manufacturing plate glasses and glass fibers		15			400			360	
Drying furnace		16			250			230	
Waste incinerator (continuous type)	40 and above	12			300			250	
	less than 40								
Nitric acid production facility		Os				200			
Coke oven (excluding Otto type)	100 and above	7			200				
	less than 100		350				170		

Notes : 1. Reference to unit, the symbol "~" means "and above/less than" : e. g. a~b means a and above/less than b.

2. NOx emission concentration shall be converted through the following equation. (Except in the case of nitric acid production facilitie)

$$C = \frac{21-On}{21-Os} Cs$$

C : Nitrogen oxides emission concentration
On : Oxygen concentration in flue gas (set values in the above table)
Os : Actual oxygen concentration in flue gas
Cs : Actual nitrogen oxides emission concentration

(7) Permissible Limits of Motor Vehicle Exhaust Gas

					Application date: New model vehicle	Application date: Existing model vehicle	Standards (maximum permissible limits)
Gasoline-or LPG-fueled vehicle	Carbon monoxide (CO)	New vehicle	Control by driving cycle	4-mode	September 1, 1966	September 1, 1967	3.0% for gasoline-fueled ordinary-sized motor vehicle and small-sized motor vehicle
					September 1, 1969	January 1, 1970 April 1970**	2.5% for gasoline-fueled ordinary-sized motor vehicle and small-sized motor vehicle **for truck and bus
					January 1, 1971		1.5% for LPG-fueled ordinary-sized motor vehicle and small-sized motor vehicle 3.0% for light motor vehicle
				10-mode	April 1, 1973	December 1, 1973	26.0 g/km for gasoline-fueled passenger car, 18.0 g/km for LPG-fueled passenger car (all vehicles except heavy-duty vehicle)
				Gasoline 6-mode			1.6% for gasoline-fueled vehicle, 1.1% for LPG-fueled vehicle (heavy-duty vehicle)
				10-mode	April 1, 1975	December 1, 1975	2.7 g/km for passenger car, 17.0 g/km for truck and bus (all vehicles except heavy-duty vehicle)
				11-mode		(April 1975)	85.0 g/test for passenger car, 130.0 g/test for light-duty vehicle (all vehicles except heavy-duty veicle)
			Idling		August 1, 1970		4.5%
		Vehicle in use	Idling				5.5%
					October 1, 1972		4.5%
	Hydro-carbon (HC)	New vehicle	Blow-by gas control		September 1, 1970	January 1, 1971	Installation of blow-by gas recirculation device
			Fuel evaporative gas control		*July 1, 1972*	*April 1, 1973*	*Installation of fuel evaporative emission control device (2.0 g/test)*
			Control by driving cycle	10-mode	April 1, 1973	December, 1, 1973	3.8 g/km for gasoline-fueled vehicle, 3.2 g/km for LPG-fueled vehicle (all vehicles except heavy-duty vehicle), 22.5 g/km for mini-sized motor vehicle with two-stroke engine
				Gasoline 6-mode			520 ppm for gasoline-fueled vehicle, 440 ppm for LPG-fueled vehicle (heavy-duty vehicle)
				10-mode	April 1, 1975	December 1, 1975 (April 1, 1976)	0.39 g/km for passenger car, 2.7 g/km for truck and bus, 15.0 g/km for truck of mini-sized motor vehicle with two-stroke engine (all vehicles except heavy-duty vehicle)
				11-mode			9.5 g/test for passenger car, 17.0 g/test for truck and bus, 70.0 g/test for truck of mini-sized motor vehicle with two-stroke engine (all vehicles except heavy-duty vehicle)
		Vehicle in use	Device installation		May 1, 1973		Installation of HC/NOx reduction device and adjustment of spark timing
			Idling		January 1, 1975		1,200 ppm for passenger car and bus with four-stroke engine, 7,800 ppm for passenger car and bus with two-stroke engine, 3,300 ppm for passenger car and bus with special structure engine
					June 1, 1975		1,200 ppm for truck with four-stroke engine, 7,800 ppm for truck with two-stroke engine, 3,300 ppm for truck with special structure engine
	Nitrogen oxides (NOx)	New vehicle	Control by driving cycle	10-mode	April 1, 1973	December 1, 1973	3.0 g/km (all vehicles except heavy-duty vehicle) 0.5 g/km for mini-sized motor vehicle with two-stroke engine
				Gasoline 6-mode			2,200 ppm for heavy-duty vehicle
				10-mode	April 1, 1975	December 1, 1975 (April 1, 1976)	1.6 g/km for passenger car, 2.3 g/km for truck and bus, 0.5 g/km for mini-sized motor vehicle with two-stroke engine (all vehicles except heavy-duty vehicle)
				11-mode			11.0 g/test for passenger car, 20.0 g/test for truck and bus, 4.0 g/test for mini-sized motor vehicle with two-stroke engine (all vehicles except heavy-duty vehicle)

	NOx	New Vehicle		10-mode	April 1, 1976	March 1, 1977 (March 31, 1973)	0.84 g/km for passenger car with EIW of 1 ton or less, 1.2 g/km for passenger car with EIW of more than 1 ton and passenger car of mini-sized motor vehicle with fourstroke engine, 0.5 g/km for mini-sized motor vehicle with two-stroke engine
				11-mode			8.0 g/test for passenger car with EIW of 1 ton or less, 9. 0 g/test for passenger car with EIW or more than 1 ton and passenger car of light motor vehicle with fourstroke engine. 4.0 g/test for mini-sized motor vehicle with two-stroke engine
				Gasoline 6-mode	August 1, 1977	April 1, 1978	1,850 ppm for heavy-duty vehicle
				10-mode	April 1, 1978 (April 1, 1981)	March 1, 1979 (April 1, 1981)	0.48 g/km for passenger car
				11-mode			6.0 g/test for passenger car
			Control by driving cycle	10-mode	January 1, 1979 (April 1, 1981)	December 1, 1979 (April 1, 1981)	1.4 g/km for truck and bus (light-duty vehicle) 1.6 g/km for truck and bus (medium-duty vehicle and mini-sized motor vehicle)
				11-mode			10 g/test for truck and bus (light-duty vecicle) 11 g/test for truck and bus (medium-duty vehicle and mini-sized motor vehicle)
				Gasoline 6-mode			1,390 ppm for truck and bus (heavy-duty vehicle)
				10-mode	January 1, 1981 (April 1, 1983)	December 1, 1981 (April 1, 1983)	0.84 g/km for truck and bus (light-duty vehicle)
				11-mode			8.0 g/test for truck and bus (light-duty vehicle)
				10-mode	December 1, 1981 (April 1, 1984)	November 1, 1982 (April 1, 1984)	1.26 g/km for truck and bus (medium-duty vehicle)
				11-mode			9.5 g/test for truck and bus (medium-duty vehicle)
				10-mode	January 1, 1982 (April 1, 1984)	December 1, 1982 (April 1, 1984)	1.26 g/km for mini-sized motor vehicle with four stroke engine
				11-mode			95 g/km for mini-size motor vehicle with four stroke engine
				Gasoline 6- mode			990 ppm for heavy-vehicle
		Vehicle in use	Device installation		May 1, 1973		Installation of HC/NOx reduction device and adjustmant of spark timing
Diesel-powered vehicle	CO, HC NOx	New vehicle	Control by driving cycle	Diesel 6-mode	September 1, 1974	April 1, 1975	CO 980 ppm HC 670 ppm NOx 590 ppm (1,000 ppm for direct injection type)
	NOx				August 1, 1977	April 1, 1978	500 ppm (850 ppm for direct injection type)
					(April 1, 1981)	Mahch 1, 1980 (April 1, 1981)	450 ppm (700 ppm for direct injection type)
					Janualy 1, 1982 (April 1, 1984)	December 1, 1982 (April 1, 1984)	390 ppm for IDI passenger car
					October 1, 1982 (April 1, 1984)	September 1, 1983 (April 1, 1984)	390 ppm for IDI vecicle
					August 1983 (April 1, 1985)	July 1, 1984 (April 1, 1985)	610 ppm for DI vehicle
	CO, HC NOx			10-mode	October 1, 1986 (April 1, 1988)	September 1, 1987 (April 1, 1988)	CO : 2.7 g/km HC : 0.62 g/km NOx : 0.98 g/km (EIW of 1,250 kg or less) 1.26 g/km (EIW of more than 1,250 kg) — Passenger car with manual transmission
					October 1, 1987 (April 1, 1989)	September 1, 1988 (April 1, 1989)	passenger car with automatic transmission
	Particulates (Diesel smoke)	New vehicle	Full-load test		July 1, 1972		Rate of contamination 50 %
			No-load acceleration test		January 1, 1975		

5. National Effluent Standards (June 21, 1971 ; Amendments 1974, 1975, 1976, 1977, 1981, 1985, 1986)

(1) Substances related to the Protection of Human Health[1]

Toxic substances	Permissible limits
cadmium and its compounds	0.1 mg/ ℓ
Cyanide compounds	1 mg/ ℓ
Organic phosphorus compounds (parathion, methyl parathion, methyl dimethon and EPN only)	1 mg/ ℓ
Lead and its compounds	1 mg/ ℓ
Hexavalent chrome compounds	0.5 mg/ ℓ
Arsenic and its compounds	0.5 mg/ ℓ
Total mercury	0.005 mg/ ℓ
Alkyl mercury compounds	Not detectable[2]
PCB	0.003 mg/ ℓ
Trichloroethylene	0.3 mg/ ℓ
Tetrachloroethylene	0.1 mg/ ℓ

Notes : 1. Prefectures may, by decree, set more stringent standards.
2. By the term "not detectable" is meant that the substance is below the level detectable by the method designated by the Director-General of the Environment Agency

(2) Items related to the Protection of Living Environment[1),2)]

Item	Permissible limits
pH	5.8~8.6 for effluent discharged into public water bodies other than coastal waters 5.0~9.0 for effluent discharged into coastal waters
BOD, COD[3)]	160 mg/ℓ (daily average 120 mg/ℓ)
SS	200 mg/ℓ (daily average 150 mg/ℓ)
N-hexane extracts	5 mg/ℓ (mineral oil) 30 mg/ℓ (animal fat and vegetable oil)
Phenols	5 mg/ℓ
Copper	3 mg/ℓ
Zinc	5 mg/ℓ
Dissolved iron	10 mg/ℓ
Dissolved manganese	10 mg/ℓ
Chrome	2 mg/ℓ
Fluorine	15 mg/ℓ
Number of coliform groups (per cc)	3,000 (daily average)
Nitrogen[4)]	120 mg/ℓ (daily average 60 mg/ℓ)
Phosphorus[4)]	16mg/ℓ (daily average 8mg/ℓ)

Notes : 1. Prefectures may, by decree, set more stringent standards.

2. The standard values in this table are applied to the effluents from industrial plants and other places of business whose volume of effluents per day is not less than $50m^3$.

3. The standard value for BOD are applied to public waters other than coastal waters and lakes, while standard value for COD is applied only to effluents discharged into coastal waters and lakes.

4. Standard values for nitrogen and phosphorus are applied to lakes and reservoirs in which problems due to eutrophication may occur.

The phosphorus standards are applicable to lakes and reservoirs where water stays for 4 days or longer (excluding those with a chlorine ion content of more than 9,000 mg/ℓ and those where special dam operations are conducted) out of lakes and reservoirs with a drainage area of more than 1 Km^2 and a total surface area of more than 0.1 Km^2 (this limitation does not apply to lakes and reservoirs used as source of tap water). Also covered are rivers and other water bodies designated as "public water areas" flowing into the above lakes and reservoirs.

The nitrogen standards are applicable to lakes and reservoirs where the figure obtained by dividing the nitrogen content of water by the phosphorus content is less than 20 and the phosphorus content of water exceeds 0.02 mg/ℓ out of the lakes and reservoirs subject to the phosphorus regulation. Also covered are rivers and other water bodies designated as public water areas flowing into those lakes and reservoirs.

〔表a〕

各国の水道水の水質基準

	日本	WHO	アメリカ	フランス	ソ連
アンモニア性窒素	同時に検出してはならない	0.5ppm	―	―	―
亜硝酸性窒素		―	―	―	―
硝酸性窒素	10ppm以下	40 (80) ppm	45ppm 硝酸性窒素として	10ppm	―
塩素イオン	200ppm以下	200 (400) ppm	250ppm	250ppm	―
有機物など（過マンガン酸カリ消費量）	10ppm以下	10ppm	―	―	―
一般細菌数	1cc中100以下	―	―	―	―
大腸菌群	50cc中検出せず	年間を通じて試験数10%以下	月間の陽性管数10%以下	陰性	―
シアン（化合物）	検出せず	0.01ppm	0.01 (0.2) ppm	0	0.1ppm
水銀	検出せず	―	0.05ppm	―	0.05ppm
有機燐	検出せず	―	―	―	―
銅	1.0ppm以下	1.0ppm	1.0ppm	0.05ppm	0.1ppm
鉄	0.3ppm以下	0.3 (1.0) ppm以下	0.3ppm	0.1ppm	0.5ppm
弗素	0.8ppm以下	1.0 (1.5) ppm	0.7～1.2(1.4～2.4)ppm	1.0ppm	1.5ppm
鉛	0.1ppm以下	0.1ppm	(0.05ppm)	0.05ppm	0.1ppm
亜鉛	1.0ppm以下	5.0 (15.0) ppm	5.0ppm	5.0ppm	1.0ppm
クロム	0.05ppm以下	0.05ppm	(0.05ppm)	―	0.1ppm
砒素	0.05ppm以下	0.2ppm	0.01 (0.05) ppm	0.05ppm	0.05ppm
マンガン	0.3ppm以下	0.1 (0.5) ppm	0.05ppm	0.05ppm	―
フェノール類	0.005ppm以下	0.001 (0.002) ppm	0.001ppm	0.001ppm	0.001ppm
カルシウム	―	75 (200) ppm	―	―	―
マグネシウム	―	50 (150) ppm	―	125ppm	―
総硬度	300ppm以下 炭酸カルシウムとして	100～500ppm	―	―	―
水素イオン濃度	5.8～8.6	7.0～8.5 (6.5～9.2)	―	―	―
臭気	異常があってはならない	―	3度	―	―
味	異常があってはならない	―	異常でないこと	―	―
色度	5度以下	―	15度	―	―
濁度	2度以下	―	5度	―	―
蒸発残留物	500ppm以下	―	500 (1 000) ppm	―	―
硫酸イオン	―	200 (400) ppm	250ppm	250ppm	―
セレニウム	―	0.05ppm	(0.01ppm)	―	0.01ppm
バリウム	―	―	(1.0ppm)	―	4.0ppm
カドミウム	(0.01ppm)	0.01ppm	(0.01ppm)	―	0.01ppm
ABS(アルキルベンゼンスルホネート)陰イオン活性剤	0.5ppm以下	―	0.5ppm	―	―
放射能	科学技術庁告示による水中 3 000μμc/ℓ	α線 10^{-9} μc/mℓ β線 10^{-8} μc/mℓ	年間 Ra 225μμc/ℓ Sr90 10μμc/ℓ		―
遊離残留塩素	0.1ppm以上	―	0.05～0.1ppm	0.1ppm以下	検出されてはならない

注 ( )内は暫定基準

〔表a〕

各国の水道水の水質基準

	日本	WHO	アメリカ	フランス	ソ連
アンモニア性窒素	同時に検出してはならない	0.5ppm	——	——	——
亜硝酸性窒素		——	——	——	——
硝酸性窒素	10ppm以下	40 (80) ppm	45ppm硝酸として	10ppm	——
塩素イオン	200ppm以下	200 (400) ppm	250ppm	250ppm	——
有機物など(過マンガン酸カリ消費量)	10ppm以下	10ppm	——	——	——
一般細菌数	1cc中100以下	——	——	——	——
大腸菌群	50cc中検出せず	年間を通じて陽性数10%以下	月間の陽性管数10%以下	陰性	——
シアン(化合物)	検出せず	0.01ppm	0.01 (0.2) ppm	0	0.1ppm
水銀	検出せず	——	0.05ppm	——	0.05ppm
有機燐	検出せず	——	——	——	——
銅	1.0ppm以下	1.0ppm	1.0ppm	0.05ppm	0.1ppm
鉄	0.3ppm以下	0.3 (1.0) ppm以下	0.3ppm	0.1ppm	0.5ppm
弗素	0.8ppm以下	1.0 (1.5) ppm	0.7~1.2(1.4~2.4)ppm	1.0ppm	1.5ppm
鉛	0.1ppm以下	0.1ppm	(0.05ppm)	0.05ppm	0.1ppm
亜鉛	1.0ppm以下	5.0 (15.0) ppm	5.0ppm	5.0ppm	1.0ppm
クロム	0.05ppm以下	0.05ppm	(0.05ppm)	——	0.1ppm
砒素	0.05ppm以下	0.2ppm	0.01 (0.05) ppm	0.05ppm	0.05ppm
マンガン	0.3ppm以下	0.1 (0.5) ppm	0.05ppm	0.05ppm	——
フェノール類	0.005ppm以下	0.001 (0.002) ppm	0.001ppm	0.001ppm	0.001ppm
カルシウム	——	75 (200) ppm	——	——	——
マグネシウム	——	50 (150) ppm	——	125ppm	——
総硬度	300ppm以下 炭酸カルシウムとして	100~500ppm	——	——	——
水素イオン濃度	5.8~8.6	7.0~8.5 (6.5~9.2)	——	——	——
臭気	異常があってはならない	——	3度	——	——
味	異常があってはならない	——	異常でないこと	——	——
色度	5度以下	——	15度	——	——
濁度	2度以下	——	5度	——	——
蒸発残留物	500ppm以下	——	500 (1 000) ppm	——	——
硫酸イオン	——	200 (400) ppm	250ppm	250ppm	——
セレニウム	——	0.05ppm	(0.01ppm)	——	0.01ppm
バリウム	——	——	(1.0ppm)	——	4.0ppm
カドミウム	(0.01ppm)	0.01ppm	(0.01ppm)	——	0.01ppm
ABS(アルキルベンゼンスルホネート)陰イオン活性剤	0.5ppm以下	——	0.5ppm	——	——
放射能	(対策指針レベル 天水中 3 000μμc/ℓ)	α線 $10^{-9}\mu c/m\ell$ β線 $10^{-8}\mu c/m\ell$	年間 Ra 225μμc/ℓ Sr90 10μμc/ℓ	——	——
遊離残留塩素	0.1ppm以上	——	0.05~0.1ppm	0.1ppm以下	検出されてはならない

注 ( )内は暫定基準

ナイル水系

RIVER NILE WATER QUALITY MONITORING

By

Eng. A. El Sherbini *
Dr. M. El-Moattassem **

INTRODUCTION

The rate of discharge of waste products into the River Nile is increasing rapidly. Because of this and the growing demand for water, its water quality is becoming of major importance.

It is evident that water pollution is affecting the use of water, and in some instances, limiting the utilization of important sources of supply. Hence, there is a growing concern about the water quality. This concern has highlighted the need to maintain and control the water quality of the River Nile. Monitoring is the first step in water quality management and pollution control. Therefore, the High Aswan Dam Side Effects Research Institute (HADSERI) has carried out a monitoring program for the River Nile since 1976. The data analysis has indicated that the River Nile from Aswan to the Mediterranean sea is suffering from the problem of pollution in some locations. This result has highlighted the very important need to establish a permanent water quality monitoring program along the River Nile.

In this paper, the water quality monitoring program undertaken by HADSERI since 1976, some data analysis using the Water Quality Index (WQI) for 1977 and 1986, and the new approach of the permanent water quality monitoring program for the River Nile from Aswan to the Mediterranean Sea, are presented.

PREVIOUS WORKS ON RIVER NILE WATER QUALITY MONITORING

Before 1976, the water quality data were incomplete and did not meet the standard requirements. Therefore, the High Aswan Dam Side Effects Research Institute (HADSERI), Ministry of Public Works and Water Resources, with Ministry of Health started the program for monitoring the pollutants along the River Nile from Aswan to the Mediterranean Sea from 1976 to 1986. Added to that, special programs were also carried out between HADSERI and the Water and Soil

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Sciences Department, Faculty of Agriculture, Alexandria University, for specific water quality studies on the Rosetta and Damietta branches in 1987 and 1989.

Therefore, in order to know the present-day situation and to use it as a basis for future estimations concerning the Nile water quality, the fundamental information from any water quality monitoring program should include:

a. The quantity and quality of the main water flowing in the Nile and its branches.

b. The quantity and quality of the wastewater discharging into the River Nile from Aswan to the Mediterranean Sea.

The monitoring programs have been carried out by a group of specialists from HADSERI with either the Ministry of Health or the University of Alexandria between 1976 to 1989.

The Program Objectives

The main objective of the program for monitoring the pollutants along the River Nile between 1976 and 1986 was to evaluate the River Nile water quality and the effects of pollutants on the water quality in its different uses.

In 1987, the objective of the sampling program on the Rosetta Branch was to study water quality changes during the closure period (high flow) in connection with future projects for the storage of the surplus water in the Northern Lakes.

In 1989, the objectives of the sampling program on the Rosetta and Damietta Branches were as follows:

- to evaluate the water quality of the Rosetta and Damietta Branches with respect to time and space,
- to evaluate the water quality and quantity of all point sources of pollution located along the two branches,
- to evaluate the quality of the water of the two branches for the different uses, and
- to calculate the quantity of surplus water to be stored in the Northern Lakes.

The Program Frequency

The water quality monitoring program along the River Nile with the Ministry of Health was conducted is two periods. During the first period between 1976 and 1979, the program was conducted once a year between HADSERI and the Centeral Laboratories of the Ministry of Health. However, the analysis of the available data showed that the purity of the water changes along the River Nile with time, from year to year. Therefore, the second period of the program was expected to be repeated twice a year during a period of five years in order to set a clear picture of the Nile water and to enable a future projection for changes in the water quality along the River Nile from Aswan to the Mediterranean Sea. However, this program was also conducted between HADSERI and the Occupational and Environmental Health Center of the Ministry of Health, and was carried out twice during 1984 and once a year in 1985 and 1986.

The River Nile, between Aswan and the Delta Barrages, had eight campaigns conducted on it during the following months (dates and durations are detailed in Table 1):

Table 1
Dates of Sampling Campaigns
from Aswan to Delta Barrages

Year	Period From	To	Number of Working Days (All Sampling Points)
1976	22nd June	3rd July	10
1977	11th October	22nd October	12
1978	11th August	23rd August	13
1979	19th March	30th March	12
1984 Mar.	1st March	15th March	15
1984 Nov.	21st October	9th November	18
1985	21st July	3rd August	14
1986	14th September	27 September	14

Rosetta and Damietta Branches had four sampling campaigns between 1984 and 1986. The four sampling campaigns were done during the following months (dates, durations are detailed in Table 2).

Table 2
Dates of Sampling Campaigns

a) Rosetta Branch

Year		Period From	To	Number of Working Days (All Sampling Points)
1984	(1st run)	23rd June	25th June	3
	(2nd run)	29th August	3rd September	5
1985		23rd August	25th August	3
1986		20th October	22nd October	3

b) <u>Damietta Branch</u>

Year		Period From	To	Number of Working Days (All Sampling Points)
1984	(1st run)	30th April	6th May	7*
	(2nd run)	18th August	22nd August	5
1985		19 August	22nd August	4
1986		15th October	19th October	5

* It has two days off.

In 1987, the sampling campaign included two runs on the Rosetta Branch. The first run was done in January during the high flow regime (closure period). The second run was done in April during the low flow period. Table 3 shows the number and periods of sampling campaigns on the Rosetta Branch.

Table 3
Dates of Sampling Campaigns

Year		Period From	To	Number of Working Days (All Sampling Points)
1987	(1st run)	19th January	24th January	6
	(2nd run)	23rd April	25th April	3

In 1989, the sampling campaign included five runs on the Rosetta Branch which are as follows: before the beginning of the high flow, during the increasing stage of the high flow, at the peak flow, during the decreasing stage, and at the low flow. In addition to these six separate runs were done for all point sources of pollution located along the Rosetta Branch. Table 4 indicates the number and periods of sampling campaign on the Rosetta Branch.

Table 4
Dates of Sampling Campaigns

a) <u>For all Sites along Rosetta Branch</u>

Year		Period From	To	Number of Working Days
1989	(1st run)	2nd January	6th January	5
	2nd run	12th January	17th January	6
	3rd run	20th January	24th January	5
	4th run	10th February	13th February	3**
	5th run	24th May	28th May	5

** Not all samples were taken

b) For all Point Sources Along Rosetta Branch

Year	Period From	To	Number of Working Days
1989 (1st run)	2nd January	4th January	3
2nd run	12th January	14th January	3
3rd run	22nd January	24th January	3
4th run	1st February	2nd February	2
5th run	12th February	12th February	1**
6th run	25th May	27th May	3

The sampling campaign for 1989 also included two runs on the Damietta Branch. Table 5 shows the number and periods of sampling campaigns on the Damietta Branch.

Table 5
Dates of Sampling Campaigns
Damietta Branch

Year	Period From	To	Number of Working Days (All Sampling Points)
1989 (1st run)	5th February	8th February	4
2nd run	30th May	31th February	2

The Program Sampling Locations

The intensity of these water quality sampling campaigns essentially lies in the space domain rather than in the time domain.

In the River Nile from Aswan to the Delta Barrages (distance 952 km), there is a network of 398 sampling points. These sampling points are of two categories:

The first category consists of sampling points that are located along the River Nile itself. There are 270 sampling sites in the river, out of the 398 points of the network. These sampling sites are located in sectors, every 10 kilometers, and within 200 meters upstream and downstream of all the discharging points.

The second category consists of sampling points that correspond to a source of discharging wastes into the River Nile. There is a total of 128 sampling points. These sampling points are located at the mouth of the agricultural drains. There are 72 agricultural drains discharging into the Nile between Aswan and the Delta Barrages. These drains collect the excess irrigation water from cultivated lands and return it to the River Nile. It has been recognized that many of these drains receive municipal or industrial effluents as well. Figure 1 shows the distribution of the agricultural drains along the River Nile.

There are 56 sampling points representing the discharge of industrial or municipal effuents. Figure 2 shows the distribution of all the industrial effluents along the River Nile.

Not all of the 398 sampling points of the network were sampled in every campaign. Table 6 shows the total number of sampling points that were sampled in each campaign from Aswan to the Delta Barrages.

Table 6
Number of Sampling Points Per Campaign

Year	Sampling Points in the River	Sampling Points for all Point Sources of Pollution
1976	88	43
1977	142	48
1978	153	70
1979	110	73
1984 Mar.	158	71
1984 Nov.	176	66
1985	193	72
1986	203	82

Along the Rosetta and Damietta Branches, 35 sampling points were considered on the Rosetta Branch for the sampling campaigns of 1984, 1985, 1986 and 1987. These included 27 sites in the Branch itself and 8 sampling points located at the mouth of the agricultural drains or at the industrial out-falls. Similarly, for the Damietta Branch, 31 sampling points were considered. These included 25 sites in the Branch itself and 6 sampling points located at the mouth of the agricultural drains or at the industrial outfalls. The number of points that were sampled varied from one campaign to another, because not all sites are sampled in each campaign. Table 7 indicates the number of points sampled per campaign.

Table 7
Number of Sampling Points Per Campaign

Year	Rosetta Branch		Damietta Branch	
	Branch	Point Source	Branch	Point Source
1984 Mar.	25	7	22	3
1984 Nov.	24	6	20	3
1985	16	6	18	3
1986	21	8	22	3
1987	19	8	—	—

For the 1989 sampling campaign, the network of sampling points was modified on the Rosetta Branch - 27 sampling points were considered. These included 19 sites in the branch itself and 8 sampling points located at the mouth of the agricultural drains or at the industrial outfalls. On the Damietta Branch, 18 sampling points were considered. These included 12 sites in the branch itself and 6 sampling points located at the mouth of the agricultural drains or at the industrial outfalls.

In general, the sampling sites along the two branches are located downstream of major point sources and downstream of big towns or cities.

The Program Parameters

All samples collected during the eight campaigns for the River Nile from Aswan to the Delta Barrages between 1979 and 1986 were analyzed for the following parameters: pH-value, temperature, conductivity, dissolved oxygen, carbon dioxide, ammonia, nitrite, nitrate, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids, ash of total dissolved solids, suspended matter, ash of suspended matter, total alkalinity, total hardness, calcium hardness, magnesium hardness, major anions and cations, oil and grease, phosphates, carbonates, sulfur and fecal coliforms. In addition, in 1986, determination of five heavy metals was added to the above mentioned parameters for the agricultural drains and some industrial effluents only.

On the Rosetta and Damietta Branches, all samples collected during the four campaigns for 1984, 1985 and 1986 were analyzed for the same parameters measured in the River Nile from Aswan to Delta Barrages as mentioned above.

Results on each of the above parameters were all obtained for composite samples over the cross section and all point sources of pollution.

For the 1987 and 1989 campaigns, two major differences must be pointed out referring to the program parameters.

1) In addition to the above mentioned parameters, laboratory analyses also included pesticides and heavy metals.

2) Water quality results were not only obtained for a composite sample over the cross section, but also for depth integrated samples taken at various locations in the lateral direction.

Field Procedures

The field sampling procedures that were followed from 1976 to 1986 through the water quality monitoring program along the River Nile from Aswan to the Mediterranean Sea were:

a) At each sampling site in the river, a composite sample was obtained over the cross section by mixing the grab samples taken at 50 cm below the surface and at 70 cm above the bed, this being done at three locations in the lateral direction, i.e., at 50 meters from each bank, and at the middle (Figure 3-a).

b) A grab sample was taken from all point sources at the middle of the source.

c) Depths and flow velocities were measured at the three sampling locations along the cross section.

d) The grab samples were mixed on the boat to form the composite samples.

Temperature, pH-values, dissolved oxygen and conductivity were determined in the boat as in-situ parameters.

e) Part of the composite samples were sent to the nearest regional laboratories for analyzing BOD, COD and coliforms; the rest of the samples were periodically sent by car to the laboratory in Cairo.

In the 1987 sampling campaign, at the three locations in the lateral direction, the surface and subsurface samples at each location were analyzed separately.

In the 1989 sampling campaign, two types of water samples were collected as follows:

- vertical integrated samples were collected from certain locations in the river. From three to five vertical integrated samples were collected at each sampling site (Figure 3-b).

- composite water samples were formed from the vertical integrated samples for each site.

Therefore, from four to six water samples were analyzed at each sampling site.

HADSERI data analyses, from previous years, through reports and bulletins, indicated that the River Nile and its branches could be facing pollution problems in some locations. Different methods of analyses were used to present the work. One of these methods is the Water Quality Index (WQI), which is used as measuring tool to indicate to some extent the locations suffering from pollution. The WQI is calculated, by very simple equations for 1977 and 1986, to study the changes in the water quality along the River Nile from

Aswan to the Delta Barrages over a period of about ten years, and to indicate the pollution problems along the river.

WATER QUALITY INDEX FOR 1977 AND 1986

The water quality index, is a numerical number, calculated from ten major parameters affecting the quality of the water in the river, by using a very simple equation in order to indicate the purity of the water along river. The equation used is:

$$WQI\ \% = \frac{10 - \sum_{i=1}^{10} P_i}{10} \times 100$$

Where:

WQI = Percentage of Water Quality Index

$$P_i = \frac{\text{Actual measurement for ith parameter}}{\text{Standard value for ith parameter}}$$

The parameters used in calculating the water quality index for the River Nile are: temperature, pH-value, dissolved oxygen, biochemical oxygen demand, total dissolved solids, suspended matter, phosphates, nitrates, ammonia and fecal coliform.

Results and Discussion

The study was done in 1977 and 1986 because the samples were taken in both years in late summer. Therefore, Figure 4 reveals many interesting features regarding the quality of water of the River Nile with respect to time and space.

It is observed that the water quality index along the River Nile from Aswan to the Delta Barrages in 1977 was always high. The maximum value was 97.590, and the minimum value was 5%. In this year the water quality index along the River Nile fluctuates almost in the range between 20 to 50%. This means that the water of the River Nile in 1977 was relatively good during the time of sampling.

In 1986, it is observed that the water quality index along the River Nile fluctuates between 0 and 46%, but almost in the range between 5% and 25%. The maximum value was 46%, and the minimum value was below 0 in some locations along the river. This means that the water quality of the river is deteriorating in some locations due to the discharge of the wastes from polluted effluents, either from industrial outfalls or from agricultural drains.

Overall, the water quality index along the River Nile from Aswan to the Delta Barrages in 1986 was lower than 1977 and the water quality of the River Nile is deteriorating with time in some critical locations.

General conclusions were drawn from all of HADSERI's work and research that the River Nile is suffering from pollution problems in some locations due to the discharging of wastes directly into the River without any or little treatment, and that the water quality of the River Nile is deteriorating with time. Therefore, the main recommendation introduced into this research work, is the important need to establish a permanent water quality monitoring program for the River Nile from Aswan to the Mediterranean Sea.

However, through the cooperation between the Ministry of Public Works and Water Resources (MOPWWR) and the Canadian International Development Agency (CIDA), the River Nile Protection and Development Project (RNPD) began in March 1988 to operate within HADSERI one of the main RNPD Project areas - the Water Quality Management and Pollution Control Division. In addition, one of the main targets in the water quality division, is the design of a permanent water quality monitoring program for the River Nile from Aswan to the Mediterranean sea supported by the new HADSERI water quality laboratory. This laboratory is one of the main achievements of the RNPD project.

THE NEW APPROACH

The new approach is a permanent water quality monitoring program prepared by the Water Quality Division within HADSERI to satisfy the following objectives.

The Program Sampling Objectives

- To serve as a general reference for water quality conditions in the whole river.
- To detect stream standard violations and maintain effluent standard.
- To determine the quantitive seasonal variations of the water quality in the river and the point sources.

The Program Sampling Locations

The location of the permanent sampling station is probably the most critical factor in designing a monitoring program for water quality.

The River Nile system will be divided into four main reaches in addition to the branches as follows:

- The reach from Aswan to Esna Barrage (0-167 km)
- The reach from Esna Barrage to Naga Hammadi Barrage (167 -359 km)

- The reach from Naga Hammadi Barrage to Assuit Barrage (362 - 544 km)
- The reach from Assuit Barrage to Delta Barrages (544 -952 km)
- The Rosetta Branch, and
- The Damietta Branch.

Along the River Nile from Aswan to the Mediterranean Sea, there are thirty-four sampling stations (Figure 5). The number and the location of the sampling sites are determined in order to meet the following needs:

- The need for minimizing the sampling effort so that a maximum of spatial information can be obtained while minimizing the number of sampling sites, and

- The need for giving more attention and getting comprehensive information at specific sites for control purposes and/or due to important point sources of pollution.

Priority was given to twelve major sites out of the thirty-four sites. These twelve sites were selected with respect to the barrages, the major industrial areas, intensive agricultural areas and big cities (Figure 5).

The other twenty-two sites are selected at fixed, well known points along the River Nile in order to fill the gaps between the major sites and to present different stages along the river.

In addition to the thirty-four sampling sites, all the point sources of pollution will be sampled (Figures 1 and 2).

<u>The Program Parameters</u>

Parameters measured by the water quality monitoring program are highly dependent upon the objectives, basin characteristics and the budget required.

A group of basic parameters will be measured in all samples (i.e., in the river or point sources) in addition to some specific parameters depending on the type of effluents and the importance of the site.

Table 8
Parameter Listing for River Nile Monitoring Program

All Samples (Basic Parameters)	Major River Sites(12)	All Agr. Drains	All Ind. Outfalls	All Sites**
* pH-value	All parameters	Calcium	Sulfide	Algal Density
* Temperature		Magnesium	Acidity	Chlorophyll"a"
* Conductivity		Sodium	Calcium	
* Dissolved Oxygen		Potassium	Magnesium	
* Total Alkalinity		Oil and Grease	Sodium	
* Turbidity		Phenols	Potassium	
Kjeldahl Nitrogen		Pesticides	Oil and Grease	
Ammonia (dissolved)		Surfactant	Phenols	
Nitrite (dissolved)		Total Copper	Surfactant	
Nitrate (dissolved)		Total Chromium	Total Copper	
Ortho-phosphorus		Total Lead	Total Lead	
Total phosphorus		Total Zinc	Total Zinc	
Biochemical Oxygen Demand			Total Chromium	
Chemical Oxygen Demand			Total Arsenic	

* Field parameters
** Should also include temp, dissolved oxygen, conductivity profile at mid-channel.

Table 8 (Cont'd)

All Samples (Basic Parameters)	Major River Sites(12)	All Agr. Drains	All Ind. Outfalls	All Sites**
Total Suspended Solids			Total Mercury	
Total Dissolved Solids			Total Cadmium	
Chloride			Iron	
Sulfates			Manganese	
Carbonates			Cyanide	
Bicarbonates			Total Nickel	
E-Coli				
Fecal Coliform				

A list of the major agriculture or industrial effluents is determined by taking into consideration the type and concentration of pollutants, waste load and some other specific criteria such as location and area served for agricultural drains and type of industry for industrial outfalls.

<u>The Program Frequency</u>

The sampling frequency at each permanent sampling station within a river basin is a very important consideration in the design of a water quality monitoring program.

In the case of the River Nile, constant frequencies overall at stations and samples from point sources may be the only practical means to implement a sampling program.

The sampling frequencies are planned to be in three stages as follows:

Short-term (1 year):

- Twice a year for all river sites (34) and the major point sources of pollution
- Once a year for minor point sources of pollution
- Monthly for four river sites which are:
  upstream of the High Aswan Dam

- upstream of the Delta Barrages
- upstream of the Edfina Barrage
- upstream of Damietta Dam

Medium-term (2 years):

- Four times a year for all river sites (34) and the major point sources of pollution
- Twice a year for the minor point sources of pollution
- Monthly for the four river sites as mentioned in the short-term

Long-term (3 years and above):

In addition to the medium-term work, special studies could be done for specific areas or certain drains, or modelling purposes, or on the bottom sediment for the major sites.

The seasonal sampling would be adjusted according to the thermograph.

Field Procedures

In order to get representative sampling sites, some general recommendations are to be followed:

- At any site a, b, c, etc., depth integrated samples (from three to five samples) will be taken. Composite samples will be formed from all the integrated samples taking into consideration the depth adjustment for the volume being contributed to the composite for each point in the cross section. The number of cross sectional sampling points could be expanded beyond five if there is a considerable number of points source inflows upstream of the sampling site (Figure 6).

- Field, biological, and bacteriological measurements will be determined in all vertical integrated samples for all sites. The rest of the measurements will be conducted on the composite samples for all samples in the laboratory.

- Flow velocity measurements will be obtained in the lateral direction at each sampling point at six-tenths of the depth measured from the water surface.

- A grab sample will be taken from all point sources and flow velocity measurements will be obtained.

CONCLUSIONS

The River Nile can be considered as one of the most important rivers in the world. Within Egypt, the Nile is a major water resource and is consequently subjected to multiple use.

In Egypt, a variety of waste effluents and run-off are frequently discharged directly into the Nile at several locations along the river. Therefore, the High Aswan Dam Side Effects Research Institute, has taken the responsibility of maintaining and controlling the quality of the water in the River Nile since 1976.

The Institute has undertaken a monitoring program with the Ministry of Health from 1976 to 1986. It has also done specific studies on the Rosetta and Damietta Branches in ,1987 and 1989 with Alexandria University.

The Institute had done much research on the available data by using different methods of analysis. One of these methods is the Water Quality Index (WQI) which is used as measuring tool to indicate the purity of the water. The Water Quality Index for 1977 and 1986 is calculated by using a simple equation to indicate the pollution problems along the river over that period of time. This study shows that the water quality is deteriorating in some locations along the river and is deteriorating also with time due to the increase in discharging wastes, without any or little treatment, to the river. These conclusions lead to the importance of establishing a permanent water quality monitoring program along the River Nile from Aswan to the Mediterranean Sea in order to achieve the following objectives:

- To serve as general reference for water quality conditions in the whole river.
- To detect stream standard violations and maintain effluent standards.
- To determine the quantitative seasonal variations of the water quality in the river and point sources of pollution.

Thirty-four sampling sites were selected along the River Nile from Aswan to the Mediterranean Sea and priorities were given to twelve sites as major sites with respect to barrage locations and heavy polluted areas. In addition to that, samples from all points sources of pollution were undertaken.

A list of basic parameters was determined that would be measured in all samples in addition to some specific parameters to be added to specific samples according to the type of pollutants and the importance of the site.

Sampling frequency was designed for three stages taking into consideration the seasonal variations according to the thermograph.

The permanent water quality monitoring program will be supported by the new HADSERI water quality laboratory.

Continued cooperation between HADSERI and other agencies is recommended to satisfy the permanent water quality monitoring program requirements, which are beyond the capabilities of the new HADSERI water quality laboratory.

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AGRICULTRAL DRAINS ON RIVER NILE

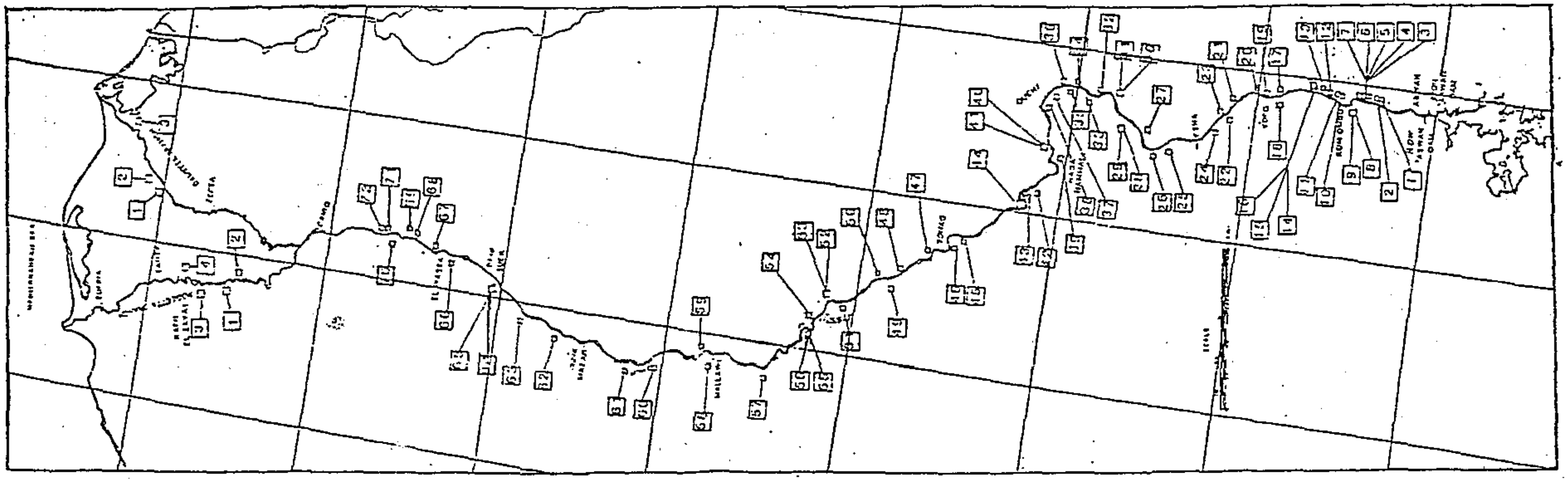


FIGURE 1

LEGEND

☐ AGRICULTURAL DRAINS

Sampling Procedures
For The Sampling Campaigns
1987–1989

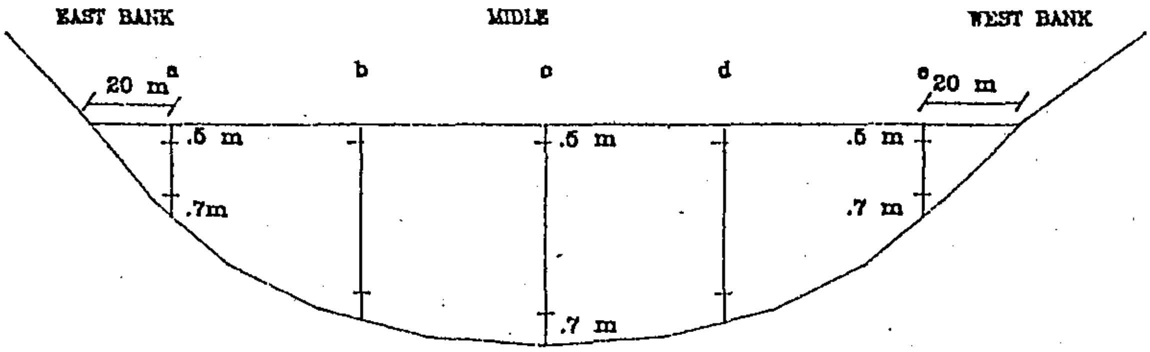


FIGURE 3–b

Note

Velocity at .6 the depth of the water for each sampling location

Sampling Procedures
For The Sampling Campaigns
1976–1986

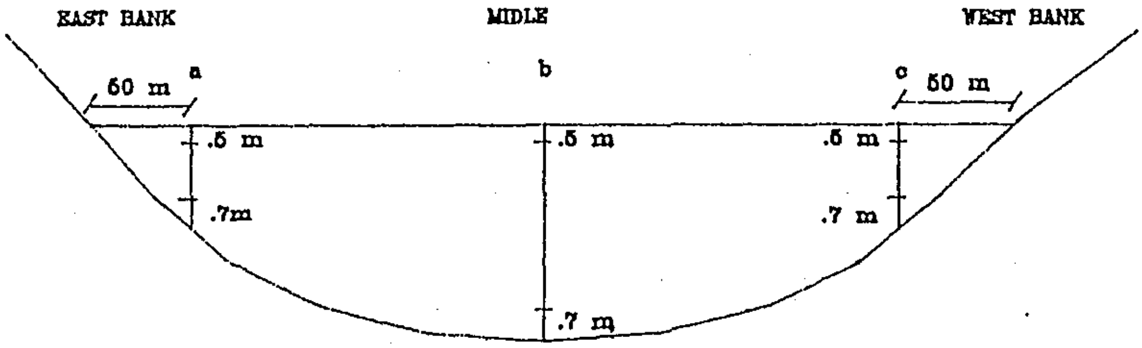
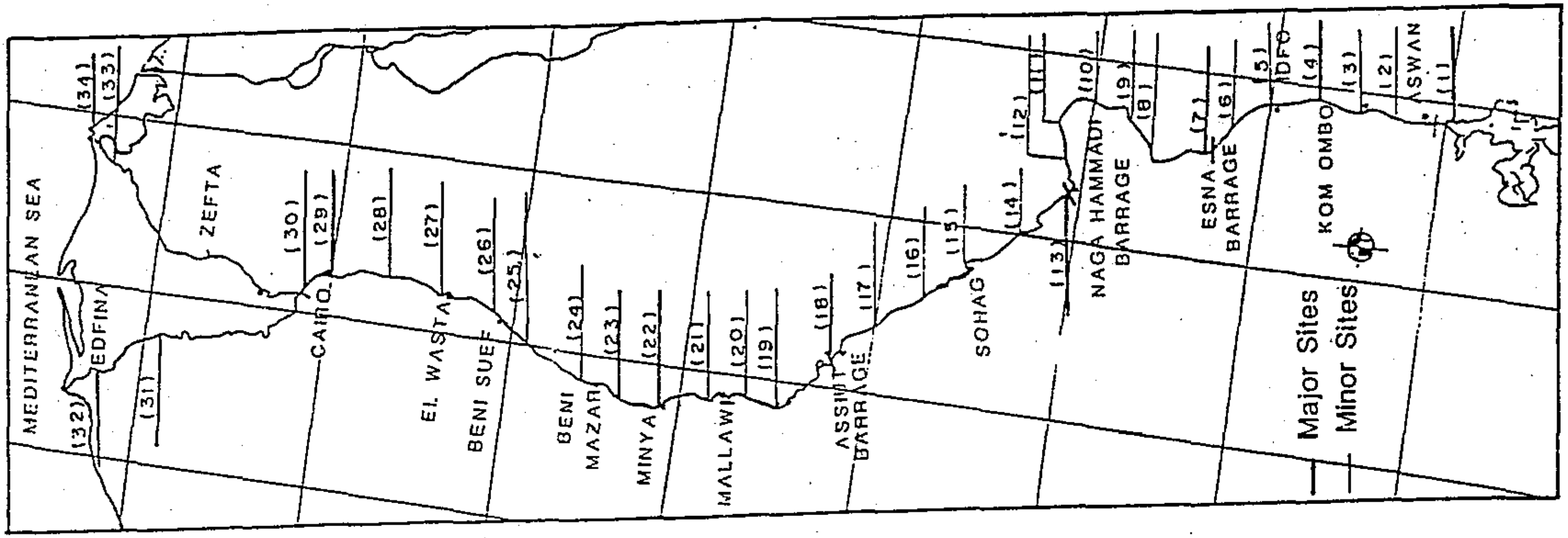


FIGURE 3–a

Note

Velocity at .2 and .8 the depth of the water for each sampling location

SAMPLING LOCATION ALONG THE RIVER NILE



FIGUER 5

Source:

working paper 520-2H

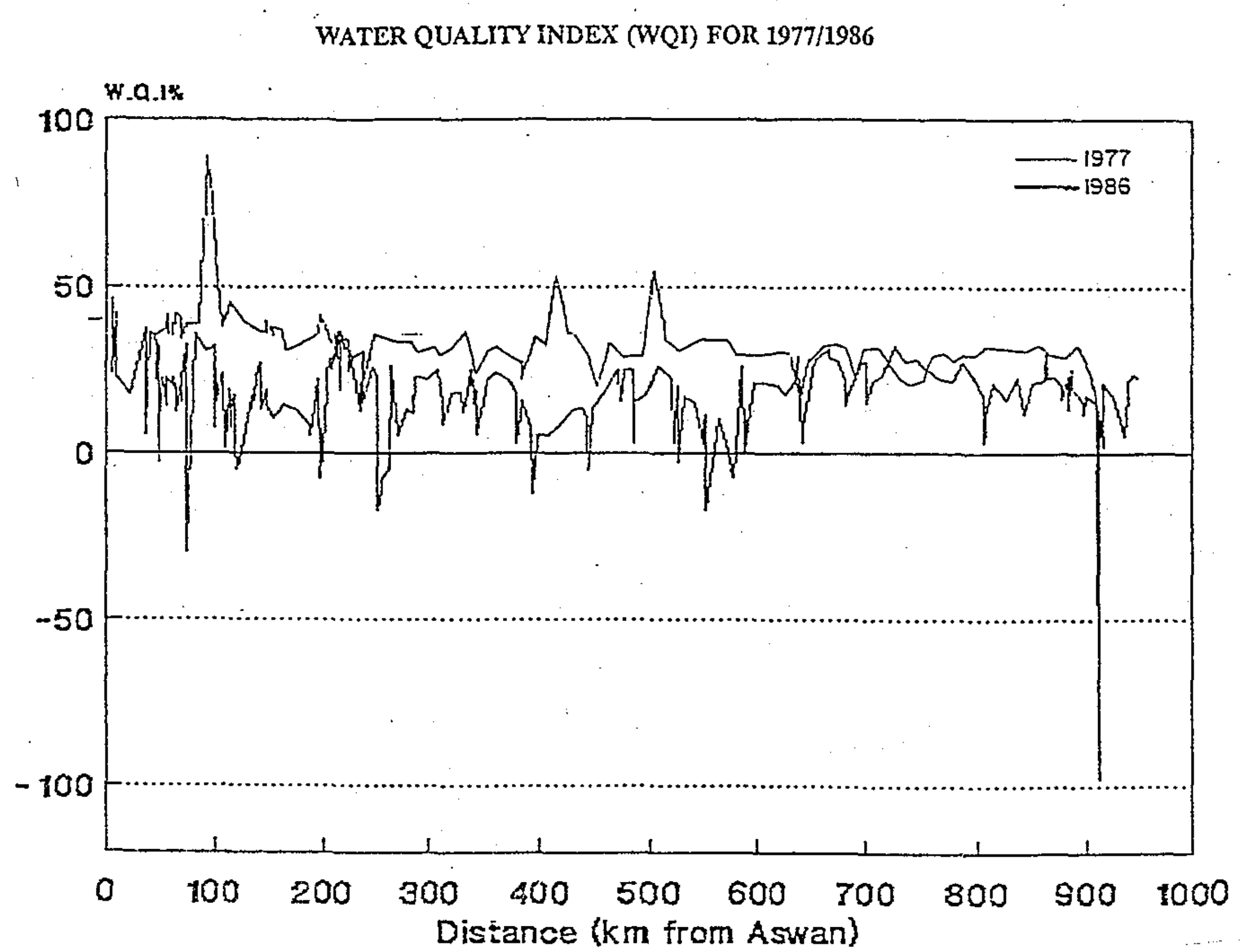


FIGURE 4

Source : Report 515

INDUSTRIAL SOURCES OF POLLUTION ON RIVER NILE

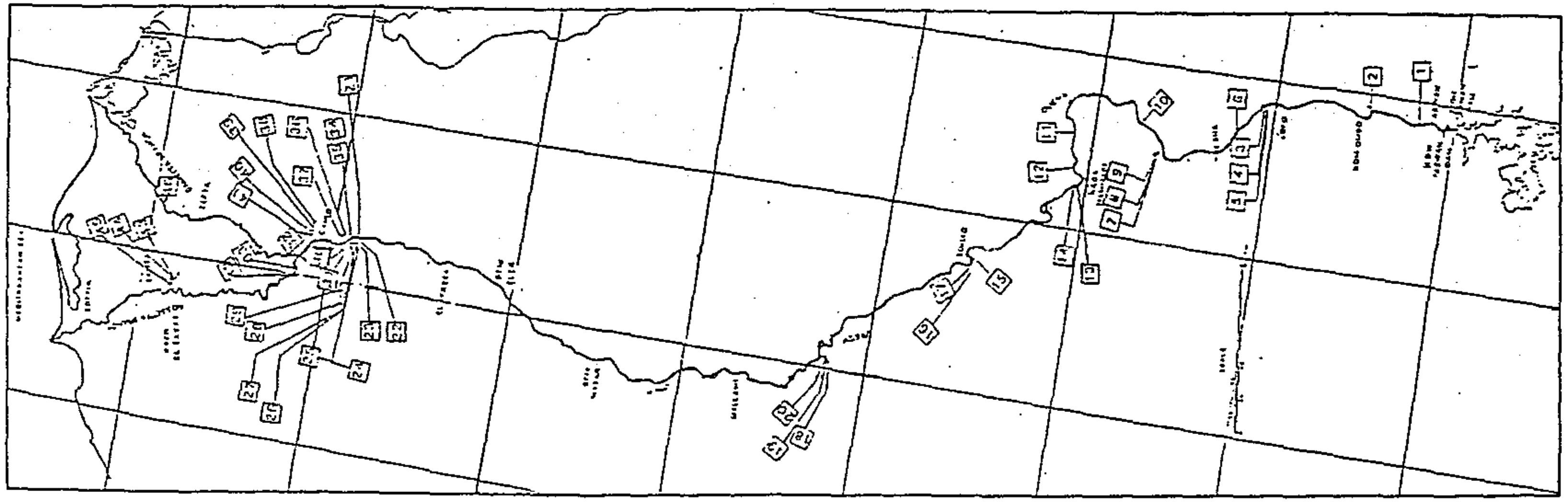


FIGURE 2

LEGEND

☐ INDUSTRIAL OUT-FALL

Sampling Procedures
For The New Approach

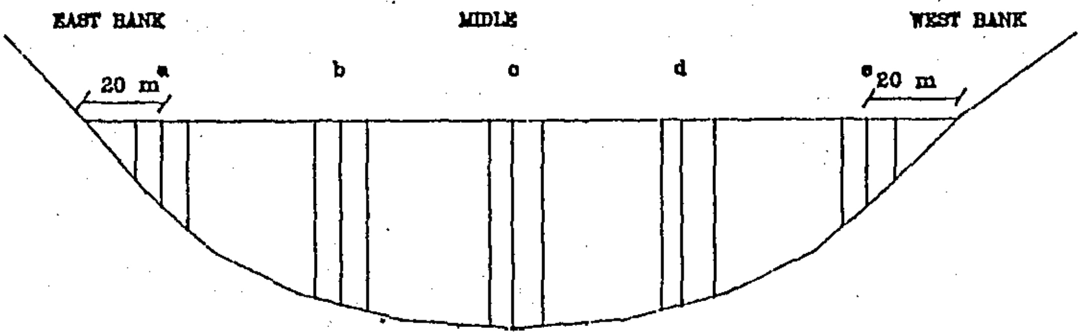


FIGURE 6

Note

Velocity at .6 the depth of the water

IMPACT OF INDUSTRIAL WASTE INFLUENT ON RIVER NILE WATER QUALITY

By

Chem. M. El-Shanshoury *
Dr. M. Abdelbary **

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 wastewaters 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 93/1962 regarding liquid waste disposal and Law 48/1982 regarding protection of the River Nile and waterways against pollution.

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The authors acknowledge the financial support of the Canadian international Development Agency (CIDA). Research done for this paper was financed under grant for River Nile Protection and Development Project (344/11871).

However, these laws are not completely enforced, especially for the existing factories which are still discharging their wastes into the river without treatment.

RIVER NILE WATER QUALITY MONITORING

The first comprehensive attempt to gather water quality data on the Nile and its branches in a systematic fashion was made in 1975 through the cooperative efforts of the Egyptian Academy of Scientific Research and Technology and the University of Michigan (4). Daniel A. Okun, 1981, stated that "this study has avoided one of the problems that has plagued similar monitoring programs in other countries including the United States. Namely, the fragmentation of data collection, where each agency of government institutes its own program without regard to the data collection activities or needs of other agencies. Not only is this fragmented approach excessively costly, it is also ineffective."

Since the High Aswan Dam Side Effects Research Institute (HADSERI) of the Water Research Center (WRC) is responsible for the research work on the River Nile, it has conducted eight sampling campaigns from 1976 to 1988 on the River Nile starting upstream of the High Aswan Dam down to the two branches of the Nile Delta at Rosetta and Damietta (5). These sampling campaigns were mainly designed according to distance variables rather than time variables.

The sampling network consisted of 398 sampling points. Out of the 398 sampling points, 270 are distributed in the main channel of the River Nile as shown in Figure 1 and 46 points in the network correspond to industrial influent discharging directly into the River Nile, as shown in Figure 2. However, not all of the 398 sampling sites of the network were sampled at every campaign. For instance, in 1976, 88 points were sampled in the River Nile (out of 270) while in 1986, 203 points were sampled (out of 270 points). Similarly, for sampling points located at industrial outfalls, the number of points sampled has varied from 8 to 27 points (out of 46) (RNPD, June 1989).

HADSERI conducted the eight campaigns in collaboration with the Ministry of Health which provided facilities for field sampling procedures (in-situ measurements, instruments, preservation and sampling equipment). In summary the campaigns were established and carried out as follows:

The river is segmented into six reaches according to the existing control points along it. These reaches are:

Reach No. 1 from HAD to Esna Barrage
Reach No. 2 from Esna to Naga Hammadi Barrage
Reach No. 3 form Naga Hammadi to Assiut Barrage
Reach No. 4 from Assiut to Delta Barrage

Reach No. 5 Rosetta Branch
Reach No. 6 Damietta Branch

- At each sampling location in the river, a composite sample was obtained by mixing grab samples taken at 50 cm above the bottom and at the same distance below the surface. This was carried out at three points in a lateral direction. Depths and flow velocities were measured at each point.

- The three samples were then mixed together on the boat to form one composite sample. In-situ parameters such as pH, Dissolved Oxygen, temperature and conductivity were measured.

- In addition to samples collected from the vicinity of agriculture drains and industrial outfalls, samples were also collected from upstream and downstream locations to cover all sources of pollution and their impact on River Nile water quality.

- Part of the composite samples collected were sent to Ministry of Health regional laboratories for prompt analysis of BOD, COD and bacteriological examination. When the sampling campaign is under way, the samples are periodically sent from the boat by car to the Central Laboratory of the Environmental and Occupational Health Center.

WATER QUALITY PARAMETERS

The parameters examined for samples collected during the eight campaigns were:

- pH
- Temperature and Dissolved Oxygen
- Conductivity
- Major cations and anions (Na, Ca, K, Mg, Cl, SO_4)
- Total alkalinity, carbonates
- Solids (dissolved and suspended)
- Hardness
- Nutrients (nitrogen and phosphates)
- BOD and COD
- Oil and grease
- Sulfides
- Fecal coliform

RESULTS AND DISCUSSION

In order to clarify and analyze the data collected by HADSERI concerning industrial wastes discharging directly along the River Nile and for the best understanding of its impact on the river water quality, the following procedures will be followed:

- Industrial waste characteristics will be defined within each reach, especially Total Dissolved Solids (TDS), Suspended Solids

(SS) and Biological Oxygen Demand (BOD) with regard to the specifications and standards of Law 48-1982 Regarding Protection of River Nile and Waterways Against Pollution.

- Impact of industries on river water quality in locations downstream of discharging points will be presented.

- Industries will be categorized into three grades according to their toxic effect and impact on the river water quality.

On implementing effluent standards and specifications mentioned in Ministerial Decree No 8 -1983 for Law 48-1982, the samples collected by HADSERI from industrial outfalls along the river are not applied to the standards and specifications mentioned. This is because of the absence of wastewater treatment facilities at these industries although the articles of the law prohibit the discharge of industrial effluents into the River Nile before issuing licenses and permits.

The following is an analysis of the impact of industrial waste on the Nile water quality reach by reach:

REACH ONE: HAD TO ESNA BARRAGE (0 -167 KM FROM ASWAN)

The following is a description of the industrial effluent and their impact on water quality in this reach:

1. Kima Factory, through Khour El-sail drain, is mixed with domestic and agriculture wastes at 9.7 km from Aswan. The water from drains potentially affects the Nile water by high contents of organic loadings and high concentrations of chemicals and solids. This effect is noticeable downstream of the discharging point for about 300 m and then the river starts to recover and purify.

2. Sugar factories of Kom-Ombu: 50 km downstream from Aswan the river receives the factories' liquid wastes. This is reflected in the high concentration of organic matter and suspended solids. Both BOD and COD concentrations are relatively released from river water 200 m downstream from the source, while suspended solids are reduced from 180mg/l to 150mg/l.

3. Edfu paper pulp and sugar factories: for about a 45 m reach length, starting at 122.450 km, the river water strongly suffers from receiving effluent of low oxygen content and high organic matter content, suspended solids and high concentrations of oil and grease and TDS.

4. El Sebaia Phosphate Port: activity here increases the concentration of phosphate downstream from the port.

Figures 3 a, b and c illustrate the impact of these industries, within the first reach, on river water quality.

REACH TWO: ESNA TO NAGA HAMMADI BARRAGE (167 -359 KM)

This reach receives the liquid wastes of sugar factories of Armant 204.5 km from Aswan, Ques 256.6 km from Aswan, Deshna 314.0 km from Aswan and Naga Hammadi 343.2 km from Aswan.

The increase in the concentration of dissolved and suspended pollutants (such as TDS, suspended solids, and organic matter), released to the river water from the raw industrial effluent, strongly affects the river water quality for about 300 m before starting to purify.

Wastes from aluminum complexes at Naga Hammadi discharge at 337.5 km from Aswan and contain high concentrations of solids, and oil and grease. The water quality starts to recover 200 m downstream from this source. Figures 4 a, b and c clarify the effects of these industrial effluents on the water quality of the River Nile.

REACH THREE: NAGA HAMMADI TO ASSIUT BARRAGE (362-544 KM)

The river water of this reach receives industrial effluent from the following industries:

- Onion drying factory at Souhag (443.2 km from Aswan), and
- Coca cola (soft drink) industry at 445.6 km has a limited impact. The pollutants mainly consist of organic matter, oil and grease and suspended matter. The river recovers easily from these pollutants 200 m downstream from the discharge points.

The waste of the Souhag edible oil and soap company for oil extraction and hydrogenation at 444.0 km from Aswan, is considered a potentially hazardous liquid discharging into the river waters of this reach since it contains high concentrations of organic matter, suspended solids, dissolved solids and oil and grease, as shown in Figures 5 a, b and c.

REACH FOUR: ASSIUT TO DELTA BARRAGE (544-952 KM)

At a length of 395 km, this reach is the longest of the six reaches. Downstream from Assiut Barrage at km 552.2 the Nile receives the wastes of chemical industries and fertilizers at Mankabad which have relatively high concentrations of TDS, SS and phosphates. The river water starts to recover from these effects at 500 m from the discharge point.

As the river water flows north, it receives potentially hazardous wastes produced from various types of industries located in the south Greater Cairo area (normally at Hawamdia, Tebeen and Helwan). Industrial effluents of iron and steel companies, coke and fertilizer industries, wood processing industries, metallurgical and light transportation industries and spinning, weaving and textile industries are discharging into El Tebeen drain and Helwan and then into the river. The lab analysis of these wastes indicates they have a very low oxygen content, high BOD and COD concentrations, TDS, and oil and grease.

On the left bank at Hawamdia, most of the polluting wastes are disposed from sugar factories, distillation and extraction and chemical production industries. These wastes have a high content of organic load, solids (suspended and dissolved) as shown in Figures 6 a, b, and c. In addition, the thermal pollution, oil and grease resulting from discharges of cooling water of El-Tebeen and Helwan thermal power plants are also sources of pollution in this reach, and with the addition of effluent from the boats travelling on the Nile, the level of pollution increases significantly in the Greater Cairo area. The improvement of the water quality takes place in the downstream direction at a much longer distance, as can be seen from Figures 6 a, b, and c.

REACH FIVE: ROSETTA BRANCH

Concerning the Rosetta Branch, there are two sources of pollution which potentially affect and deteriorate the water quality of this reach.

The first source is Rahawy drain which discharges its wastes in the branch a few kilometers downstream of Delta Barrage. Its wastes are a mix of agricultural, domestic wastes and sanitary drainage from a large area of Greater Cairo. The impact of this source on the water quality of the branch is extended for about 500 m before starting to recover due to the content of organic loads, suspended solid and low oxygen content.

The second source is Kafr El-Zayat industrial area. The industrial effluents produced from the Malyia Company (super phosphate, sulfur compounds), oil and soap industries (salt and soda) and pesticide factories are discharging directly from the right bank of the Rosetta Branch and their effects on water quality of the branch are detectable for about 300 m downstream.

REACH SIX: DAMIETTA BRANCH

Talkha fertilizer factory is considered the main source of industrial pollution in the Damietta Branch. Its impact on the water quality of the branch is due to the high concentration of nitrogen and TDS. This industrial pollution extends for about 300 m before recovery.

According to industrial effluent characteristics discharging into River Nile and their impact on river water quality, and in order to define priorities for wastewater treatment, industries are classified into three grades:

- Grade One includes chemical, metallurgical, and mineral industries. Their wastes contain a high concentration of chemicals, metals, ions, and oil and grease which necessitate the highest priority for treatment of wastes. This grade is identified in Figure 7 by a square.

- Grade Two includes food and food processing industries. Their wastes are characterized by high concentrations of solids, organic loads, dye traces and alkaline impurities. This grade is given a second priority for treatment and is shown in Figure 7 by a hexagon.

- Grade Three includes food and food processing industries. Their wastes contain high concentrations of oil and grease, organic compounds and suspended solids. This grade is given the last priority for treatment and is shown in Figure 7 by a circle.

CONCLUSIONS AND RECOMMENDATIONS

Based on the HADSERI Water Quality Data Base, and from the above discussion, the following may be concluded:

- The river and its two branches receives industrial pollutants from Aswan to the Mediterranean Sea. These wastes produce localized effects on river water.

- In spite of the controlled water flows after the HAD and the increase in the amount of waste from industry, the quality of the river water is still considered far from being poor.

- Enforcement of Law 48, since being issued in 1982, has faced complications and difficulties in requiring the violators to meet the standards for licenses and permits.

Finally, in order to have the ability for the River Nile to purify its water and to keep its quality in good condition the following statements are recommended:

Although, the water quality of the River Nile is still considered appropriate as a source for different uses, it would be necessary to strictly implement the law and issue no permits for discharging new pollutants.

Old technology used in industries needs modernization and remodelling. Care should be given to optimum recycling of all usable resources to reduce waste loads generated and wastage of raw material.

Industrial waste discharges will be licensed and permitted according to the standards and specifications mentioned in Law 48-1982. However, these standards are relatively hard to achieve at a reasonable cost. These standards need to be reviewed.

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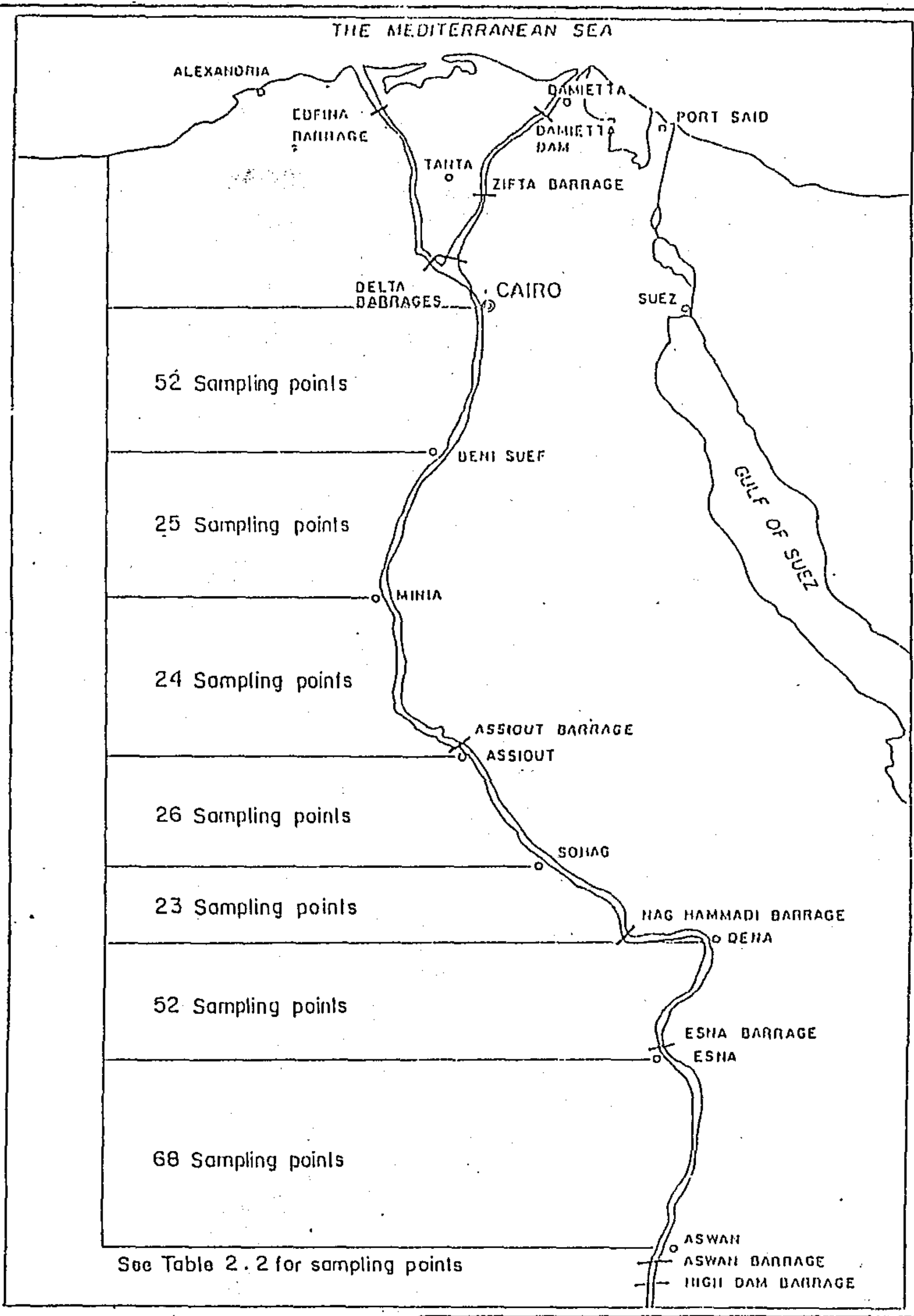


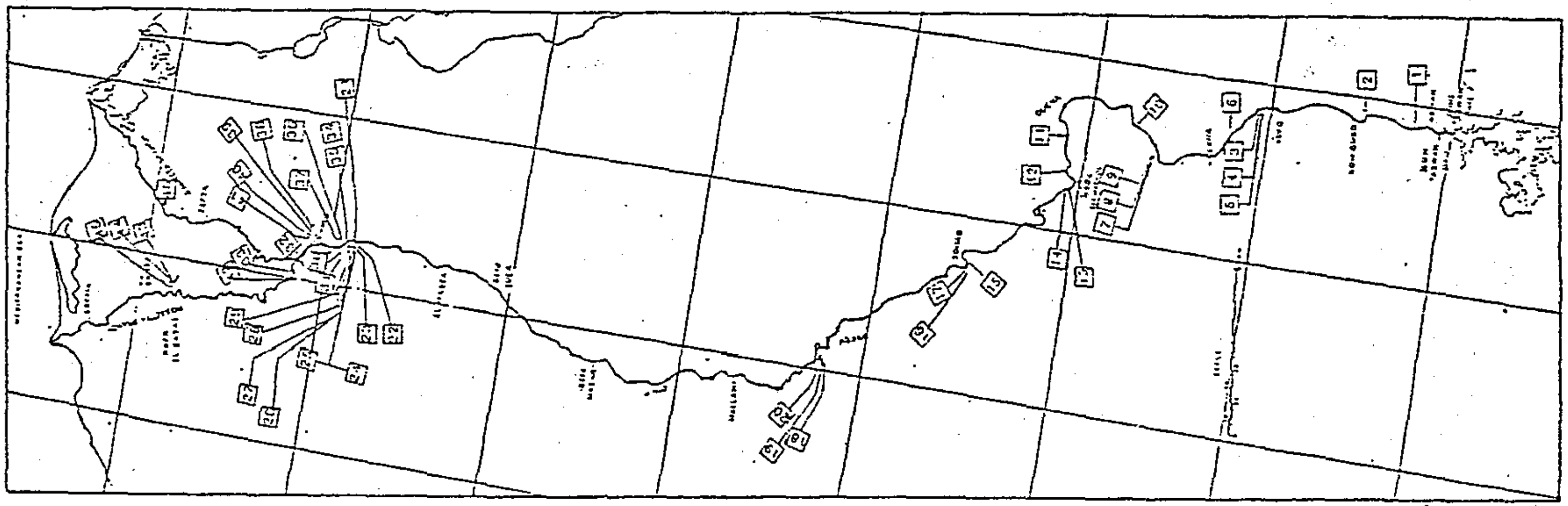
RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

SPATIAL DISTRIBUTION OF SAMPLING POINTS IN THE MAIN CHANNEL OF THE RIVER NILE

OCT. 1990

FIGURE: 1

Source:
WP 500-4



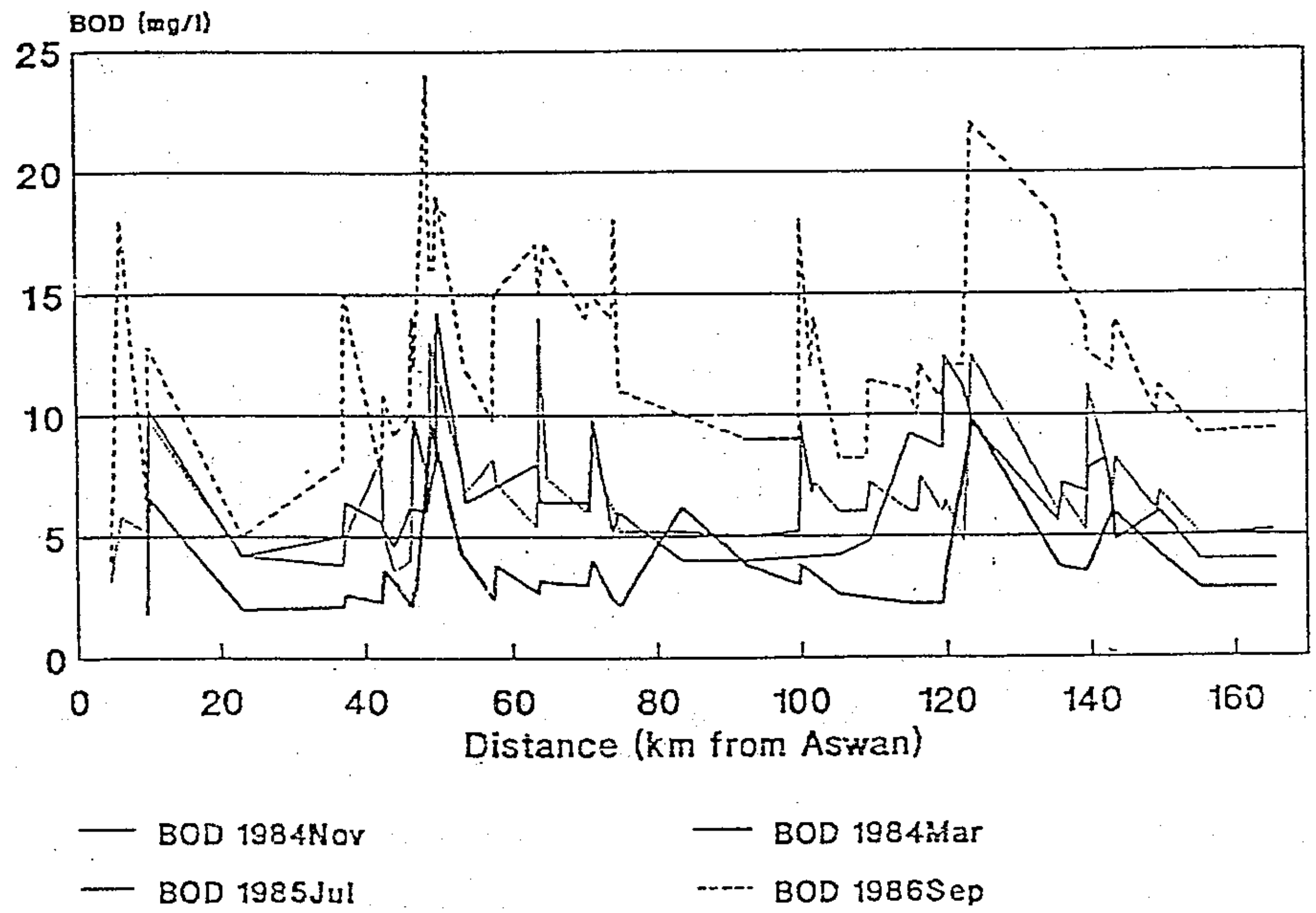
LEGEND

☐ INDUSTRIAL OUT-FALL

RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

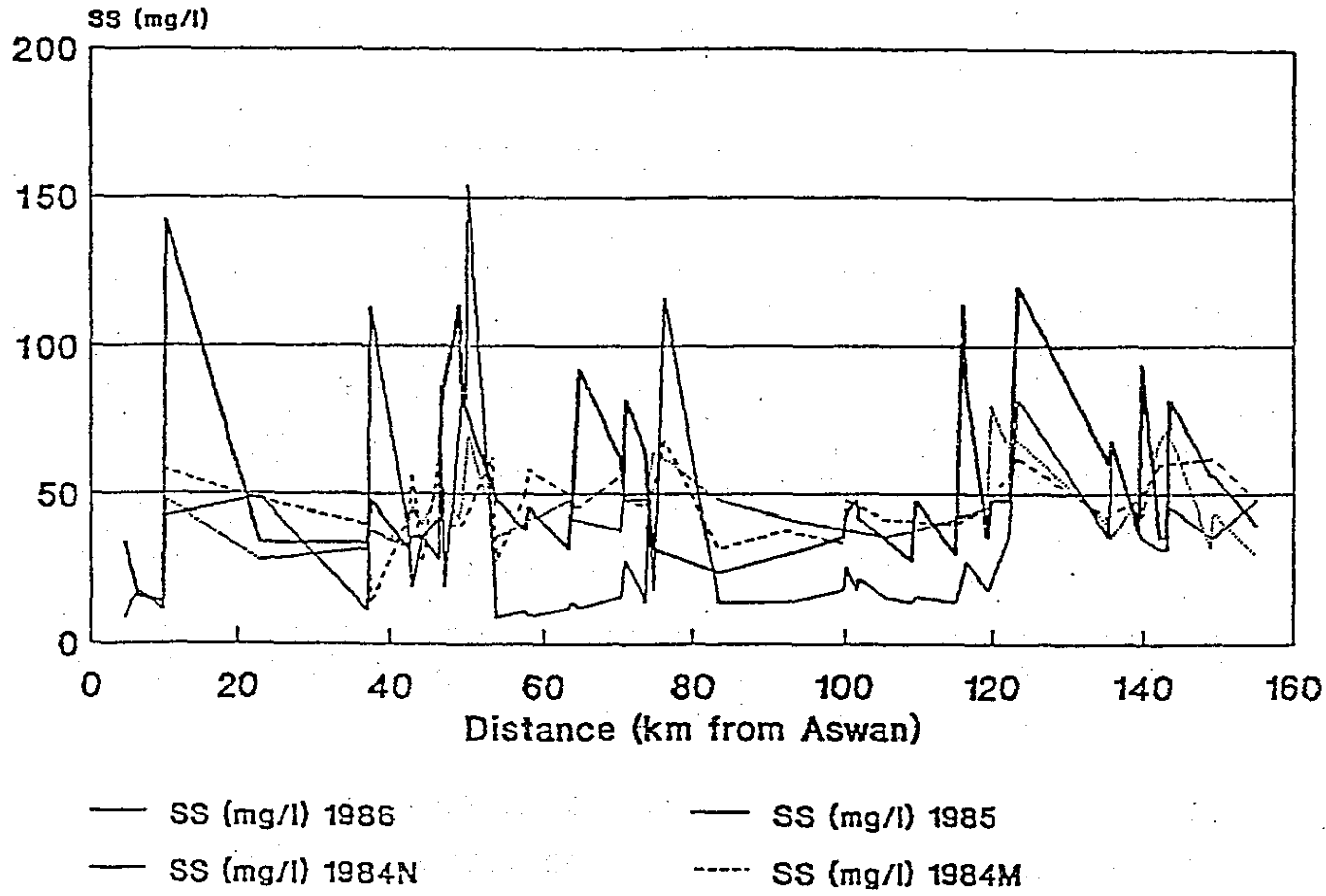
INDUSTRIAL SOURCES OF POLLUTION
ON RIVER NILE

OCT. 1990 | PAPER | FIGURE 2



Source : Report 515

RIVER NILE PROTECTION & DEVELOPMENT PROJECT		
BOD5 Concentration in the River Nile Reach 1- Aswan to Esna '84'85'86		
OCT. 1990		FIGURE: 3 - a

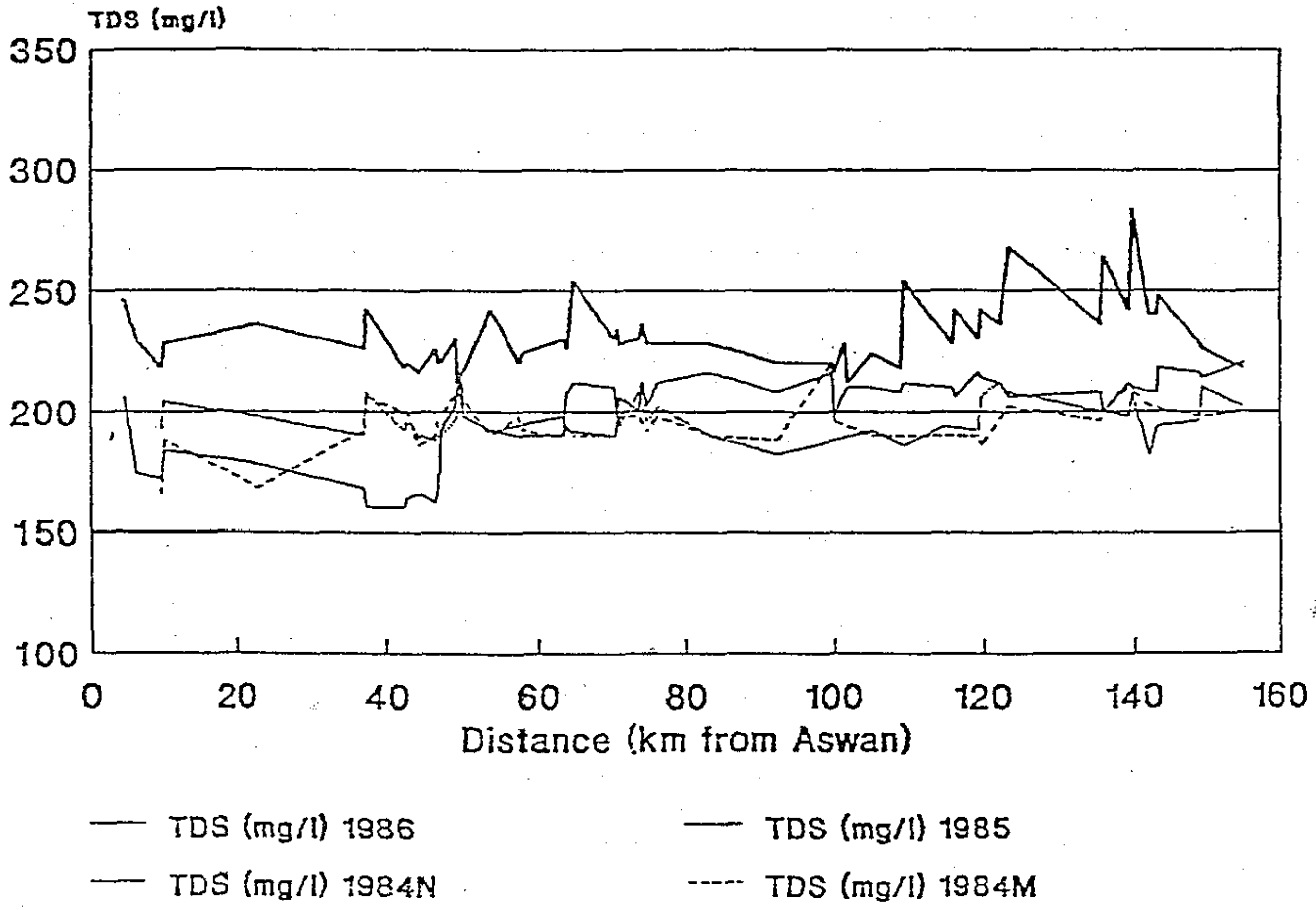


Source: Report 515

RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

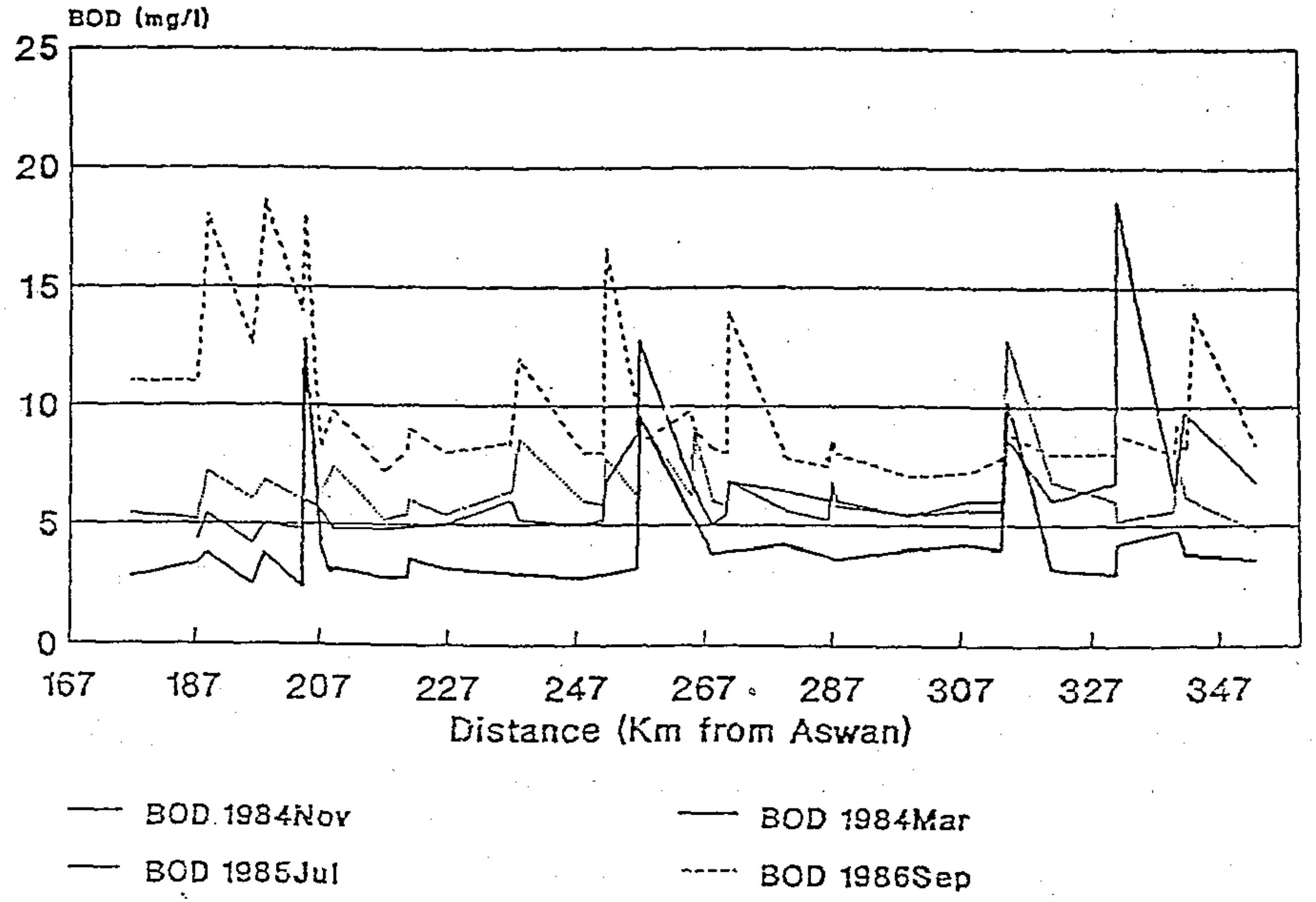
SS Concentration in the River Nile
Reach1- Aswan to Esna '84'85'86

OCT. 1990 | FIGURE: 3-b



Source : Report 515

RIVER NILE PROTECTION & DEVELOPMENT PROJECT	
TDS Concentration in the River Nile Reach1- Aswan to Esna '84'85'86	
OCT. 1990	FIGURE: 3 - c



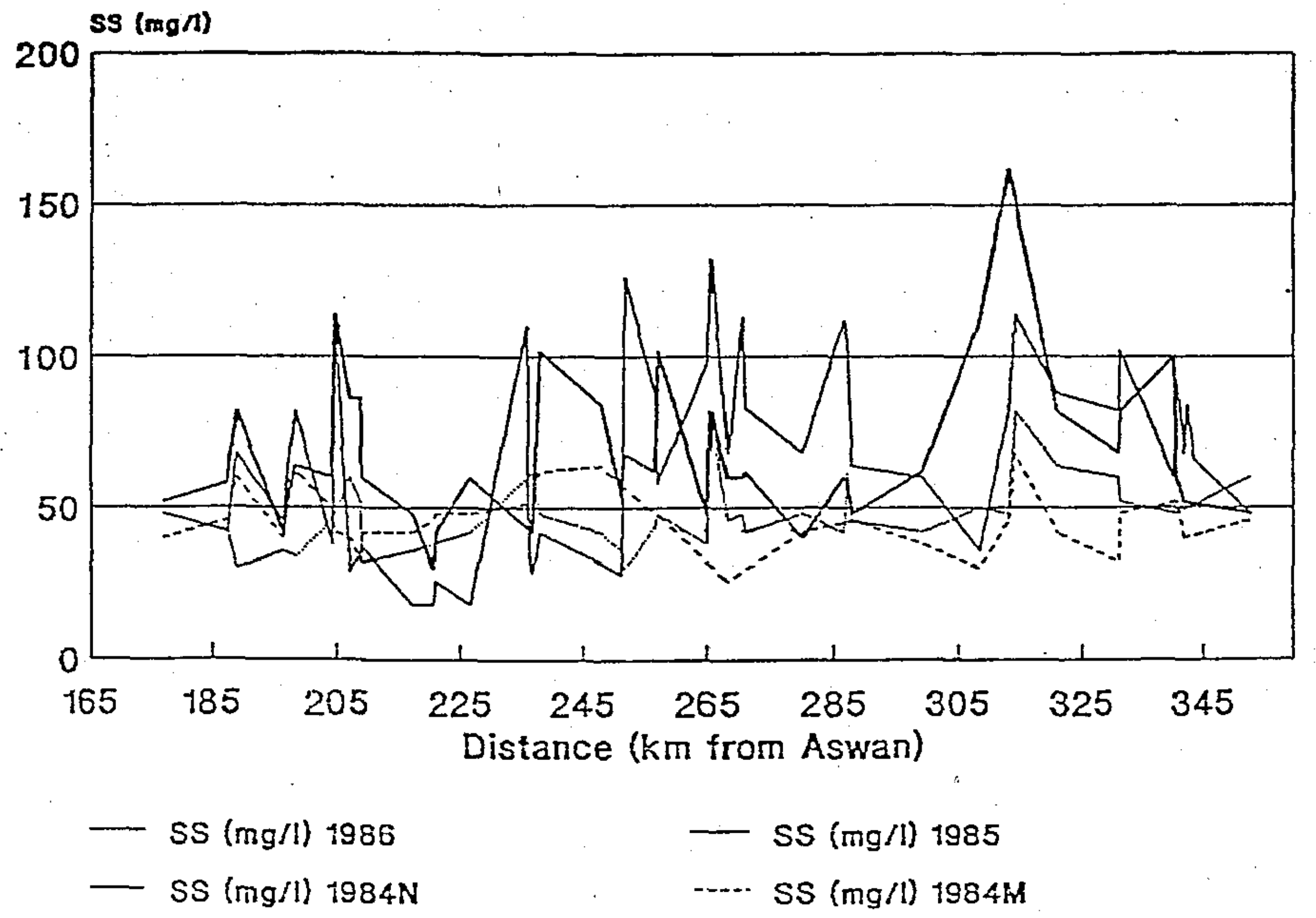
Source : Report 515

RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

BOD5 Concentration in the River Nile
Reach2- Esna to Nag Hammadi '84'85'86

OCT. 1990

FIGURE: 4 - a

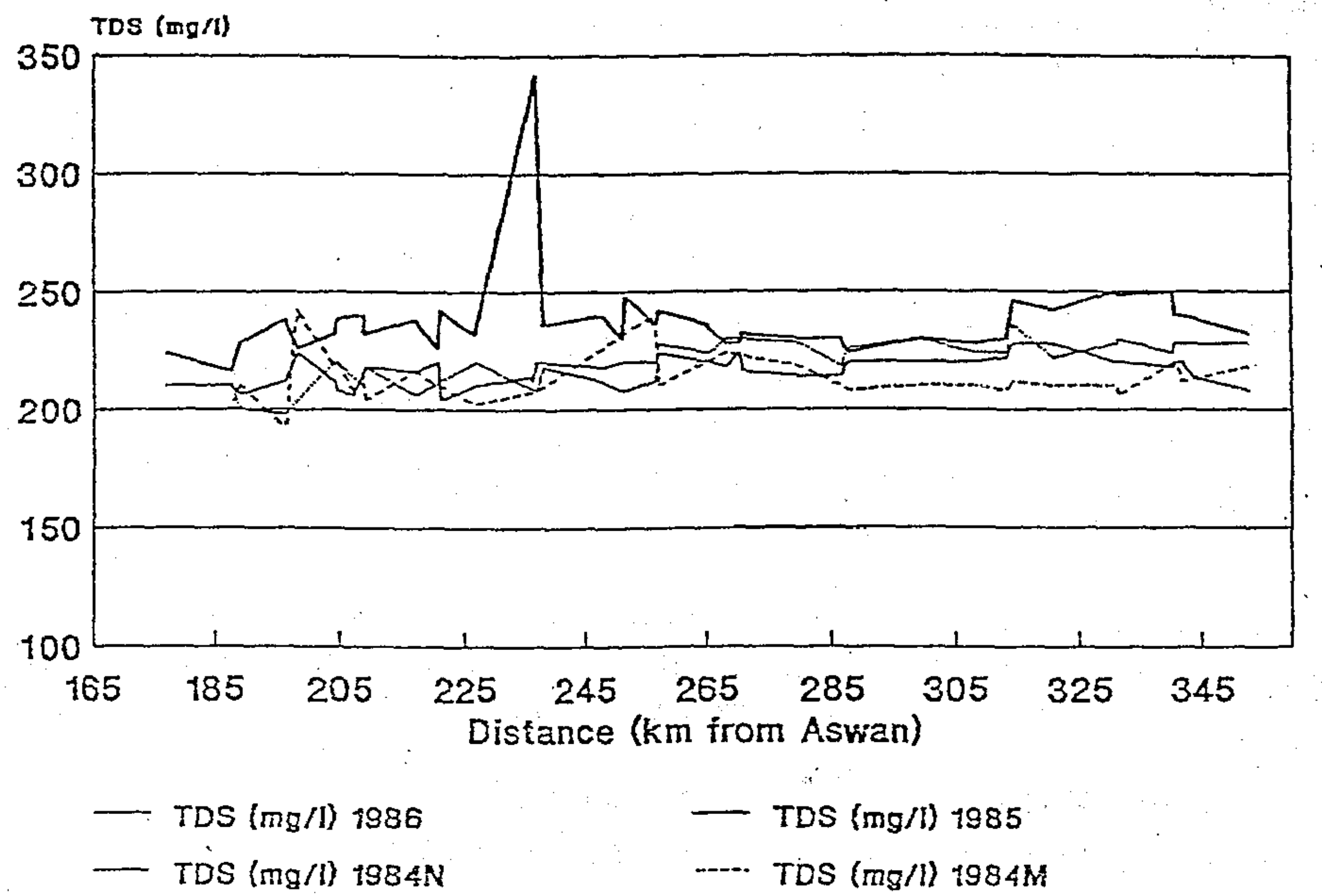


RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

SS Concentration in the River Nile
Reach2- Esna to Nag Hammadi '84'85'86

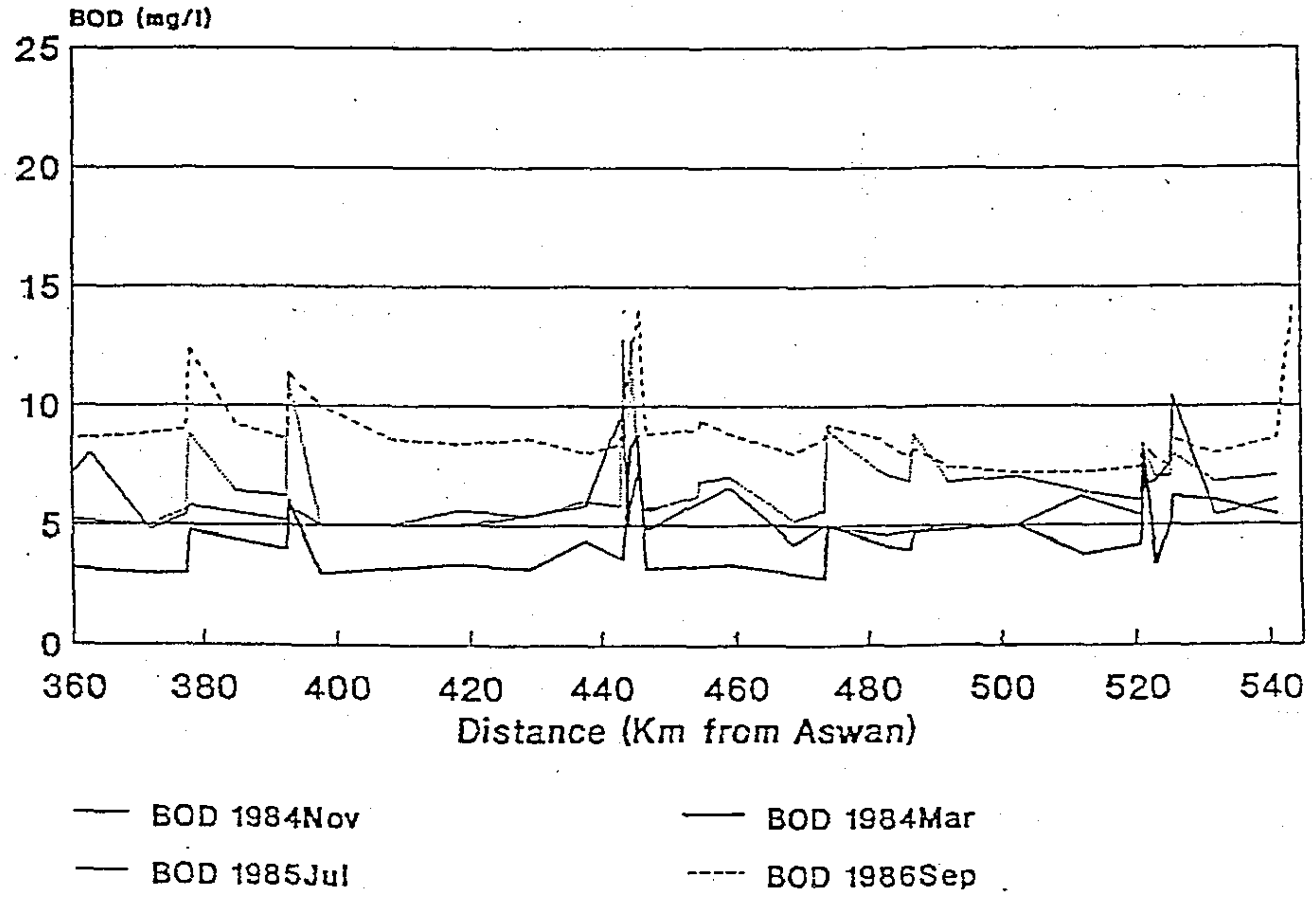
OCT. 1990 | FIGURE: 4 - b

Source : Report 515



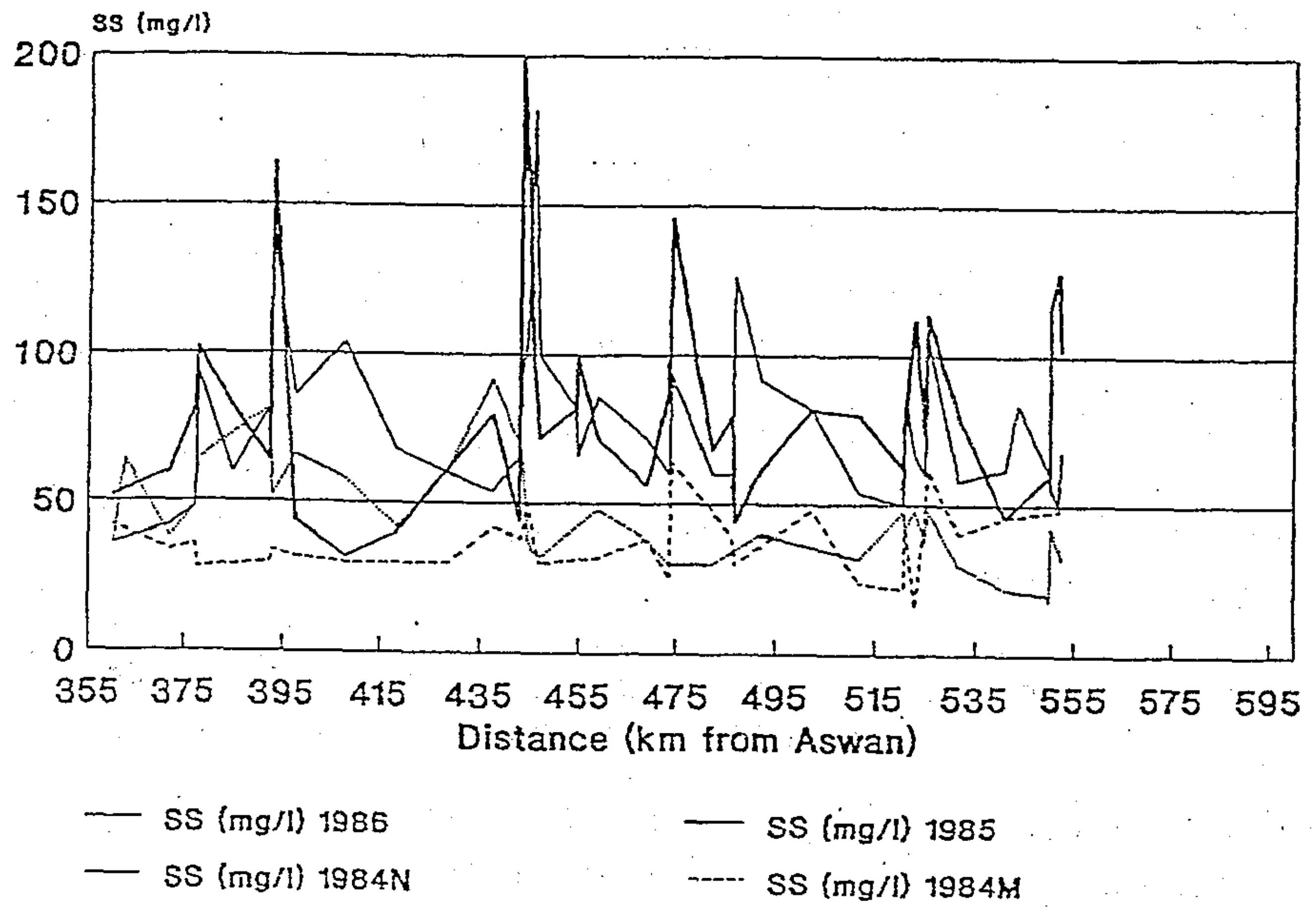
Source : Report 515

RIVER NILE PROTECTION & DEVELOPMENT PROJECT	
TDS Concentration in the River Nile Reach2- Esna to Nag Hammadi '84'85'86	
OCT. 1990	FIGURE: 4-c



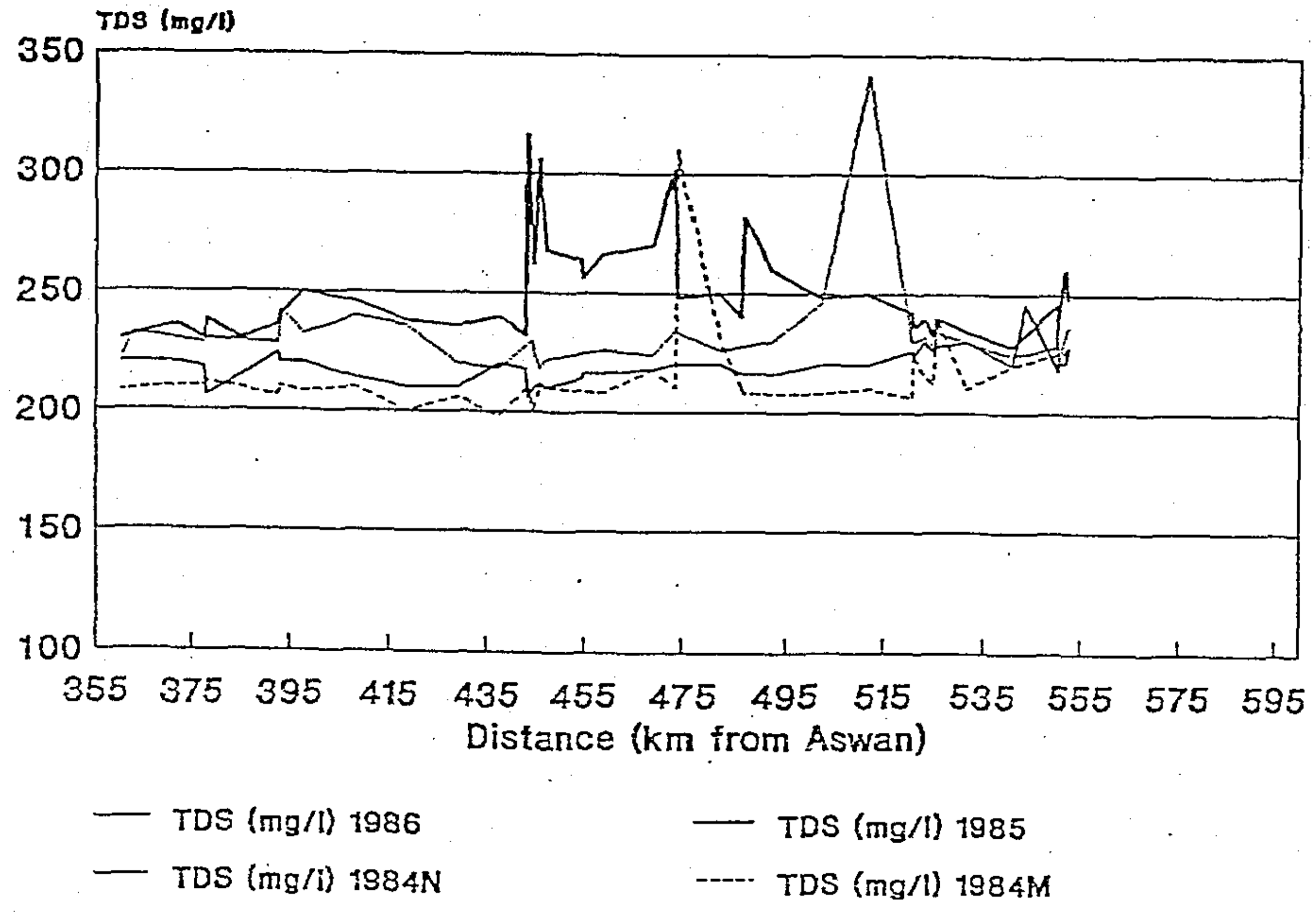
Source : Report 515

RIVER NILE PROTECTION & DEVELOPMENT PROJECT		
BOD5 Concentration in the River Nile Reach3- Nag Hammadi to Assult '84'85'86		
OCT. 1990		FIGURE: 5-a



Source: Report 515

RIVER NILE PROTECTION & DEVELOPMENT PROJECT	
SS Concentration in the River Nile Reach3- Nag Hammadi to Assuit '84'85'86	
OCT. 1990	FIGURE: 5 - b



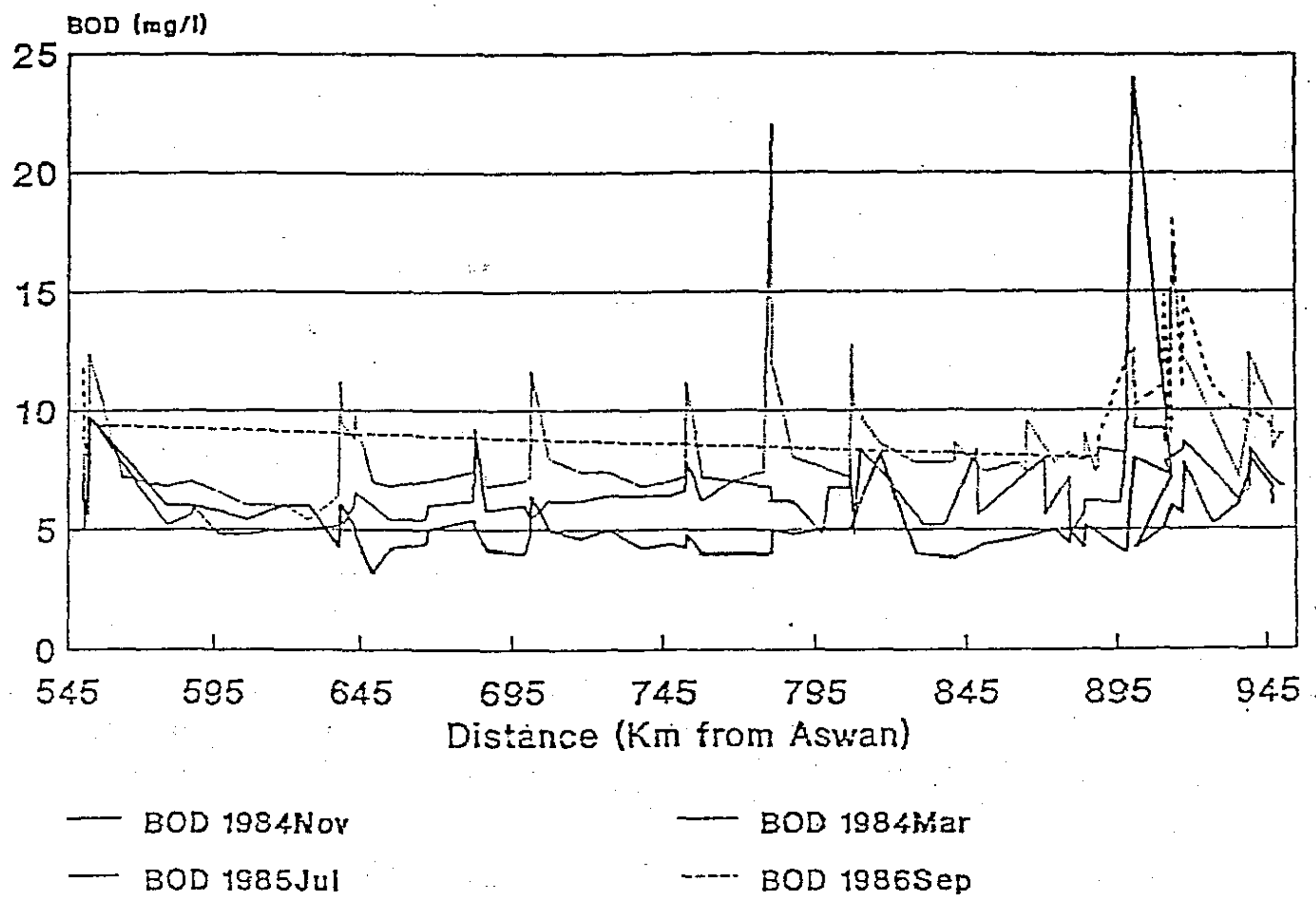
Source : Report 515

RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

TDS Concentration in the River Nile
Reach3- Nag Hammadi to Assuit '84'85'86

OCT. 1990

FIGURE: 5 - c

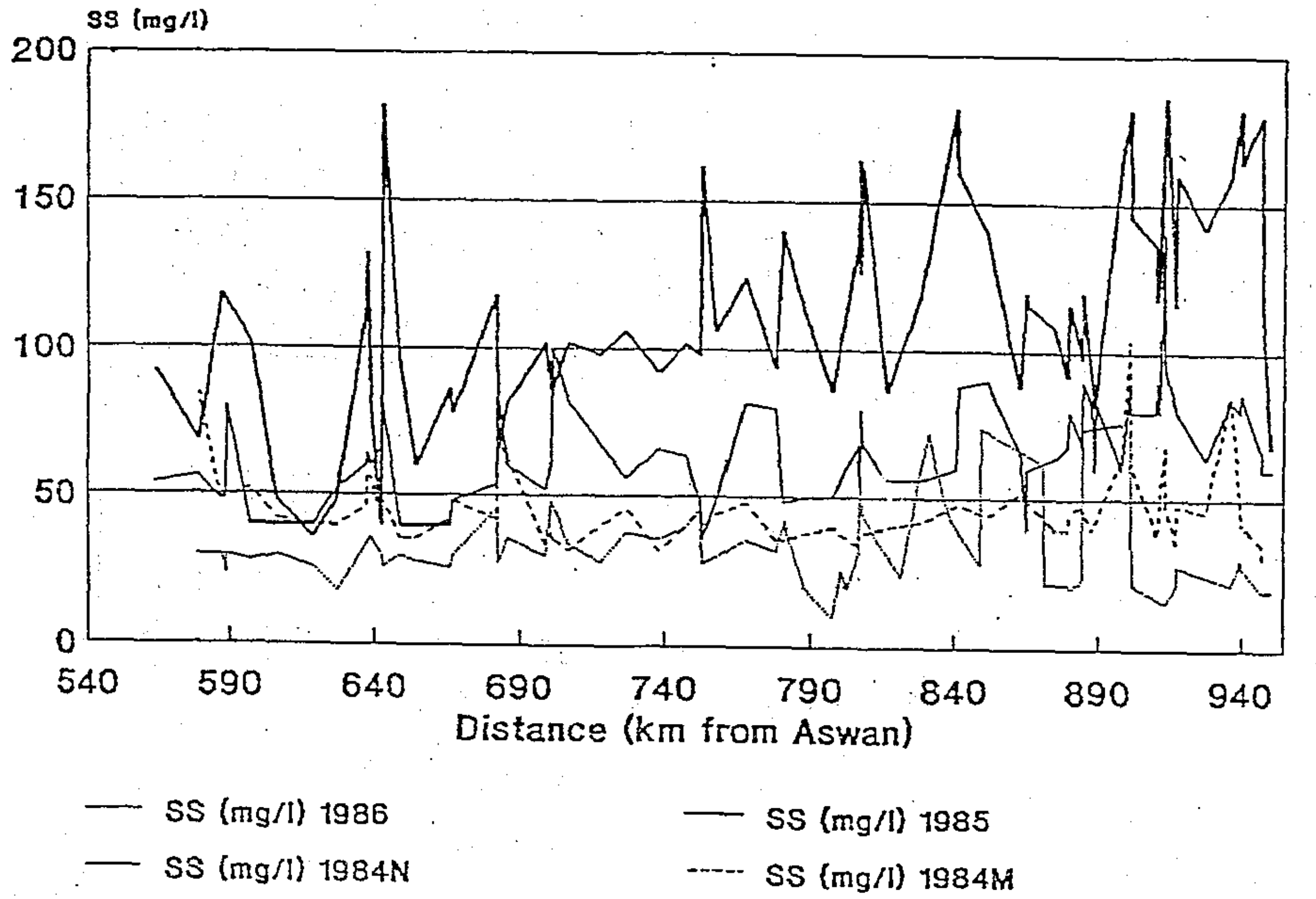


Source: Report 515

RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

BOD5 Concentration in the River Nile
Reach4- Assult to Cairo '84'85'86

OCT. 1990 | FIGURE: 6 - a

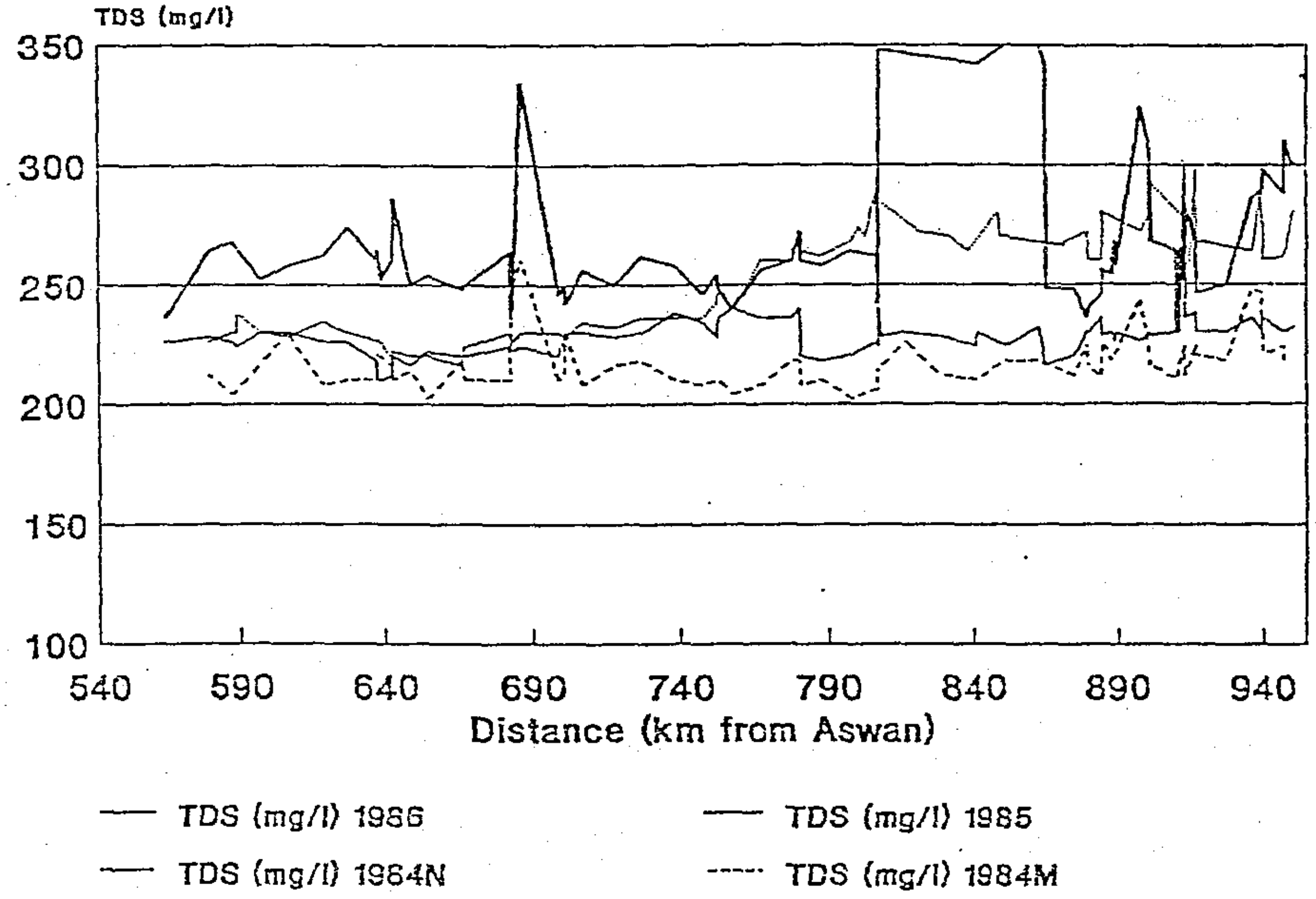


RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

SS Concentration in the River Nile
Reach4- Assult to Cairo '84'85'86

OCT. 1990 | FIGURE: 6 - b

Source: Report 515

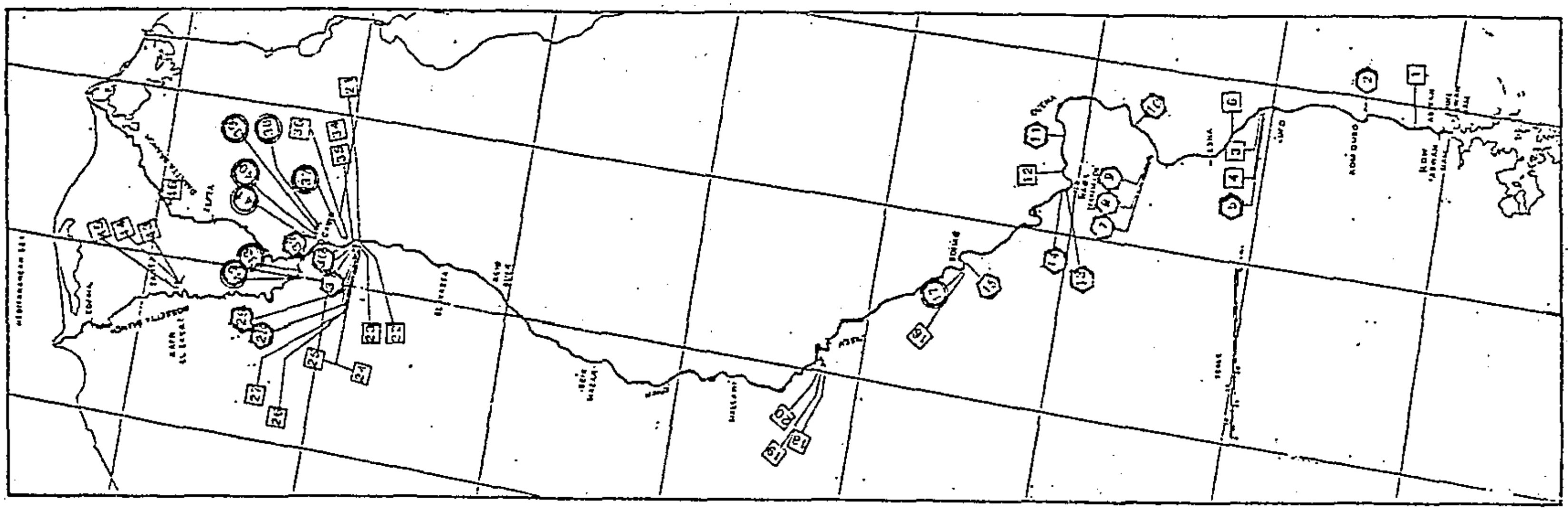


RIVER NILE
PROTECTION & DEVELOPMENT PROJECT

TDS Concentration in the River Nile
Reach4- Assult to Cairo '84'85'86

OCT. 1990 | FIGURE: 6-c

Source: Report 515



LEGEND

- ☐ INDUSTRIAL OUT-FALL OF GRADE I
- ⬡ INDUSTRIAL OUT-FALL OF GRADE II
- ⊙ INDUSTRIAL OUT-FALL OF GRADE III

RIVER NILE PROTECTION & DEVELOPMENT PROJECT		
INDUSTRIAL SCURCES OF POLLUTION ON RIVER NILE		
OCT. 1990	PAPER	FIGURE: 7

MINISTRY OF PUBLIC WORKS
AND WATER RESOURCES
WATER RESEARCH CENTER

وزارة الأشغال العامة
والموارد المائية
مركز البحوث المائية

RIVER NILE PROTECTION
AND DEVELOPMENT PROJECT
(R N P D)

مشروع حماية
وتطوير مجرى
نهر النيل

MODERN HADSERI WATER QUALITY LABORATORY

معمل معهد بحوث الآثار الجانبية للسد العالى الحديث

NOVEMBER 12, 1990

نوفمبر ١٢ ، ١٩٩٠

HIGH ASWAN DAM SIDE EFFECTS
RESEARCH INSTITUTE
(H A D S E R I)

ARAB REPUBLIC OF EGYPT
MINISTRY OF PUBLIC WORKS AND WATER RESOURCES (MOPWWR)
WATER RESEARCH CENTER (WRC)

and

CANADIAN INTERNATIONAL DEVELOPMENT AGENCY (CIDA)

RIVER NILE PROTECTION
AND DEVELOPMENT PROJECT

MODERN HADSERI WATER QUALITY LABORATORY

NOVEMBER 12, 1990

Prepared by

HIGH ASWAN DAM SIDE EFFECTS RESEARCH INSTITUTE
(H A D S E R I)

and

SNC/NHC/ECG

QANATER, EGYPT, NOVEMBER, 1990

MODERN HADSERI WATER QUALITY LABORATORY

By

Dr. M. El-Moattassem *
Dr. S.K Hassan **

ABSTRACT

The water of the River Nile represents the only significant source of fresh water available to Egypt. There has been growing awareness of the impact of toxic chemicals and pollutants, at trace and ultra-trace levels, on the environment. Social pressures have created a need for elucidation of the effects of chemicals on the ecosystem and humans. Due to a high population density and a high industrialization level in Egypt. The River Nile could face water pollution problem in some places.

A variety of waste effluents and runoffs are frequently discharged directly into the Nile at several locations from agricultural drains, industrial effluent, power stations and domestic wastes. The quantities of waste water effluent requiring treatment and disposal are rising rapidly.

In March 1988, the Ministry of Public Works and Water Resources (MOPWWR) and the Canadian International Development Agency (CIDA) have jointly funded the River Nile Protection and Development Project (RNPD) to strengthen the capabilities of HADSERI to fulfil its responsibilities and to assist in developing special projects for the protection and development of the Nile . One aspect of the RNPD projects was the construction of the new HADSERI Water Quality Laboratory.

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* HADSERI Director and RNPD Project Manager
** Laboratory Manager

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INTRODUCTION

In 1976, the High Aswan Dam Side Effects Research Institute (HADSERI) with the cooperation of the Ministry of Health, started a program for measuring pollutants along the River Nile. That program was carried out eight times during the period 1976-1986. The data analysis indicated that the River Nile is suffering from the problem of water pollution in some locations. HADSERI issued reports and bulletins discussing the results of these programs.

WATER QUALITY MANAGEMENT

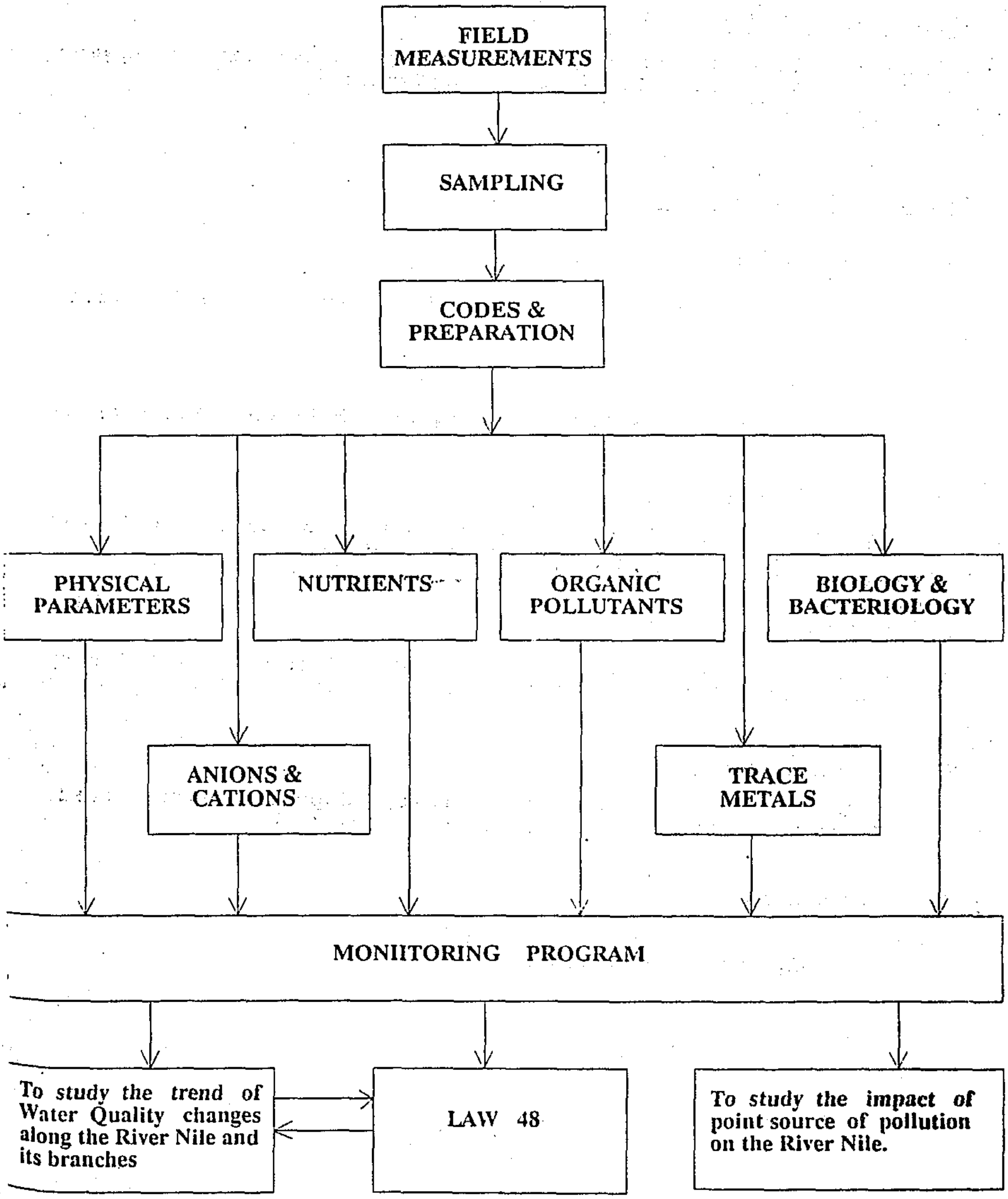
During the last decade HADSERI has been taken the responsibility of the Water Quality Management and Pollution Control for the River Nile channel and its branches. HADSERI has had collected quantitive information on physical, chemical and biological characteristics of the River Nile channel and its branches, in addition to waste water from all points of discharge which are located along the River Nile and discharge directly into it.

HADSERI WATER QUALITY VARIABLE SELECTION

Variables measured by a water quality monitoring program are highly dependent upon the objectives required, the characteristics of the sampling site and of course on the budget available.

HADSERI Water Quality Laboratory has been designed to receive about (250) samples yearly yielding almost (10000) parameters every year.

HADSERI WATER QUALITY LABORATORY FLOW CHART



HADSERI WATER QUALITY LABORATORY CAPABILITY

FIELD MEASUREMENTS

Acidity, Alkalinity, Chlorine (residual), Conductivity, Oxygen (dissolved), pH value, Temperature and Turbidity.

LABORATORY MEASUREMENTS

1) PHYSICAL PARAMETERS:

Color, Conductivity, Solids, pH, Temperature & Turbidity

2) NUTRIENTS:

Ammonia, Nitrate, Nitrite, Organic Nitrogen, Phosphorous

3) Organic Pollutants:

Biological Oxygen Demand, Chemical Oxygen Demand, Oil and Grease Detergents, Phenols and surfactants

4) Cations & Anions:

Calcium, Magnesium, Potassium, Sodium, Alkalinity (Carbonates & Bicarbonates), Chloride and Sulfates

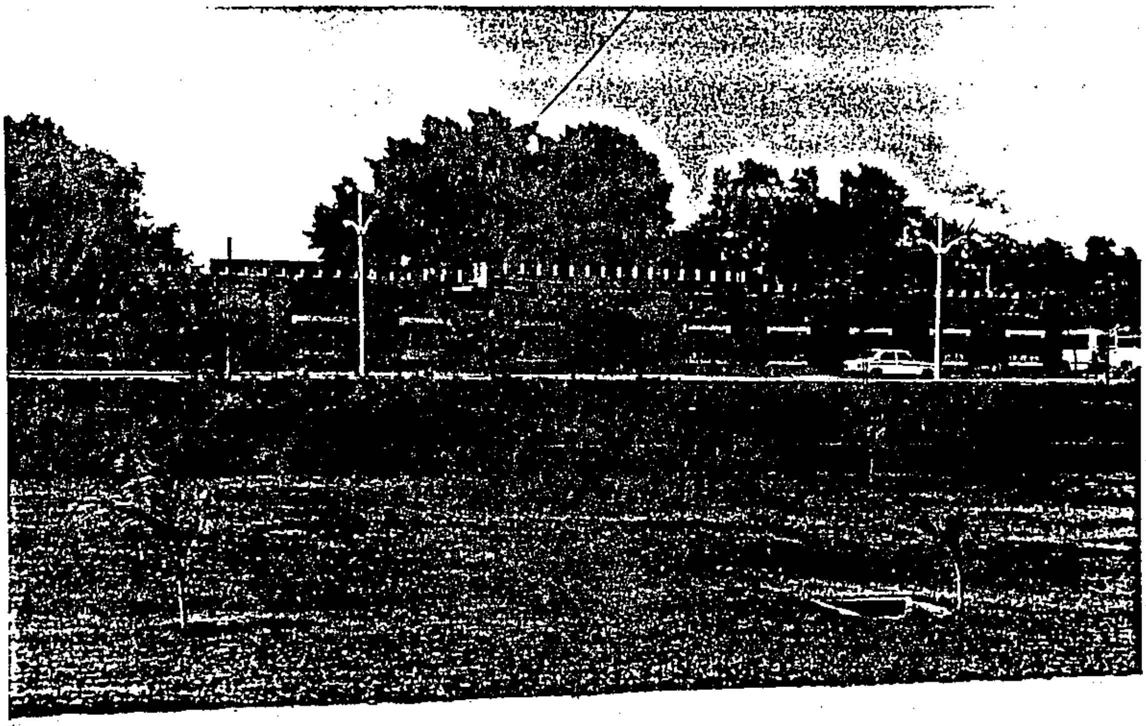
5) Trace Metals:

Arsenic, Boron, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nical, Silicon, and Zink

6) Microbiology:

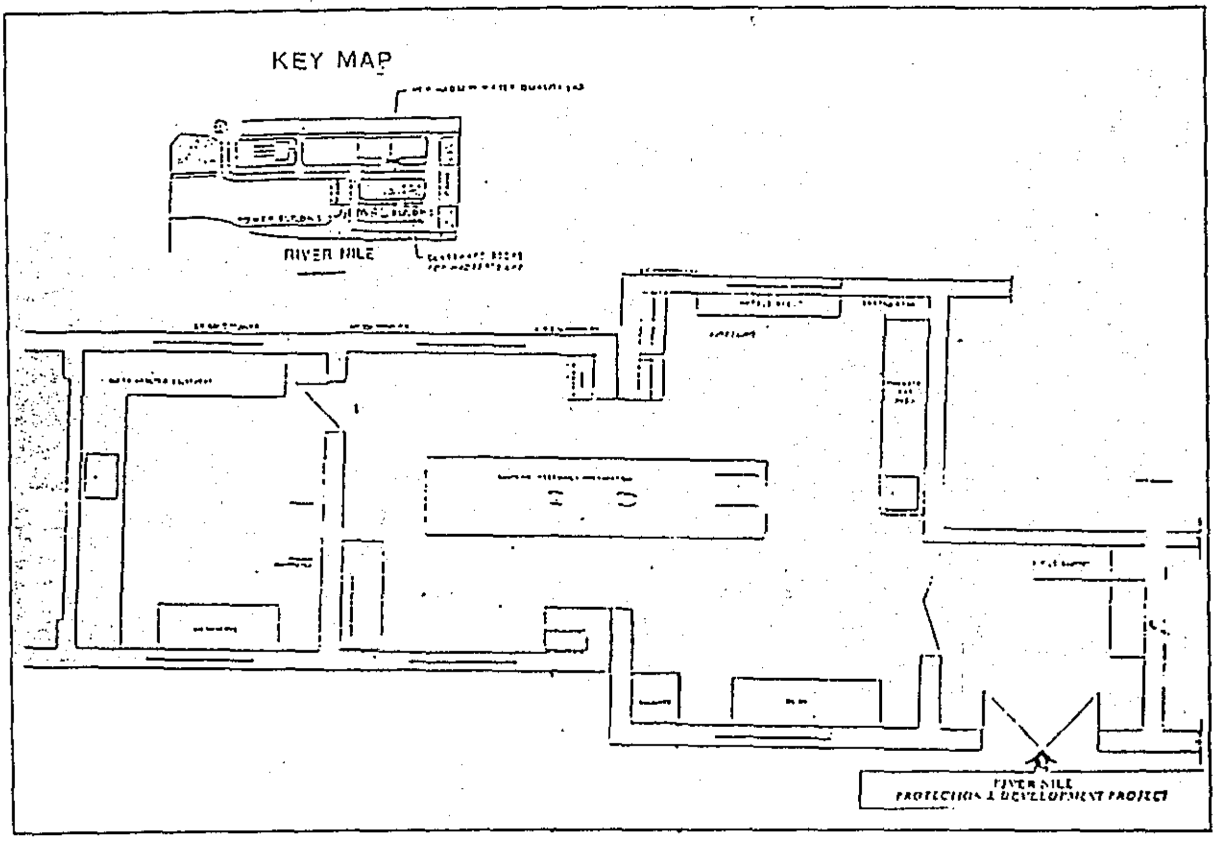
a. Coliform (Fecal & E-Coli)
b. Algea and chlorophyll "a"

HADSERI WATER QUALITY LABORATORY



In a quietly, beautiful park facing the great River Nile at Delta Barrage (Qanater) stands a traditional one story building facing the WRC main building find the new HADSERI Water Quality Laboratory.

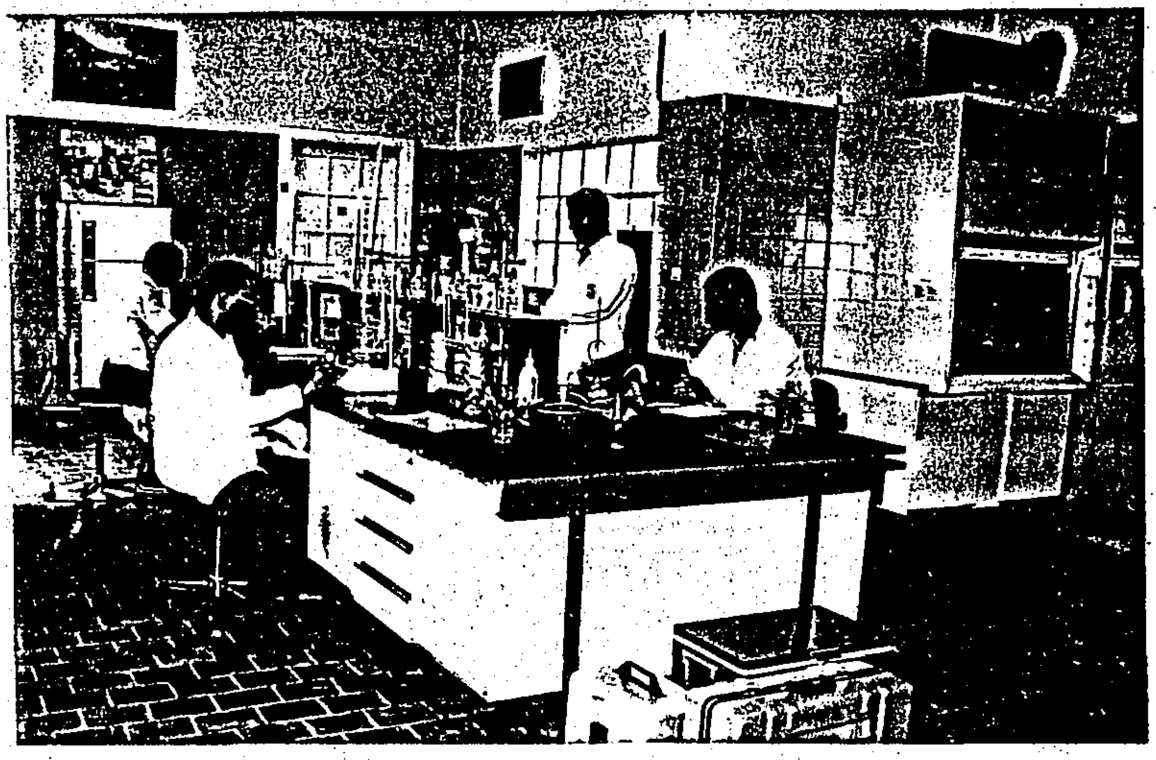
HADSERI WATER QUALITY LABORATORY



The Laboratory contains two unequally rooms, fully air-conditioned, furnished with alkali and acid resident - bench made of wood together with wall and floor cabinets to provide storage area for chemicals and glassware.

The outer room is designed to be used for receiving, preserving and preparing water sampler, operating wet methods analysis for water testing, solids determination, bioligical and biochemical examination. The inner room is designed to be used for heavy metals analysis, flame and spectrophotometer analysis and a computer to receive water quality data.

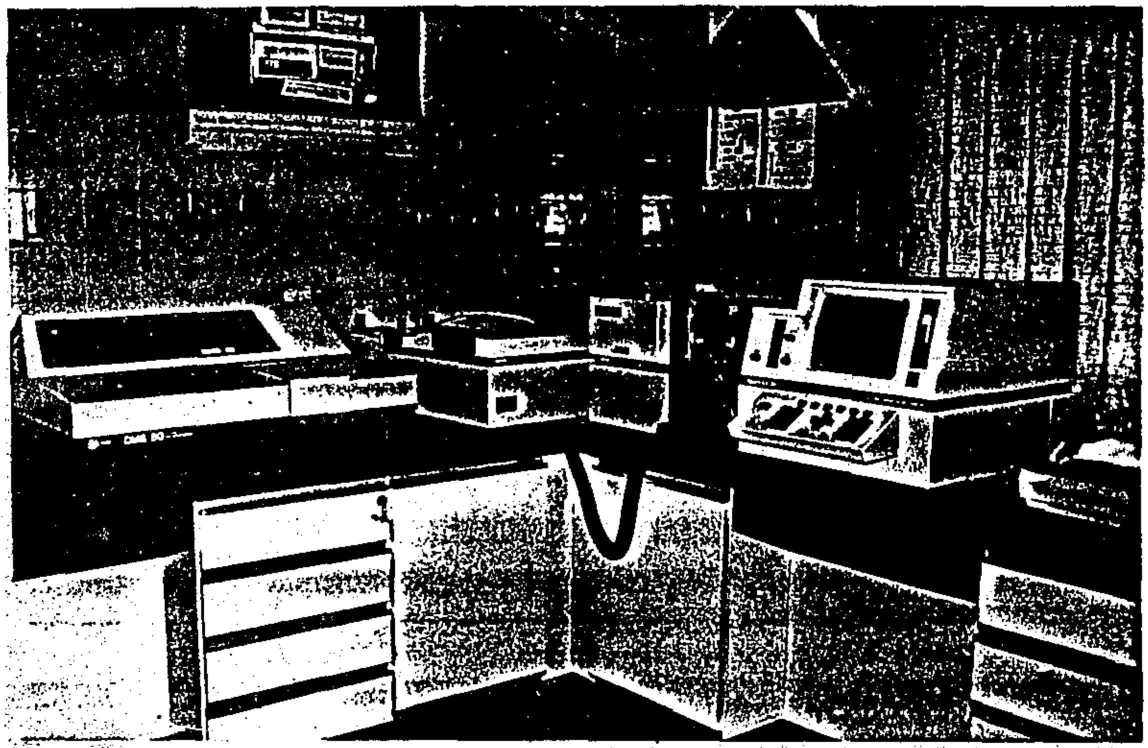
HADSERI WATER QUALITY LABORATORY has been provided with five main groups of instruments and equipment



I. BASIC EQUIPMENTS:

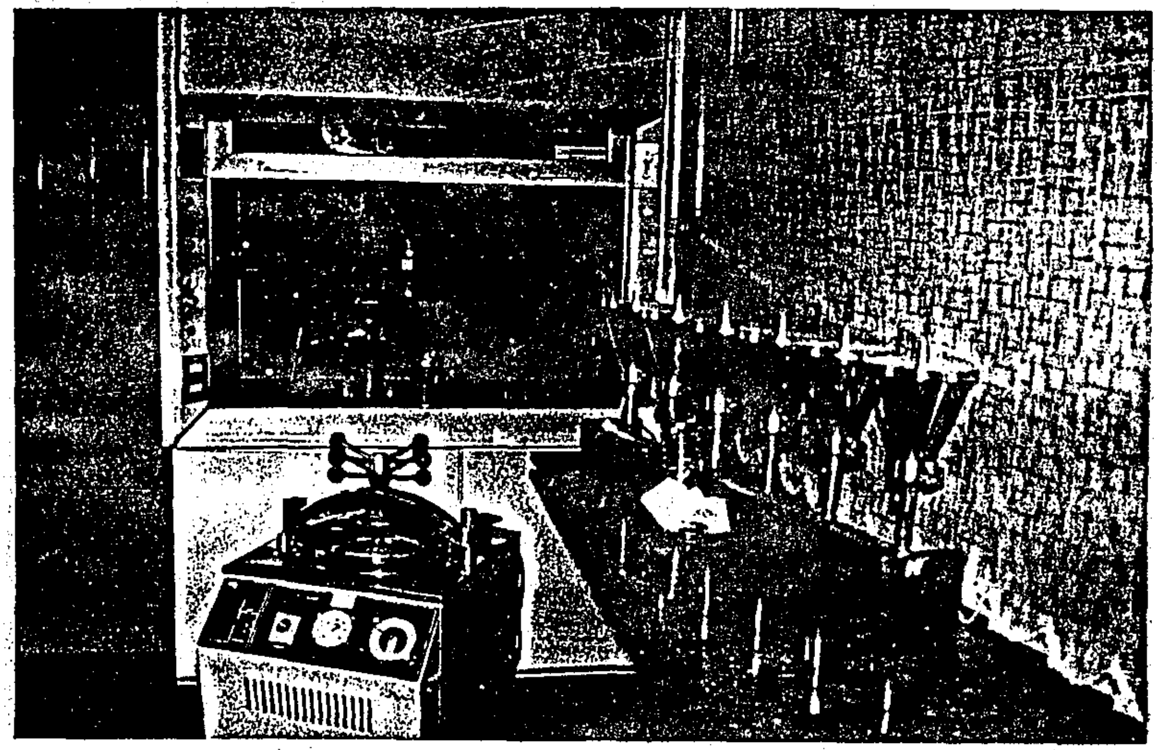
- Automatic water distiller 7L/hour and a water deionizer 120 L/hour.
- Electronic water bath 25 L capacity.
- Immersion cooler units operate down to -10 °C.
- Hot plates, magnetic stirrers and heating mantels.
- Analytical balances of different weighing ranges with a readability down to 0.1 mg.
- Vacuum and pressure pumps.
- Fume hood with dimensions 120 - 88 - 244 cm.
- An oven and a muffle furnace with operating temperatures up to 270 ° C and 1159 °C respectively.
- Refrigerators.
- Macro Kjeldahl digestion and distillation apparatus to accomodates six digestions and six distillations 500 mL Kjeldahl flasks.
- Computer for data collection.

II. ANALYTICAL AND RESEARCH INSTRUMENTS



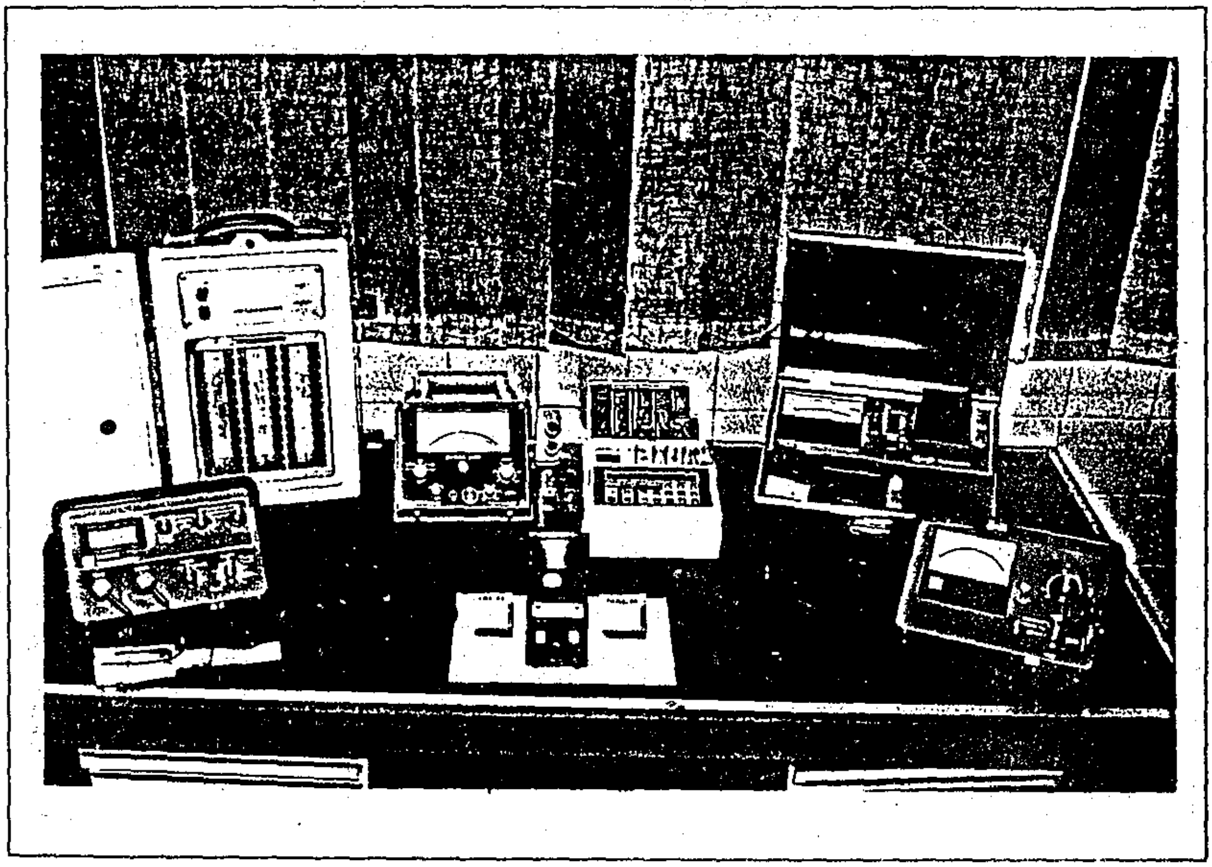
- Atomic Absorption Spectrophotometer, computerized, with Graphite Furnace, Vapor Generation & Emission capability.
- Ultra Violet & Visible Spectrophotometer, microprocessor controlled, 4 - digit readout in ABS, T, CONC., First and Second derivatives.
- Flame Photometer, digital, with Sodium, Potassium, Barium and Calcium filters.
- pH/mV/Ionizer, microprocessor controlled, complete with ion-selective electrodes for some cations and anions.
- Conductivity, Oxygen and Nephelometric Turbidity meters.

III. BIOLOGICAL INSTRUMENTS AND EQUIPMENT



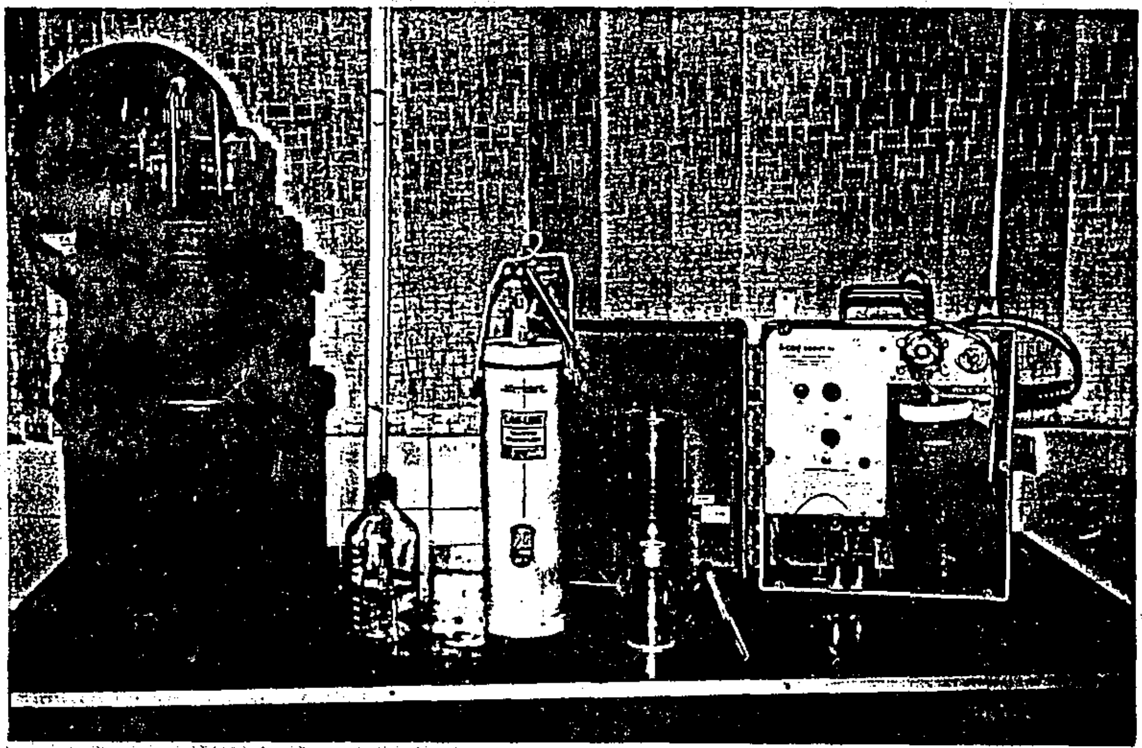
- Refrigerated Incubators from zero to 60 °C.
- Automatic Autoclave.
- Filtration systems made of stainless steel to hold six 500 mL funnels and Cellulose Nitrate membrane filter 0.4 m pore size.
- Centrifuge with Swing out head (8) tubes, Angle rotor (16) tbes and Hematocrit roter (24) tubes.
- Research Microscope.

IV. FIELD INSTRUMENTS AND EQUIPMENT



- Visible Spectrophotometer, single beam, micoprocessor, for direct concentration measuremnets of Ammonia, Nitrite, Chemical Oxygen Demand, Phosphorous, Copper, Sulfide and Detergents.
- Conductivity, Salinity and Temperature meter.
- Oxygen and Temperature meter.
- pH meter.
- Turbidity meter.
- Chlorine comparator for direct concentration of free and total Chlorine.
- Current meter.
- Digital Thermometer.
- Portable Desicator.

V. SAMPLING EQUIPMENT



- Programmable microprocessor, portable, Automatic Samplers accomodate 12 x 1 L glass containers or 24 x 500 mL polyethylene containers.
- Portable Composite Samplers, one gallon polypropylene containers.
- BOD Samplers for 300 mL glass bottles.
- Integrated Water Sampler, autoclavable rigid polypropylene two liters.
- Grab Samplers, hand held for BOD bottles 300 or 1000 mL.

QUALITY ASSURANCE, QUALITY CONTROL AND QUALITY ASSESSMENT

In the field of environmental analysis, Quality Assurance and Quality Control are receiving greater attention by laboratory managers and users of data. It is essential for each laboratory engaged in the generation of data to document the internal quality control practices and protocols, which comprise its quality assurance program. This would assist analysis in the generation of high quality documentation of Quality Control data on "Quality Assessment Forms" and their systematic evaluation.

The need for Quality Assurance has been recognized by the HADSERI Water Quality Laboratory. The laboratory is developing a Quality Assurance and Quality Control documents for analysis within the laboratory. It is anticipated that by implementing these practices, systematic errors will be minimized. The proposed topics covered in those documents include, definitions of analytical terminology, protocols, quality control procedures and practices, guidelines for good laboratory practices, guideline for instrument performance control checks and quality assessment forms.

Let us define "QUALITY ASSURANCE" as the overall verification program which provide procedures and users of data the assurance that predefined standards of quality at predetermined levels of confidence are met.

"QUALITY CONTROL" is the overall system of guidelines, procedures and practices which are designed to regulate and control the quality of products or service with regards to previously established performance criteria and standards.

"QUALITY ASSESSMENT" is the overall system of activities which ensure that quality control is being performed effectively. This is carried out immediately following Q.C. and involves evaluation and additing of Q.C. data to ensure the success of the Quality control program.

WATER QUALITY CONDITION OF THE RIVER NILE

By

A. El Sherbini*
M. El-Moattassem**
H. Sloterdijk

Abstract

A water quality sampling program has been established on the River Nile to describe the condition of water quality in the Nile. Several water quality sampling programs were undertaken between 1976 and 1986 to determine the spatial changes in water quality parameters along the river.

These changes are discussed along with a water quality index which is used to describe the status of the river using data collected in July, 1991. Critical sites have been identified which would be related to the presence of important point sources.

A general pollution control strategy for improving the quality along the river is also presented.

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WATER QUALITY CONDITION OF THE RIVER NILE

1.0 INTRODUCTION

The River Nile can be considered as one of the most important rivers in the world. It is the major water resource in Egypt and is, therefore, subjected to multiple uses. Due to human activities of various kinds along its course such as domestic, commercial, agricultural, industrial and navigation activities, different types of waste material enter the river, affecting its water quality.

Several water quality surveys of the River Nile (from Aswan to the Mediterranean Sea) were undertaken between 1976 and 1986. The main objective of these surveys was to evaluate Nile water quality and the potential effects of some pollutants with respect to different water uses. The historical data show that the quality of the water has deteriorated in some locations. The situation is probably getting worse with time, as the discharge of wastes is increasing.

These observations led to the need to establish a permanent water quality monitoring program along the River Nile from Aswan to the Mediterranean Sea. This program was set up in 1991 in order to achieve the following objectives (El Sherbini et al 1990):

- to serve as a general reference of water quality conditions in the river,
- to detect -stream standard violations and maintain effluent standards, and
- to determine the seasonal variations in water quality in the river and point sources of pollution.

Thirty-five sampling sites were selected (Figure 1). Priorities were given to 13 major sites with respect to barrage locations and heavily polluted areas. In addition, sampling of all of the major point sources was carried out.

The number and the location of the sampling sites were determined taking into consideration (El Sherbini et at, 1990):

- minimizing sampling effort and maximizing spatial information, and obtaining more comprehensive information at specific sites for control purposes.

In this paper we will discuss the spatial changes in water quality using the most recent data which were collected in July, 1991 between Aswan and Delta Barrage. The two branches will be discussed in another paper.

2.0 INTEGRATED EFFECT OF THE WATER QUALITY PARAMETERS

The increase of population, industrialization and agricultural activities result in more and more wastes entering the Nile River. The Ministry of Public Works and Water Resources issued Law 48-1982 regarding the protection of the River Nile and its various waterways in order to maintain and control the water quality for its different uses.

However, little effort has been made to keep the general public informed in simple and understandable terms. One of the more effective ways to communicate information on water quality to policy makers and the general public is by means of indices. The Water Quality Index (WQI) may be defined as a rating reflecting the composite influence of a number of parameters on the overall water quality (Tiwari et al., 1987). It is calculated by using a simple equation developed by Tiwari et al., 1987 with some modifications to suit our situation which allow us to discriminate between locations and to give an overview on the overall water quality conditions.

2.1 Method of Approach

For the purpose of the present study, 10 water quality parameters were considered according to their importance as pollution indicators and the availability of standards (also known as water quality criteria). These parameters and corresponding standards are listed in Table 1.

In the formulation of the water quality index (WQI), the importance of the variable depends on the intended use of the water. In this paper we calculate the WQI from the point of view of stream water quality criteria with regard to all uses: raw water intake for the production of drinking water, recreational and aesthetics, fresh water aquatic life, agricultural uses, industrial water supplies, etc., (Bhargawa, 1985). We have used the "Standards" stated in the Egyptian regulation "Decree No.8 for 1983, Article 60" whenever available. In some cases, when the Egyptian regulation has not set up standards, we have used the standards recommended by the United States (EPA) or surface water standards suggested by Hammer (1986). These standards for stream water quality criteria are given in Table 1, and must be taken as the upper limit, except for dissolved oxygen, where it represents the lower limit.

The quality rating q_i for the i^{th} water quality parameter can be obtained by the following relation (Tiwari et al., 1987):

$$q_i = 100 \; (V_i/S_i) \qquad (1)$$

where V_i = observed value of the i^{th} parameter at a given sampling site and S_i = stream water quality standard. Equation (1) ensures that q_i = 100 if the observed value is just equal to its standard value. Thus, the larger the value of q_i, the more polluted the water is with respect to the corresponding pollutant.

The exception to Equation (1) is the quality rating for dissolved oxygen, which requires special handling because the quality of water is enhanced if it contains more oxygen. The rating equation takes the following form (Das et al. 1986):

$$q_{DO} = 100 \left[\frac{DO_{Sat.}}{(DO_{Sat} - 5.0)} - \frac{V_{DO}}{(DO_{Sat.} - 5.0)} \right] \ldots . (2)$$

Where V_{DO} = observed value of dissolved oxygen, DO_{Sat} = saturation level of dissolved oxygen in mg/l corresponding to the measured water temperature, and 5.0 is the standard value (mg/l). Thus q_i = O, when V_{DO} = saturation level (in mg/l) and q_i = 100, when V_{DO} = 5 mg/l; for simplicity, V_{DO} will be taken as saturated whenever it exceeds the saturation level.

2.2 Calculation of the Water Quality Index

To calculate the water quality index, we determine first the quality rating q_i corresponding to the i^{th} parameter by using the Equations (1) and (2). The overall water quality index can then be calculated by aggregating these quality ratings linearly as follows:

$$WQI = \sum_{i=1}^{n} q_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where n = number of parameters.

The average water quality index (AWQI) for n parameters will be calculated using the following equation:

$$AWQI = \frac{\sum_{i=1}^{n} q_i}{n} \quad \ldots\ldots\ldots\ldots (4)$$

The AWQI = 0 when all pollutants are absent, and the AWQI = 100 when all pollutants reach their permissible limits. Values of AWQI exceeding 100 indicate that the river may be suffering from serious pollution problems. However, with some parameters above and some below the standard values, averaging may result in an AWQI above or below 100, depending on the relative contribution of each parameter.

The AWQI was calculated for 31 sampling sites along the River Nile, from Aswan to Delta Barrage, assuming equal weighting for all parameters used in the index calculation. The following discussion on the quality of the River Nile is limited, of course, to the parameters used in the index calculations. Thus, it is in no way conclusive on the river's conditions, since toxic chemicals (contaminants) have not been considered, due to a lack of data.

2.4 Results and Discussion

2.4.1 Water Quality Index

A critical study of Figure 2 reveals many interesting features regarding the quality of the Nile and its variation along its course from Aswan to Delta Barrage. In the first place, we observe that the AWQI at site 0, upstream from the High Aswan Dam, is very low (17). The index increases downstream from the Dam, varying from 21 at site 11 to 108 at site 14. Another interesting feature of Figure 2 is that at most sampling sites the indices are below 100, the exception being site 14. Also, about 90% of the sites have an index below 50.

In the second place, the highest levels of pollution were observed at a few locations only (sites 13 and 14). This is most likely the result of high pollutant loads from the point sources (industry, major agricultural drains and urban centers) located immediately upstream from these sites.

In the third place, we found that the AWQI varies from site to site according to the specific water quality parameter contribution (Figure 3). For example, dissolved oxygen seems to be a problem mainly immediately downstream from the High Aswan Dam. Coliforms are an important contributing factor at some sites only, especially at site 14.

In order to rank the water quality parameters according to their contribution to the WQI, we have given 1 for the parameter which has highest contribution and 10 for the parameter which has lowest contribution. This was done at each site. Theoretically, the parameter which has the highest contribution will get a rank of 31 (i.e., scoring 1 at all the 31 sites), and the parameter which has lowest contribution will get a rank of 310 (i.e., scoring 10 at all the 31 sites).

The water quality parameters were ranked in descending order, according to their contribution to the overall water quality index, as shown in Table 2. Chemical and Biochemical Oxygen Demand rank as the most important parameters, mainly because they contribute significantly at all stations, while surfactants, nitrate and organic nitrogen values were never observed to be above stream standards.

2.4.2 Variations of Water Quality Parameter Values

The water quality parameters varied along the entire course of the River Nile from Aswan to Delta Barrage as shown in Figures 4a - j.

Dissolved Oxygen (DO): The DO levels fluctuated along the river between 3.1 mg/l at site 1 and 9.5 mg/l at site 15. The DO levels along the river violated the standard value of 5 mg/l at 4 sites only: 1, 2 and 3.

Chemical Oxygen Demand (COD): The concentrations of COD along the river varied between 5 mg/l (site 0) and 25 mg/l (site 20). About 65% of the sites were below the standard value of 10 mg/l. The highest values were observed at 9 sites only: 16 - 21, 23, 25, 27 and 30 where inputs from point sources are important.

Biochemical Oxygen Demand (BOD): The concentrations of BOD varied between 0.4 mg/l at site 5 and 4.7 mg/l at site 20. Along the river, the concentration of BOD was observed below the standard value (6 mg/l). Its spatial distribution pattern is similar to the one observed for COD.

Total Phosphorus (TP): The concentrations of TP were between 0 mg/l at sites 0,1,2 and 7, and 0.077 mg/l at sites 28 and 30. Concentrations were below the standard value of 0.1 mg/l at all sites from Aswan to the Delta Barrage.

Fecal Coliforms: The fecal coliform counts (Most Probable Number = MPN) varied between 14 MPN/100 ml at site 0 and 12000 MPN/100 ml at site 14, exceeding the standard value (2000 MPN/100 ml) at 4 sites only: 4, 13, 14 and 24.

Total Coliforms: Total coliform counts fluctuated along the river between 76 MPN/100 ml at site 0 and 33600 MPN/100 ml at site 13, exceeding the standard value (10,000) at only 5 sites: 4, 13, 14, 15, and 29.

Ammonia (NH_3): The concentrations of NH_3, fluctuated between 0.01 mg/l at sites 1, 2, 11, 12, 15, 16, 21, 23, 25 and 29, and 0.6 mg/l at site 8. Concentrations were below the standard value (0.5 mg/l) except at site 8 where it exceeded this standard value by 20%.

Surfactants: Concentrations of surfactants were mainly between 0.008 and 0.06 mg/l. An extreme value of 0.18 mg/l was observed at site 27, which is still well below the standard of 0.5 mg/l.

Nitrate (NO_3): The concentrations of NO_3 along the river were very low and below the standard value of 45 mg/l. It fluctuated between 0.87 mg/l at site 24 and 3.8 mg/l at site 19.

Organic Nitrogen: Organic nitrogen concentrations along the river were very low and below the standard of 1 mg/l. It fluctuated between 0.01 mg/l at sites 3, 5, 7, 8, 10, 22, 25, 27, 28 and 29, and 0.08 mg/l at site 11.

2.4.3 Conclusions

The use of a simple water quality index (WQI) enabled us to integrate the results from the July, 1991 campaign into a single number for each site.

A spatial comparison, using the WQI, of the different sampling sites along the Nile has been made. The most polluted sites along the river was found to be in the reach between Naga Hammadi and Assuit, which can be explained by the presence of point sources immediately upstream. Sites 13 and 14, just downstream of the Naga Hammadi Barrage were highly polluted by coliforms. High levels of nutrients and coliforms were important contributing parameters for the WQI rating.

Low oxygen levels seem to be a problem immediately downstream from the High Aswan Dam. This may be due to the Dam's discharge, which delivers water from Lake Nasser at lower depths. In general, high COD values occur at most stations. It is the major contributing parameter to the WQI rating, except at the stations mentioned above.

3.0 RECOMMENDATIONS FOR ENHANCING THE QUALITY OF THE RIVER NILE

With the increase in water demand for domestic, agricultural and industrial uses, the quantities of wastewater requiring treatment and disposal are rising rapidly. In Egypt, a variety of waste effluents and run-off are frequently discharged directly into the river at several locations. This is done either without any or with little treatment.

Agricultural activities have introduced several substances, such as nutrients, into the water through the excess agricultural water drains. About 88 of these drains are located on both sides along the River Nile from Aswan to the Mediterranean Sea. These drains often also receive municipal and industrial wastes, which are then discharged directly into the River Nile.

Most of the population of Egypt is concentrated along the narrow fertile strip of the Nile valley in urban centers. These centers discharge their wastes and runoffs either directly to the Nile or through drains which also flow into the river. Much effort should be made towards a substantial clean-up of urban waste effluents.

River development works along the Nile could also help to improve the situation by increasing the river discharge and modifying its configurations to augment the surface area, bed slope, velocity, etc., for better re-aeration and assimilative capacity.

Thus, there is an urgent need to establish a pollution control program to improve and maintain the water quality of the River Nile, not only in the more heavily polluted areas, but also at all possible identifiable point sources of wastewater entering the river. Such a control program would involve several approaches, including some which are described below.

1 Improved Agricultural Practices

After the High Aswan Dam construction, the Egyptian lands lost much of their natural fertility, which introduced the need for chemical fertilizers. As a result of the dam construction the irrigation system also changed, increasing weed growth and the use of insecticides and herbicides. Thus, during the last few decades, these modern agricultural activities have introduced several polluting substances such as organic matter, chemical fertilizers, insecticides, herbicides, etc., into the river through surface runoff, erosion and drainage systems.

To decrease this pollutant load, the existing agricultural practices must be improved through (i) an efficient, optimal and economical use of chemicals, (ii) erosion control in the fields, and (iii) recycling of organic wastes back onto the agricultural lands.

3.2 Wastewater Treatment

There are several industrial outfalls discharging their wastes directly into the Nile without any or with little treatment. These wastes should undergo appropriate treatment before their final disposal. Otherwise, the industries should be advised to reduce their waste load generation through the following:

- efficient use of raw materials used in the industrial production,
- applying the most appropriate technologies and modifications which suit the local conditions, and
- practicing the recycling of wastewater.

4.0 REFERENCES

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Hammer, M. J. (1986). Water and Waste Water Technology, Second Edition, New York: John Wiely & Sons, Inc. PP169.

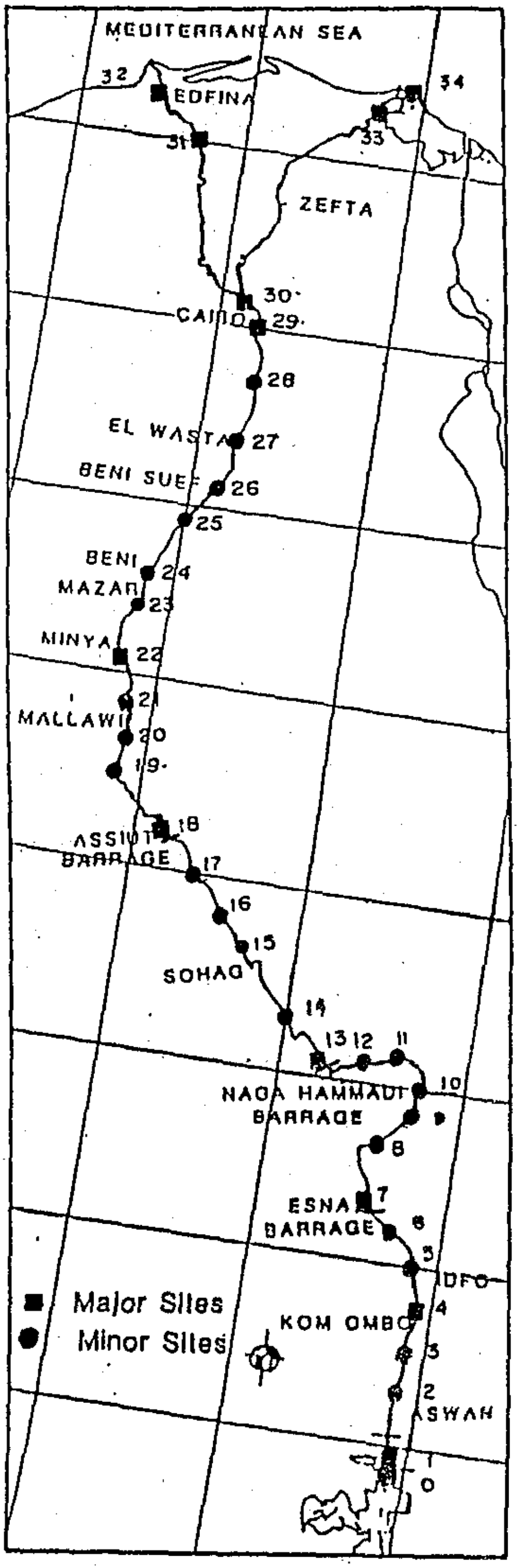
Table 1. Water Quality Parameters and Their Standards

Water Quality Parameters	Standard Value	Recommending Agency
Dissolved Oxygen	5 mg/l	Egyptian
Biochemical Oxygen Demand	6 mg/l	"
Chemical Oxygen Demand	10 mg/l	"
Total Phosphorus	0.10 mg/l	U.S. EPA
Ammonia	0.50 mg/l	Egyptian
Nitrate	45 mg/l	"
Organic Nitrogen	1 mg/l	"
Fecal Coliforms	2,000 MPN*/100 ml	Hammer (1986)
Total Coliforms	10,000 MPN*/100 ml	" (1986)
Surfactants	0.5 mg/l	Egyptian

* MPN = Most Probable Number

Table 2: Descending Order of the Water Quality Parameters Contribution

Contribution Order	Parameters	Calculated Rank
1	Chemical Oxygen Demand	52
2	Biochemical Oxygen Demand	117
3	Total Phosphorus	137
4	Fecal and Total Coliform	141
5	Ammonia	167
6	Dissolved Oxygen	212
7	Surfactant	229
8	Nitrate	234
9	Organic Nitrogen	258



Sampling Locations

Figure (1)

Average Water Qality Index (AWQI)
along the River Nile
July,1991

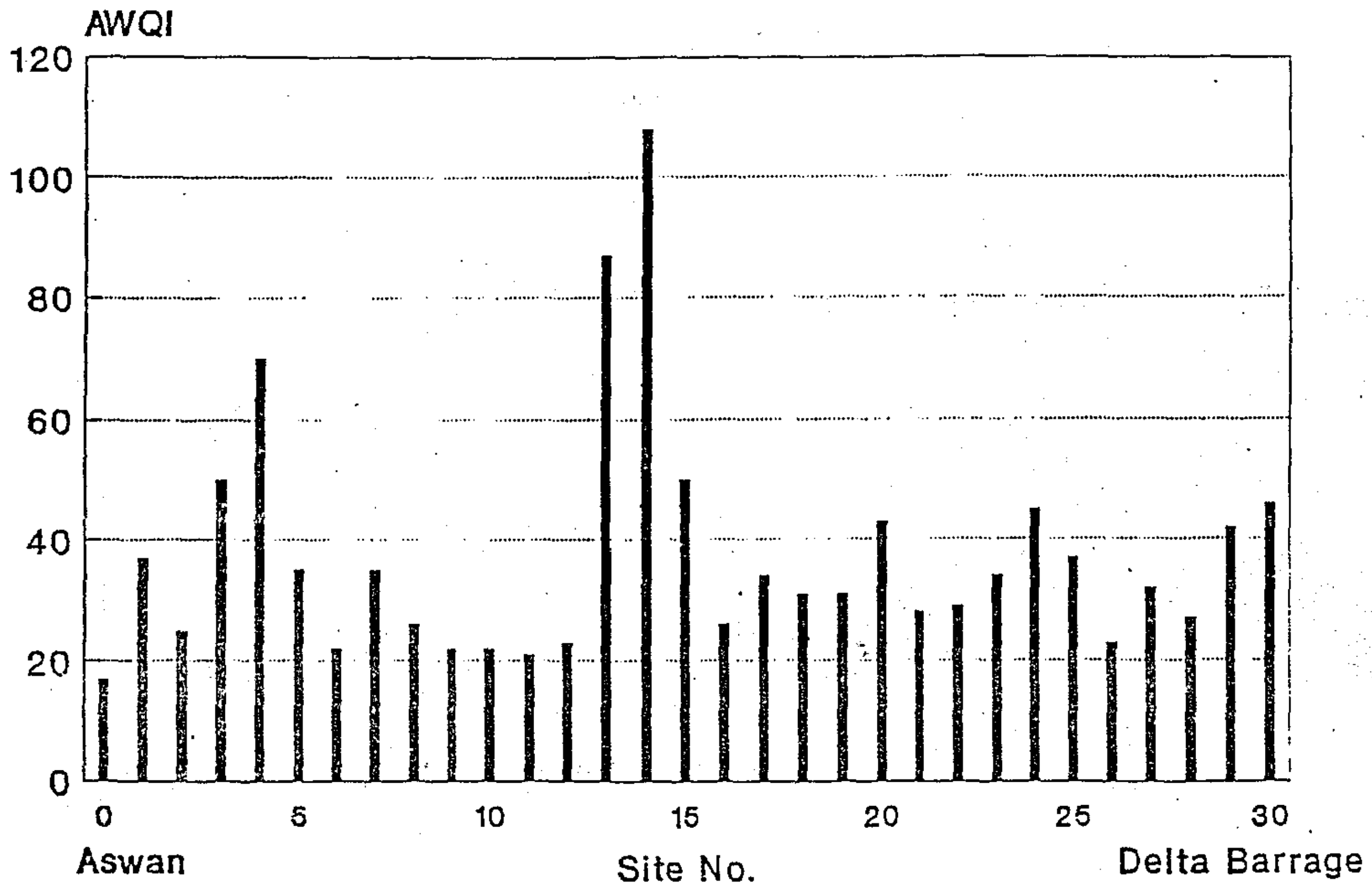


Figure (2)

Water Quality Parameters Contribution

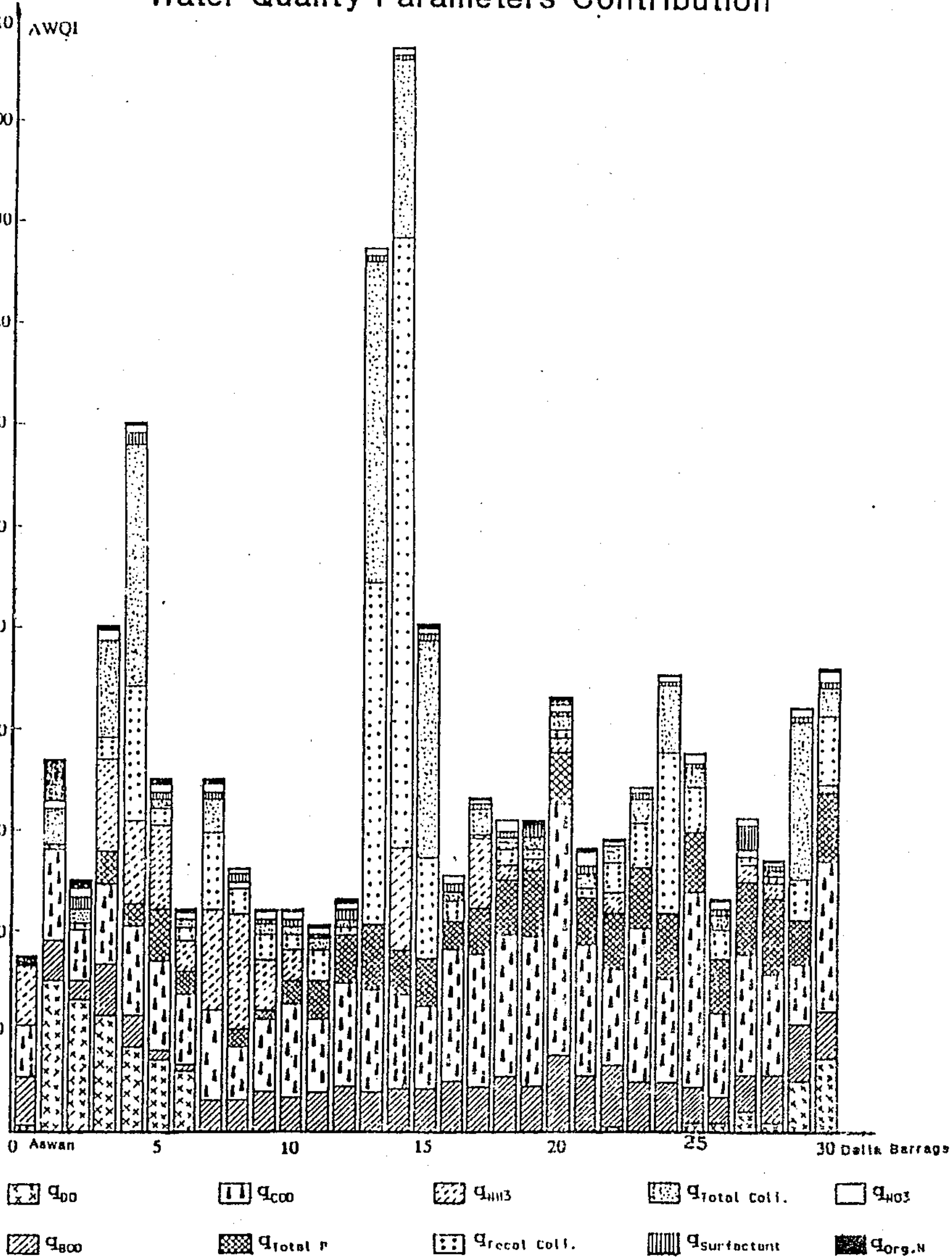


Figure (3)

Variations of Water Quality Parameters

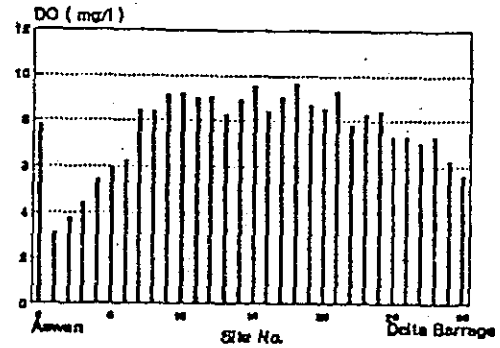


Fig. (4-a)

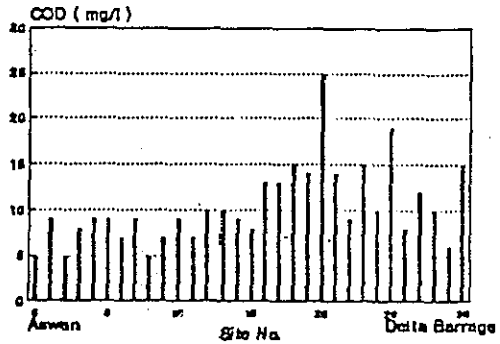


Fig. (4-b)

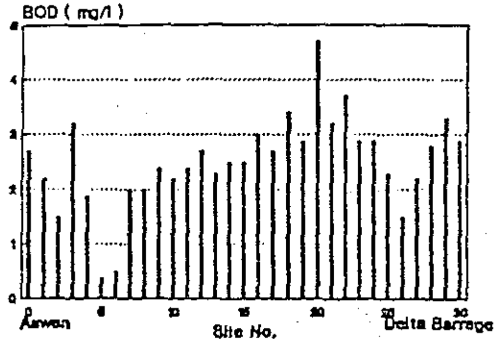


Fig. (4-c)

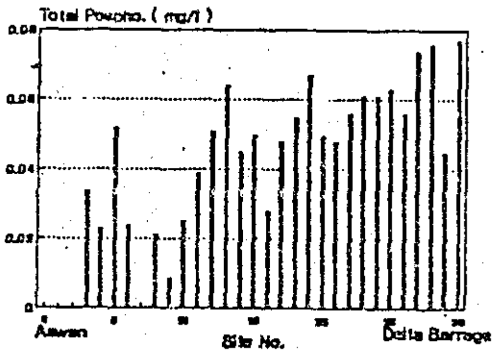


Fig. (4-d)

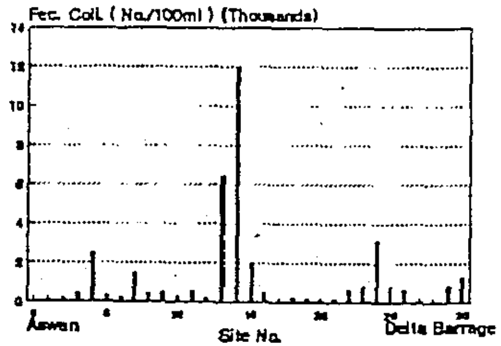


Fig. (4-e)

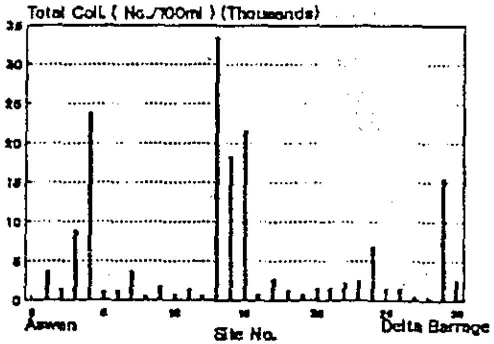


Fig. (4-f)

Variations of Water Quality Parameters

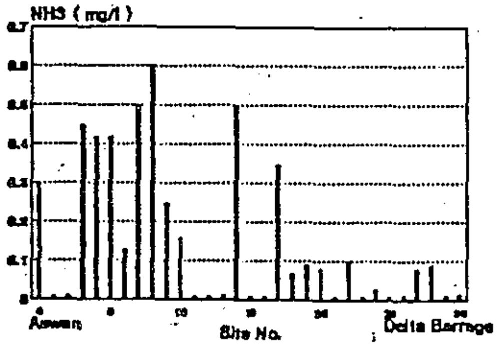


Fig. (4-g)

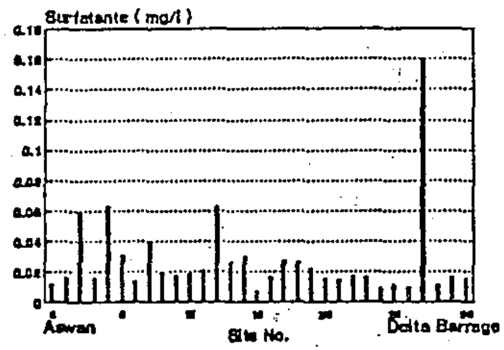


Fig. (4-h)

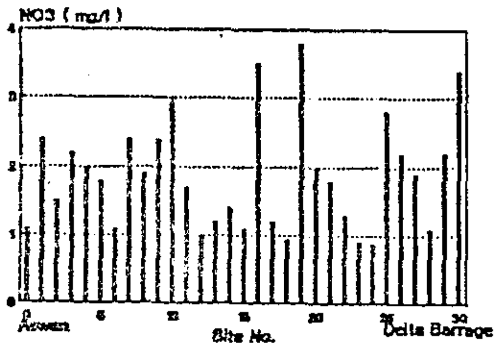


Fig. (4-i)

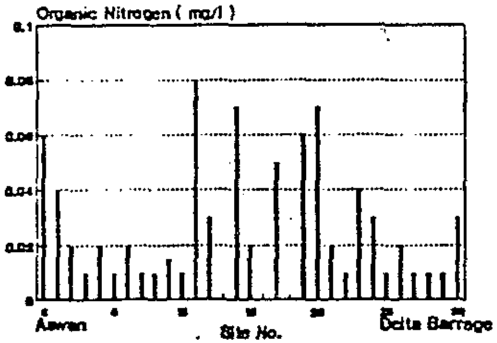


Fig. (4-j)

廃 棄 物

SOLID WASTE

Dr. Mounir S. Neamatalla
President of EQI

TABLE 1

Estimated Household Waste Composition for High Middle, and Low-Income Neighborhoods in Cairo
January 1991

Solid Waste Component	High Income		Middle Income		Low Income	
	%	Qty (Ton/ per day)	%	Qty(Ton/ per day)	%	Qty(Ton/ per day)
Fixed Glass	3.00	36	2.60	78	1.00	18
Mixed Plastics	0.60	7.2	0.20	6	0.00	0.00
Non-Ferrous Metals	0.21	2.52	0.16	4.8	0.00	0.00
Copper	(0.00)	0.12	0.01	0.3	(0.00)	0.00
Aluminum	0.02	0.24	0.00	0.00	0.00	0.00
Zinc Batteries	0.18	2.16	0.15	4.5	0.00	0.00

N.B. Household wastes are not the only source of glass and non-ferrous metal waste.

Source: M.S. Neamatalla. Solid Waste Management Practices in Cairo Progress Report. Environmental Quality International

April 1981, p.54. Revised for 1991 percentages.

TABLE 2

Market Values of Recovered Materials and Prorated Revenues
Per Ton of Refuse for High, Middle, and Low-Income Neighborhoods

January 1991

Solid Waste Component	Market Value (LE/Ton)	Revenue/Ton of Refuse		
		High	Middle	Low
Mixed Glass	40.00	1.20	1.04	0.40
Mixed Plastics	750.00	4.50	1.50	0.00
Non-Ferrous Metals				
Copper	3,000.00	0.30	0.30	0.00
Aluminium	1,000.00	0.20	0.00	0.00
Zinc (Batteries)	100.00	0.18	0.15	0.00
Inerts, Rejects, and Organic Fines	0.00	0.00	0.00	0.00

Source: Neamatalla. Op. Cit., P.52. Revised for 1991 Prices

FIGURE 1

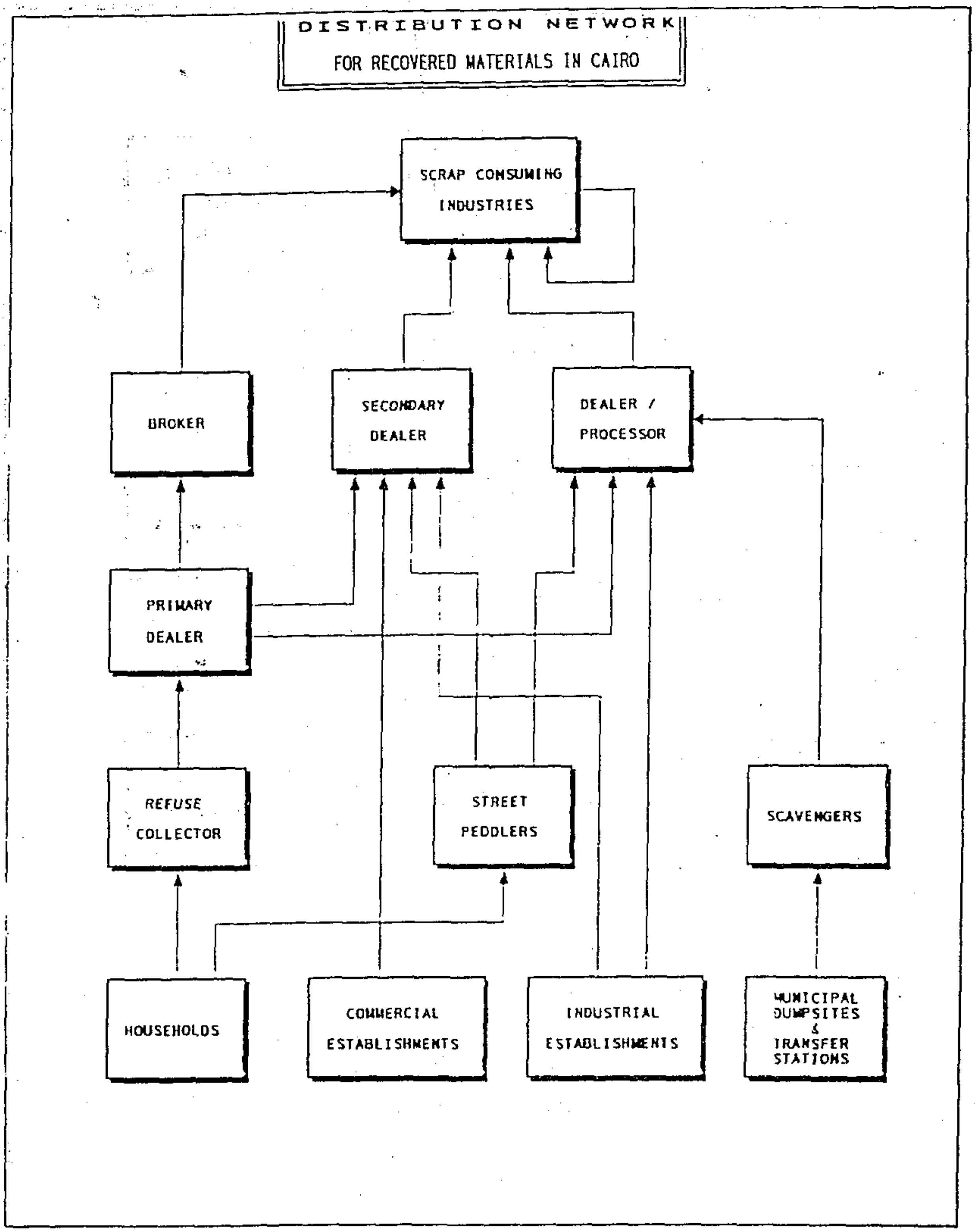
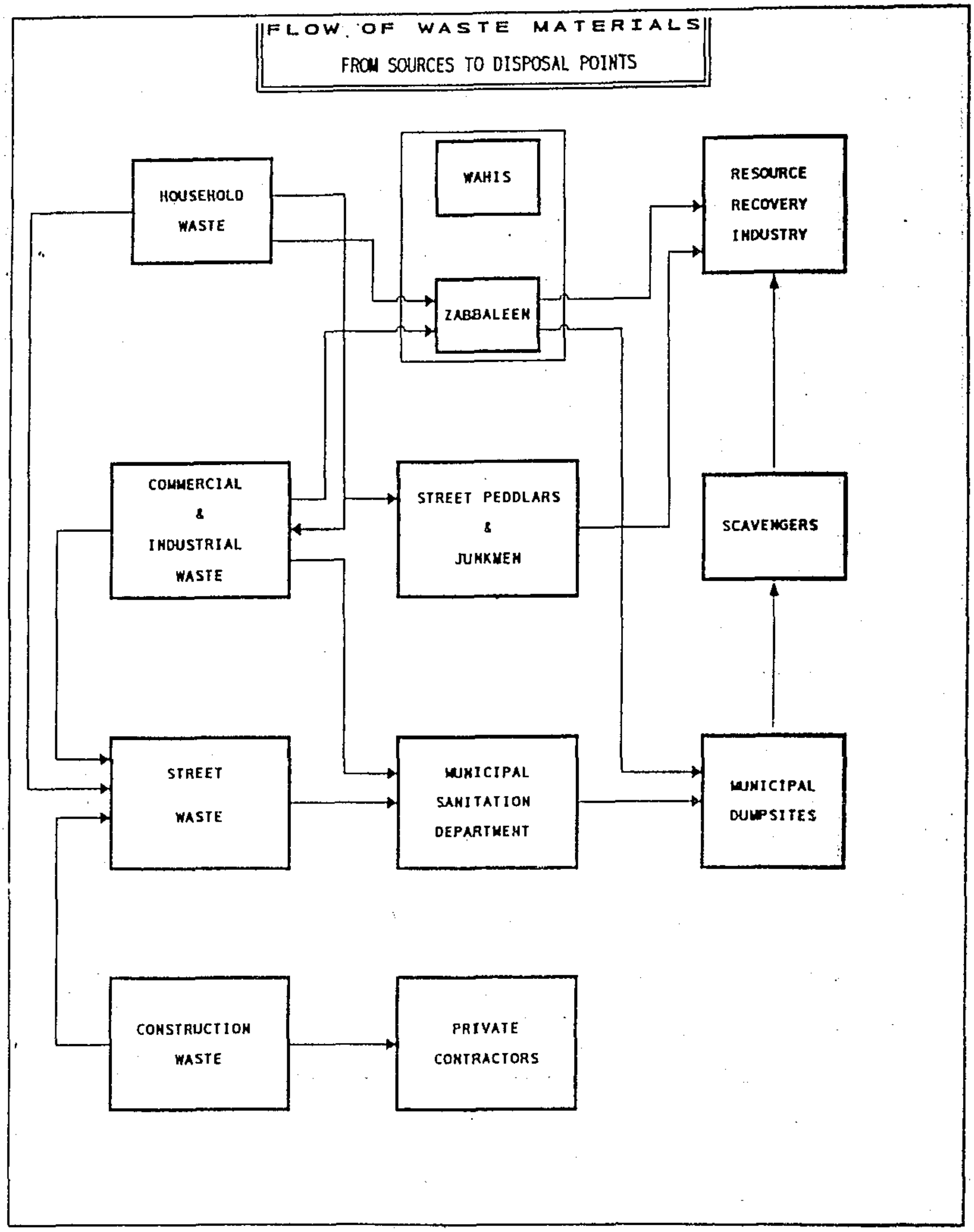

DISTRIBUTION NETWORK
FOR RECOVERED MATERIALS IN CAIRO
SCRAP CONSUMING INDUSTRIES
BROKER
SECONDARY DEALER
DEALER / PROCESSOR
PRIMARY DEALER
REFUSE COLLECTOR
STREET PEDDLERS
SCAVENGERS
HOUSEHOLDS
COMMERCIAL ESTABLISHMENTS
INDUSTRIAL ESTABLISHMENTS
MUNICIPAL DUMPSITES & TRANSFER STATIONS

FIGURE 1


FLOW OF WASTE MATERIALS
FROM SOURCES TO DISPOSAL POINTS
HOUSEHOLD WASTE
WAHIS
ZABBALEEN
RESOURCE RECOVERY INDUSTRY
COMMERCIAL & INDUSTRIAL WASTE
STREET PEDDLARS & JUNKMEN
SCAVENGERS
STREET WASTE
MUNICIPAL SANITATION DEPARTMENT
MUNICIPAL DUMPSITES
CONSTRUCTION WASTE
PRIVATE CONTRACTORS

SUMMARY

The recycling of solid waste in any country is closely tied to the whole solid waste management system. Several factors affect and shape recycling activities. These are: the relevant government policies, the municipal and private sector approaches to recycling, available human resources and labor, waste collection methods, the end-products and their potential markets, and the origin of recycling equipment.

In Egypt generally, and in Cairo specifically, household waste collection is undertaken mainly by garbage collectors or "zabbaleen" who not only collect household waste, but also transport it, sort it, pile it, and sell and/or process certain waste materials. Over the last ten years, some waste collectors or zabbaleen have become dealers who buy and sell specific components of waste material such as plastic, rags, etc... while other zabbaleen have become involved in processing or recycling material recovered from waste.

In Cairo and some other Egyptian cities such as Alexandria and Tanta, the recycling industry has grown rapidly. It is dominated by the private sector, and thus creates healthy competition among entrepreneurs. Most of the recycling equipment and machines are locally manufactured in these cities; labor is both available and cheap, and the end-products of recycling are therefore reasonably priced. The most important element supporting the recycling industry in Egypt is the highly skilled labor force engaged in this industry which is responsible for the manufacturing and the operation of recycling machines, and for innovating recycling processes and end-products. It is very difficult to obtain exact measurements of temperatures and quantities of the various recycling processes, as most of them are done manually, on a trial and error basis. It is also difficult to obtain models and registrations for locally made machinery for the following reasons:

1. They are made on an individual, and not a mass production, basis.

2. They are not registered in the Chamber of Commerce.

3. They are not copies of the imported machines, but machines modified to fit the local conditions.

4. Recyclers do not care if these machines are registered models or not.

Egyptian government policy encourages the recycling industry as a local alternative to importing raw materials. At present, the government is trying to promote recycling as a potential alternative to unemployment and underemployment. For example, with the help of development agencies such as the Social Fund for Development under the auspices of the World Bank, the government is trying to simplify the lending processes of different financial institutions, allocate revolving funds for credit loans, establish technical assistance services and simplify administrative laws and decrees with respect to employment, social security and taxation. In addition, the increase in prices of most imported end-products and raw materials, which are brought in under the Open Door Policy, encourages consumers to buy locally manufactured raw materials or end-products produced by the recycling industry, in spite of their inferior quality.

The markets for various recycled materials differ. Plastics are the most marketable materials, for example. The market for certain recycled material such as glass is subject to social demand. Other materials such as zinc from household batteries, and cooking oil, are difficult to collect in large quantities. Certain materials require more sophisticated recycling equipment (e.g. hard rubber, refining motor oil).

In the final analysis, it can be stated that in Egypt, the most profitable and feasible of the six recycling industries discussed in this report is the plastic recycling industry. The recycling of cooking oil comes second, followed by glass (which requires highly skilled labor and relatively costly equipment), and finally, rubber. The recycling industries for batteries and motor oil are the least feasible of the six industries.

上下水道

DRINKING WATER

AND SEWAGE STATUS

IN EGYPT

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*

By: MOHAMED KHALED MOSTAFA

NOV. 1991

DRINKING WATER AND SEWAGE STATUS IN EGYPT

DRINKING WATER SYSTEM :

THE NILE is the source of drinking water to 55 million of the population living in more than 4500 communities ranging from 500 to more than 10 millions inhabitants , mostly situated around the NILE valley .

Design Criteria , The main parameters affecting the design are ,

- Population , is decided with an annual growth rate of 2.7 % for the year 2025 to be served .
- Per capita water consuption , it varies , correlated to the size of community . It ranges from 110 L./C./D. for small communities in rural areas , to 220 L./c./d. for big cities .

Treatment System , The NILE water has to be purified & disinfected according to the Egyptial standards before it is allowed to be distributed to the consumers . At present there are more than 100 water treatment plants with capacities ranging from 50 to 1300 L./S. & more than 250 small water treatment plants with capacity of 30 L./S. . These plants are designed to treat the surface water through ; pre- chlorination , cougulation , sedimentation , filtration and post - chlorination .

In addition , there are in operation now more than 3500 schems of ground water plants comprising of about 4800 wells , producing about 50 % of the treated surface water capacity . These plants are designed simply by applying just chlorination , as disinfection ,

However , in some cases , to attain the water quality standards , treatment to remove iron (Fe) & manganese(Mn) is needed . Removal of iron & manganese is achieved by ;

- Areation followed by filtration method
- Dry filtration method , i.e. trickling over a sand bed media .
- Ion exchange method (Zeolite process)

However , in 1989 the total potable water supply capacity was as 9.366 million M^3 ./day . , with an average of 180 L./ cap./ day., the development of the supply capacity from 1952 to 1992 (planned) is seen in fig.(1) for cairo , rural areas & Alexandria , a detail for which , including the development of average consumption rate per capita/ day is cleared in fig,(2) .

<u>Distribution System</u> ; The system to convey drinking water to the consumers is varies correlated to urban & rural areas.

- For rural areas ; Either public fountains or combination of house connections from a pipe net small system & public fountains too .

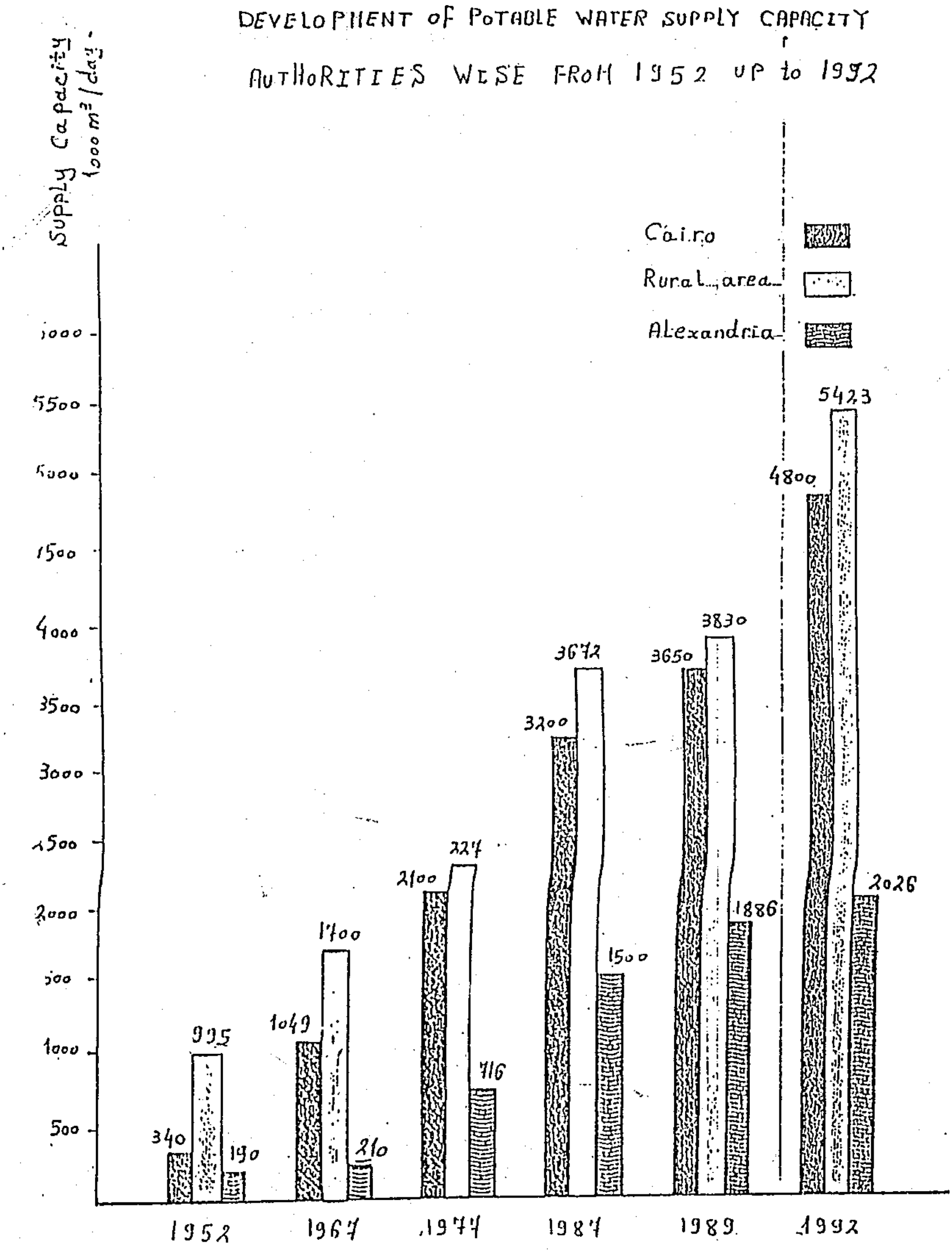

DEVELOPMENT OF POTABLE WATER SUPPLY CAPACITY
AUTHORITIES WISE FROM 1952 UP to 1992
Supply Capacity
1000 m³/day
Cairo
Rural area
Alexandria
5500
4000
3500
3000
2000
1000
500
340
995
190
1049
1700
210
2100
224
716
3200
3672
1500
3650
3830
1886
4800
5423
2026
1952
1967
1974
1987
1989
1992

FIG. 1

- For urban areas ; A pipe net , boosting units , storage facilities (underground & elevated) system is used to convey the treated water through the house connections to the consumers .

Operation & Maintenance ; Operation & maintenance are the responsibility of the local governorates . Chemicals , as alum & Chlorine are locally available . Also , pipes , fittings & valves are locally manufactured .

Water Tarrif ; In general , still the government is subsidising the consumers . In rural areas it is almost free , while the tarrif is covering about 50 % of the O & M cost for rural population with house connections , & 70 % of the O & M cost for the urban population . However , the tarrif is increasing yearly to cover the 100 % of the O & M cost mostly in 1997 .

System of invoicing the consumers is not so adequate , it is based mostly on average by distributing the consumed quantity according to the main meter record to each flat of the building .

Quality of drinking water ; Egyptian standards for drinking water are shown in fig.(3) for both chemical standards & bacteriological standards . Ministry of Health is the concerned authority to govern & control the capability of the treated water & the quality of the distributed water to consumers .

However , from the health & environment point of view, the bacteriological characteristics are of most importance . Surface water is endangered by the unscientific ways of domestic , & industrial waste disposed . The ground water is not an exception , but in general the main body of the ground water is still safe , though the high density populated areas in the NILE valley has created favourable conditions for contaminants to affect the ground water .

DEVELOPMENT OF POTABLE WATER SUPPLY CAPACITY

From

1952 UP TO 1992

	1952			1977			1987			1989			1992		
	Population in thousand	Supply Capacity 1000 m³/day	Rate of consumption. Capita/day	Population in thousand	Supply Capacity 1000 m³/day	Rate of Consumption Capita/day	Population in thousand	Supply Capacity 1000 m³/day	Rate of Consumption. Capita/day	Population in thousand	Supply Capacity 1000 m³/day	Rate of Consumption Capita/day	Population in thousand	Supply Capacity 1000 m³/day	Rate of Consumption. Capita/day
Cairo	2947	340	115	7200	2100	291	8800	3200	363	9275	3650	393	100000	4800	480
Alexandria	1194	190	160	2430	716	294	2925	1500	512	3083	1886	612	3325	2026	609
Governorates	17291	995	75.5	29236	2277	88	37735	3672	97	39773	3830	97	42902	5423	111
Total	21433	1525	71	38871	5093	131	49460	8372	170	52131	9366	180	56227	12249	218
Avarge annual increase in supply Capacity				143			328			497			770		

Fig. 2

WATER QUALITY STANDARDS

A. CHEMICAL STANDARDS

PARAMETER	DRINKING WATER STANDARDS*
PH value	6.5- 9.2
color (PT.Co. scale)	50
Taste	Acceptable
Odor	Acceptable
Turbidity"Jackson units"	5
Total dissolved solids	1500
Total hardness ($CaCO_3$)	500
Calcium	200
Magnesium	150
Nitrates	45
Floride	0.8
Chloride	600
Sulfate	400
Iron	1
Manganese	0.5
Copper	1.5
Lead	0.1
Zinc	15

Units = mg/l unless indicated otherwise

* Maximum allowable limits

B. BACTERIOLOGICAL STANDARDS

- Throughout any year, 95% of samples should not contain any total caliform organisms in 100ml.
- No sample should contain fecal coliform in 100ml.
- No sample should contain more than 10 total coliform in 100 ml.
- Total coliform should not be detectable in 100 ml at any two consecutive samples.

Fig. 3

SEWAGE SYSTEM :

Egypt , as a 55 million inhabitants living , mostly , around the NILE valley in more than 4500 communities , of population density ranging between 500 & over 10 million inhabitants .

So , as a developing country , though an adequate system for waste water for each community is a must , but remains very difficult to realize . However , all towns - over 50 000 inh.- have a sewer system , which is also available in some of smaller communities . Treatment plants are constructed only in large towns , though plans to cover all towns of 50 000 inh. & above by treatment plants are already decided . So the final effeluent find its way to the River Nile , treated or raw .

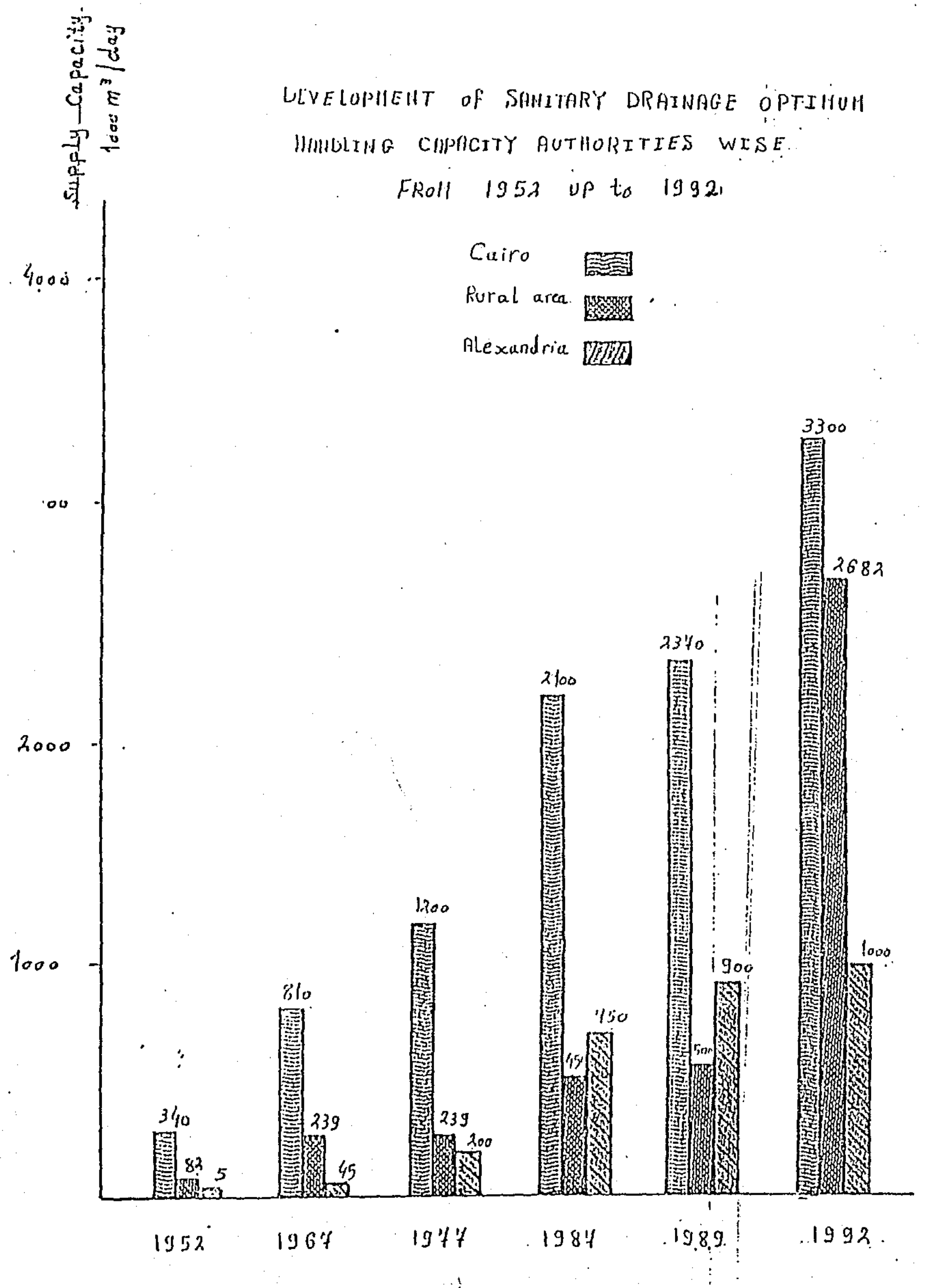
Sewer System ; The system to recieve the waste water of the consumers through gravity pipes to collectors & is pumped by boosters through force mains to the treatment plants , if any , or directly to the drains or the NILe & its branches .

However , in 1989 the total capacity of the sewer system reached 3.770 million M^3 ./day only . The development of the sewer system capacity from 1952 to 1992 (planned) is seen in fig.(4) for Cairo , rural areas & Alexandria , a detail for which is cleared in fig.(5).

Treatment System : The waste water , to gether with the industrial waste disposal are treated , by differents nethods , in treatment plants , according the standards . Howev r , among the treatment methods , areation , oxidation ditches , oxidation ponds , ... are applicable whenever feaseble . According to law No. 48/1982 - limits covering all parameters are decided to prevent polution of the NILE & secure its cleaness , as seen in fig.(6) for the limits of the fresh water ways into which the fluid wastes are licenced to be discharged , fig.(7) for the standard measures of the fluid wastes to be licensed to discharge to the drains & underground water reservoirs , fig. (8) for the standard measures of the fluid wastes to be licenced do discharge to non - potable water surfaces & fig.(9) for the standard measures of the non - potable water surface to be after the discharge of the fluid wastes .

Operation & Maintenance ; Operation & maintenance are the responsibility of the local governorates .

Sewage Tarrif ; The consumers are subsidised by the government , only part of the O & M cost paid as a percentage of the drinking water invoice , which is 20 % now . The total cost of the O & M is expected to be covered by the year 1997 .



Supply Capacity 1000 m³/day
DEVELOPMENT of SANITARY DRAINAGE OPTIMUM
HANDLING CAPACITY AUTHORITIES WISE
FROM 1952 UP to 1992
Cairo
Rural area
Alexandria
4000
2000
1000
340
82
5
810
239
45
1200
239
200
2100
750
2340
500
900
3300
2682
1000
1952
1967
1977
1984
1989
1992

Fig. (4)

DEVELOPMENT OF SANITAR DRAINAGE OPTIMUM HANDLING CAPACITY

From 1952 up to 1992

	1952	1977		1987		1989		1992	
	Capacity 1000 m³/day	Capacity 1000 m³/day	Percentage of added capacity to the year 1952	Capacity 1000 m³/day	Percentage of added Capacity to the year 1952	Capacity 1000 m³/day	Percentage of added Capacity to the year 1952	Capacity 1000 m³/day	Percentage of added Capacity to the year 1952
Cairo	340	1200	353 %	2100	617 %	2370	697 %	3300	970 %
Alexandria	5	200	40000 %	750	15000 %	900	18000 %	1000	20000 %
Governorates	82	239	291 %	450	548 %	500	609 %	2582	3271 %
Total	427	1639	Average 384 %	3300	Average 773 %	3770	Average 883 %	6882	Average 1535 %

N.B.

Optimum handling capacity for effluent waste water treated by plants or non treated due to non availablity of plants.

FIG.(5)

The standard measures for the license to discharge treated industrial fluid wastes into the potable water surfaces, and underground water reservoirs which were laid down by the Ministry of Health are:

(All standard measures are in milligram/litre unless otherwise is mentioned)

Parameter	Maximum Limit for the Standard Measures of the Treated Industrial Fluid Wastes which are Discharged into: The River Nile from the Egyptian Southern borders to Delta Barrages	The Nile Branch, Large Irrigation Canals, Channels, Side Channels, and underground Water Reservoirs.
Temperature	35°	35°
PH (Units)	6 - 9	6 - 9
Colour	Free of coloured materials	Free of coloured materials
Biochemical oxygen demand (BOD 5)	30	20
Chemically consumed oxygen (dichromate)	40	30
Chemical oxygen consumed	15	10
Total dissolved solids	1200	800
Suspended matter	30	30
Ashes of suspended matter	20	20
Sulphides AS S	1	1
Oils, greases and resins	5	5
Phosphate (inorganic)	1	1
Nitrate (N)	30	30
Phenol	0.002	0.001
Fluorides	0.5	0.5
Residual chlorine	1	1
Total heavy metals, and they include (x):	1	1
x Mercury	0.001	0.001
x Lead	0.05	0.05
x Cadium	0.01	0.01
x Arsenic	0.05	0.05
x Hexavalent chrome	0.05	0.05
x Copper	1	1
x Nickel	0.1	0.1
x Iron	1	1
Manganese	0.5	0.5
Zinc	1	1
Silver	0.05	0.05
Industrial detergents	0.05	0.05
Most Probable Number of Fecal Coliforms in 100 cm³	2500	2500

FIG. 16

Fresh(Potable)waterways into which treated industrial fluid wastes are licensed to be discharged - must be within the following Standard Measures and Specifications:

Parameter	Standard Measures (Milligram/litre unless otherwise mentioned)
Colour	not more than 100 degrees
Total solids	500
Temperature	5 degrees over the normal
Dissolved oxygen	not less than 5
PH (units)	not less than 7, and not more than 8.5
Biochemical oxygen demand	not more than 6
Chemical oxygen demand	not more than 10
Organic nitrogen	not more than 1
Ammonia	not more than 0.5
Greases and oils	not more than 0.1
Total alkalinity	not more than 150, and not less than 20
Sulphate	not more than 200
Mercury compounds	not more than 0.001
Iron	not more than 1
Manganese	not more than 0.5
Copper	not more than 1
Zinc	not more than 1
Industrial detergents	not more than 0.5
Nitrate	not more than 45
Fluorides	not more than 0,5
Phenol	not more than 0.02
Arsenic	not more than 0.05
Cadmium	not more than 0.01
Chromium	not more than 0.05
Cyanide	not more than 0.1
Lead	not more than 0.05
Selenium	not more than 0.01

FIG.(7)

SECOND: DISCHARGE INTO NON-POTABLE WATER SURFACES

ARTICLE (65):

Sanitary drainage water, and the industrial fluid wastes which are licensed to be discharged into non-potable water surfaces, must fulfill the following standard measures and specifications:

Parameter	Maximum limit for the Standard Measures and Specifications (Milligram/litre, unless otherwise mentioned)	
	Sanitary Drainage Water	Industrial Fluid Wastes
Temperature	35° centigrade	35° centigrade
PH	6 - 9	6 - 9
Biochemical oxygen demand	60	60
Chemical oxygen consumed (dichromate)	80	100
Chemical oxygen consumed (permanganate)	40	50
Dissolved oxygen	Not less than 4	4
Oils and greases	10	10
Dissolved substances	2000	2000
Suspended matter	50	50
Coloured matter	Free of coloured substances	Free of coloured substances
Sulphides	1	1
Cyanide	-	0.1
Phosphate	-	10
Nitrate	50	40
Fluorides	-	0.5
Phenol	-	0.005
Heavy metals (total)	1	1
Insecticides (different kinds)	Non existent	Non existent
MPN of fecal Coliforms	5000	5000

FIG. (8)

The non-potable water surfaces - into which the discharge of treated fluid wastes is licensed - must remain within the limits of the following standard measures and specifications:

Parameter	Standard Measures and Specifications
Temperature	Not more than (5)centigrades over the prevailing average.
Dissolved oxygen	Not less than (4) milligram/litre at any time.
PH Value	Not less than (7),and not more than (8.5)
Industrial detergents.	Not more than (0.5) milligram/litre.
Phenol	Not more than (0.005)milligram/litre.
Sediment	Not more than (50) unit.
Dissolved solid substances.	Not more than(650) milligram/litre.
Most probable number of Fecal Coliforms	Not more than (5000)

Fig.(9)

DRINKING WATER AND SEWAGE PROJECTS PLANS ;

The projects in the field of water & sewage are decided on phases of five years each according to a master plan to be updated perodically. However the government invested 2441.3 million E.L. for such projects in the period 1982 /1987 & 1019.9 million L.E. in the year 87 /1988 out of 3343.6 million L.E. as a budget decided for the period 1987 /1992 , as seen in details in fig.(10).

Plans for Drinking Water Projects ; It is planned to increase the treated drinking water capacity for the year 1992 to be 12.249 million M^3 . / day , of which 4.800 m. M^3./d. in Cairo, 5.423 m. M^3 ./d. in the rural areas & 2.002 m. M^3. /d. in Alexandria , by implementring projects for extra capacity ;

- In Rural Areas ; expansion of 29 plants & construction of 21 new plants for the towns & 265 compact size for villages for a capacity of 1.751 m. M^3./ d. & its distribution system in towns mostly , to reach an average consumption of 111 L./C./d.

  In Alexandria , expansion of plants & construction of new plants for a capacity of 0.526 m.M^3 ./d. & its distribution system , to reach an average consumption of 609 L./C./d. including Industrial water

Plans for Sewage Projects ; It is planned to increase the capacity of the collecting sewer system for the year 1992 to be 6.982 million M^3 ./day , of which 3.300 m. M^3 ./d . in Cairo , 2.682 m. M^3 ./d. in the rural areas & 1.000 m. M^3 ./d. in Alexandria by implementing projects for extra capacity ;

- In Cairo ; A major project of an estimated cost of 4000 million L.E. , togeather with other related projects to expand & rehabilatated ;

  * The sewer system ; 35 areas of 28.5 m.L.E. cost .

  * The pumping stations ; 61 main pumping stations & 38 boosters , togeather with construction of 11.0 Km of gravity & force main 197.3 m .L.E. cost .

  * Treatment plants ; one plant (Zienane) to treat 0.330 m. m^3 ./d. of 183.0 m. L.E. cost .

- In rural Areas ; construction of 123 treatment plants of capacity range between 1000 & 40 000 M^3 ./d. of 1150 million L.E. , in addition to the collecting sewer system .

- In Alexandria ; A majr project of an estimated cost of 1000 million L.E. , togeather with other related projects to expand & rehabilitate the collecting sewer system , the pumping stations & boosters and the treatment plants to reach 0.8 million M^3. /d .

DEVELOPMENT of PUBLIC UTILITIES INVESTMENT

From

1952 to 30/6/1989

Value in milion L.E

	1952 to 1960	1/7/1960 30/12/76	1/7/1977 * 30/6/82	1/7/82 * 30/6/87	1/7/1987 (@) 30/6/88	1/7/88 (@) 30/6/89
Cairo Potable W. Supply	34,50	176,30	183,10	242,50	67,30	76,20
Alexandria " " "			94,60	174,50	37,00	33,60
Rural area and sewis canal cities potable w. supply			105,80	233,40	181,00	104,10
Total of P. W. S	34,50	176,30	383,50	650,40	285,30	213,90
Cairo Sanitary drainage	6,30	130,50	192,2	678,60	411,70	348,00
Alexandria " "			70,50	254,20	71,00	58,00
Rural area " "		-	125,20	292,00	107,40	118,20
Total For Sanitary drainage	6,30	130,50	387,90	1324,80	590,10	524,20
Other Utilities (1)			245,3	841,00	144,50	85,00
Total of Public utilities	40,80	306,80	1016,70	2816,20	1019,90	823,10
Annuel Average	5,10	18,60	184,85	563,20	1019,90	823,10
Percentage to the year 52/1960	-	365 %	3625 %	11000 %	1980 %	1614 %

(1) Utilities carried out by the ministry of development, new Urban Communities Housing and utilities.

* Investment For Five years.

Fig. (10)

ASSESMENTS AND COMMENTS :

It is obvious that serious importance is decided by the government of EGYPT towards the DRINKING WATER AND SEWAGE SECTOR , which in result , will realize considerable improvements in the field for the sake & welfare of the population . However , still more efforts , is a must to ;

- Make available safe drinking water for all the population , including – of course – the rural areas .
- To complete construction of the collecting sewer system to be able for recieving the total quantities of waste water , as the treated drinking water capacity at 1992 will be about 12 million M^3./d. while the max.capacity of the collecting sewer system will be about 7 million M^3./ d. only .
- To treat all the waste water quantities before discharging to the NILE & its drains .

So , it is clear that still the problem is serious & a big investment is required to overcome the problem . To reduce the cost needed it is proposed to :

- Reinforce the local industry in the field of water treatment equipments , including the related engineering activities by establishing new local companies for both engineering & manufacturing of water treatment equipments .
- Establish local companies for engineering & manufacturing of waste water treatment equipments .

In addition to the above mentioned objectives , reduction of pollution of the River NILE will be achieved as a re - sult , which will be of high appreciation from the environ- ment point of view .

* *

產業排水

STATUS AND TRENDS OF INDUSTRIAL POLLUTION CONTROL IN EGYPT

BY

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I. INTRODUCTION

Environmental pollution has become one of the disturbing problems confronting both developed and developing countries. In the 1960'S it became increasingly clear that nature is not an infinite asset, but a fragile and limited resource. "Environment" became part of the vernacular, and the world moved into the decade of the 70's with growing awareness of the need for protecting the environment.

Adverse effects on the environment emmerge from a variety of pollutants, whereas some of them are the product of agricultural and industrial developments, the use of sophisticated technologies etc., others emanate from socio-ocultural conditions prevailing in human settlements.

Industrialization is a major activity promoted by governments in their devlopment strategies and makes a significant contribution to economic growth and enhacement of human welfare. There are however, despite the enormous benefits of industrial development, examples of industrialization without the integration of proper environmental management which have lead to serious environmental degradation. One of the major problems resulting from industrial development is the quantity and diversity of wastes it generates. The proper treatment and disposal of most industrial wastes are expensive: even worse, certain wastes are hazardous to human health and to the quality of the environment. Many countries are now faced with the need to invest in this sector for restoration and clean-up of the environment.

II. PRACITICES OF INDUSTRIAL WASTEWATER CONTROL IN EGYPT

Industry in its modern sense has been known in Egypt since the early nineteenth century. Following World War "1" industrial activities based on natural resources began to increase, with emphasis on food processing, textiles, cement and fertilizers

In the early fifties, industrial development took a new path. New industrial activities shifted from the traditional agrarian base to heavy industries such as steel, organic and inorganic chemicals, and machinery. An important feature of the revolutionary plan to industrialize Egypt was the concentration of the new industries in the metropolitan areas along the Nile Delta (north and South Cairo: Kafr El-Zayat: Talka).

The concentration of labour-intensive industries in densely-populated metropolitan centres has disrupted the fragile ecological conditions and lead to widespread deterioration of the environmental quality.

Another feature of this phase of industrialization was the fact that most of the new industries were state-owned, making the simplist form of government supervision unacceptable. The most important legislation was Law "93",(1962) concerning wastewater disposal. Regulations and standards were not applied to the public sector industries,inspection was not encouraged, and the rules were not enforced. No one was ever apparently judged under this low bacause of fear of hindering industrial production.

The trend at that time was to support industrial development to attain rapid returns on their investments. However, the problem of industrial wastes was given inadequate attention, partly because of shortage of funds and partly because of the idea that environmental deterioration is not an issue of immediate concern. The expectation was that gains in material well-being would far exceed losses incurred by degradation of the environment. Consequently, wastewaters have been discharged ever since without treatment to the Nile,lakes drains or Mediterranean.

III. EFFECT OF WATER POLLUTION

Studies completed in the last 20 years showed that some lakes the river and seashores within Egypt are polluted. The impact of water pollution became evident from diminishing fish catches from water bodies, deteriorating recreational areas, and the declining quality of water resources. Many industrial establishments generating solid and hazardous wastes are dumping the wastes, at random in unauthorized sites or burning the combustible matter in open sites.

HELWAN AREA

The Helwan area is one of the most industrialized areas of Egypt, with many large factories such as the steel company, cement companies, textile factories, and Nasr automobile company, which discharge large quantities of air and water pollutants that affect the health and economic and social welfare of the people. This situation, has turned the Helwan area into a zone of severe pollution when it was once internationally known as a place for tourists to visit for health treatment.

ALEXANDRIA AREA

Alexandria is the largest seaport in Egypt, a prime industrial centre, and a major summer resort on the Mediterranean. Industries in the Alexandria metropolitan area are distributed in industrial complexes near Mahmodia Canal,along the north and south shores of western Lake Maryut in Amria, along the coastal areas of El-Max and Abu Kir, and near the city of Kafr El-Dawar.

The industrialization in Alexandria has had a profound effect on public services, transportation,water supply,and waste disposal systems. Environmental quality and natural resources have been severely affected by the continued industrial development.

SHOUBRA EL-KEMA

Shoubra El-Kema constitutes one of the heaviest concentrations of industry in Egypt. Industrial activities range from food processing and detergents & soap manufacturing to textile finishing and paper production. Huge quantities of untreated wastewaters are discharged in the agricultural drains causing serious water pollution problems.
Similar problems exist in many other industrialized areas of Egypt such as:

- Talka
- Kafr El-Zayat
- Upper Egypt (Komombo, Kona, Kos,)

IV-CONTROL STRATEGIES

Strategies for limiting the introduction of toxic pollutants into the environment are of two general types, control of products and control of industrial effluents disposal.

Experience accumulated during the last two decades suggested that in many circumstances it is more efficient and less expensive to incorporate pollution preventive measures than corrective techniques. Therefore, more effort shoud be directed at redesigning chemical processes to reduce waste of raw materials, to produce less by-product and to assure systems that recycle, purify or otherwise find use for by-products.

According to the studies carried out by the Water Pollution Control Department of the National Research Centre, there is a mounting evidence that pollution in most of the industries is a direct consequence of inefficient production practices. If efficiency is improved, the pollution load would be simultaneously reduced.

Over half the energy used is wasted, this raises the ambient temperature of receiving water courses leading to thermal pollution. The corresponding implications is reduction of dissolved oxygen which renders the streams hardly capable of sustaining aquatic life. Rather than investing in cooling towers which ultimately discharge the heat into atmosphare attention should be directed to improving the processing efficiency and putting the residual heat to better uses such as for heating greenhouses and industrial processes.

In metal factories, agro-industries, Oil and Soap plants, processes are so inefficient that the waste generated contains, raw as well as processed products. This represents a drain of the finite raw material resources, a burden to the national economy and a direct financial loss to the industry. Reclamation of by-products from industry may appreciably substitute the needs for other resources.

There is no doubt in my mind that technologies to prevent or reduce pollution will undergo profound development in the years ahead. Some areas of change will concern the recycling of residues, adoption of low and non-waste technologies, and conservation of materials and energy. At the same time, it is evident that introduction of environmental considerations is possible at the project level, without impeding the main objective of increasing the rate of return and improving the cost-benefit ratio. It should be recalled here that preservation of the environment and conservation of raw materials within a framework of rational management of productive resources would in most instances lead to lower production costs and alleviation of pollution problems.

Whilst the idea of abating industrial pollution and conserving resources is now accepted in principle, the problem seem to be approached by the concerned authorities in a rather hesitant manner. What is needed now is to place more emphasis on the cost/benefit aspects of low-waste technologies. The level of technology acquired by industry should not therefore be limited by shortage of capital, lack of qualified labour or incentives of short-term returns, but should rather reflect the need for environmentally-sound technologies which would undoubtedly result in substantial profit margins for the industry and protection or even enhancement of environmental quality.

V. Legislation

Realizing the benefits of preventing pollution to the Nile. the Government of Egypt has taken several steps in recent years to curb pollution. The ministry of Irrigation issued law No. 48 of 1982 concerning pollution protection of the River Nile and the drains· while the ministry of industry and GOFI prepared an emergency plan, to be executed within 3 year period (1/1/84-31/12/86). The achievements in this sector is so far very limited. This may be due to the fact that existing legislation are not practical and agencies are not equipped to monitor the situation and enforce regulations.

VI. INSTITUTIONAL ORGANIZATION FOR INDUSTRIAL POLLUTION CONTROL

In Egypt there is no central agency responsible for the management of wastes. Diffirent agencies operate within their own sectors and there is little coordination among them. The responsibility for municipal liquid waste collection and treatment is vested in the regional sanitary sewage authorities under the supervision of the Ministry of housing and Utilities. Liquid wastes from industrial sources are theoretically handled through on-site pre-treatment systems before discharge to public systems according to low No."93" of 1962.

The drawbacks of the existing management system are:(a) lack of machinery and responsibility for strategic planning for waste water control and (b) inadequacy of monitoring programms and facilities for operation of waste water management systems.

Experiences in the industrialized countries suggest that giving sufficient autonomy and power to specialized waste management organizations in industrial localities whould ensure incorporation of appropriate environmental elements in the industrialization process and better handling of pollution problems. The establishment of environmental Management Boards in major industrial areas in the region is therefore recommended. These Boards would comprise representatives of municipalities, local councils, and the concerned industries.

VIII. PERSPECTIVE ON ENVIRONMENTAL-SOUND TECHNOLOGY IN EGYPT

Analysis of the situation in Egypt indicates that major constraints to adoption of industrial wastewater control programs arise from inadequacy of industrial infrastructure, domination of less developed technologies, lack of expertise and prevailailing attitudes by management against the introduction of new technology and research promotion.

Recently, however, new concepts began to develop as to how to continue industrial development while simultaneously improving utilization of resources and alleviating pollution problems. The recommended approach is to continue relying on waste treatment when deemed necessary but to give more attention to means of preventing the generation of pollution which, after all, represents wasting of materials and deterioration of receiving environment.

Industrial management in Egypt therefore, needs to evolve an indigenous solution aimed at encouraging recycling of used materials,purifying by-products for reuse in other processes: providing incentives for investment in cleaner technologies: and the linking up, of various industrial, agricultural and urban activities in an integrated delivery system permitting reuse of wastes. Pollution abatement requires preventive approaches rather than costly curative measures. The Government,therefore, should promote Low & non-waste technology programs (LNWT). Apart from the immense advantages of LNWT in resource conservation and mitigating pollution levels, it will lead to less dependence on conventional waste-treatment technologies thus avoiding frequent operational failures and to a drop in efficiency usually encountered in operational functions.

The concept of cleaner technology implied in LNWT goals should be applied to the manufacturing chain through process-design modifications: loss cotrol: recovery and utilization of spent chemicals: operational control: and good housekeeping.

Through choice of appropriate processes and technologies, waste production in the manufacturing process can be reduced.

The reclamation industry may in itself be profitable and thereby is responsible for a major part of the recovery of waste materials. The manufacturing industry can complete this cycle and makes the basic decisions on whether to use raw materials or recovered secondary products.

IN-PLANT CONTROL IS THEREFORE,THE MOST PROMISING AREA FOR "BREAK-THROUGH" WITH INTENSIFIED RESEARCH AND DEVELOPMENT.

WASTE THAT CANNOT BE AVOIDED,RE-USED OR RECYCLED MUST BE DISPOSED OF IN AN ENVIRONMENTALLY ACCEPTABLE WAY. THE CHOICE AND DEVELOPMENT OF WASTE TREATMENT

AND DISPOSAL TECHNOLOGIES IS DEPENDENT ON A LARGE BODY OF KNOWLEDGE AND EXPERIENCE.

VIII. CONCLUSIONS AND RECOMMENDATIONS

1. Industrial development projects must continue to receive top priority and at the same time we must continue to insist that all such projects take into consideration the prevention of pollution. However, we must also consider giving priority to the execution of pollution control projects. Like all countries, Egypt's natural resources, particuliarly it's water supplies, are limited and will become increasingly more valuable in the future. Projects that control the pollution of such resources will have a very large net positive economic impact and therefore should be given priority.

2. Water pollution protection can be achieved better through control of pollution at the source. The pollutant liability that industry has built up over the course of many years now should be paid up. The challenge to industry is to accomplish this task practically and economically, without an excessive burden to itself.

3. Environmental impact assessment is of considerable importance, not only in evaluating the present environmental pollution situation but also in predicting the effects of development policies and programmes.
Sensible environmental control legislation will depend on a thorough knowledge of the existing situation and a careful assessment of its likely impact on development.

4. The bad condition of the equipment in some of the factories belonging to the public sector often results in the production of excessive wastes as well as losses of raw materials, lubricating oils and processed products.

Public sector plants modernization and replacement projects will help in improving and correcting the environment inside and outside those plants.

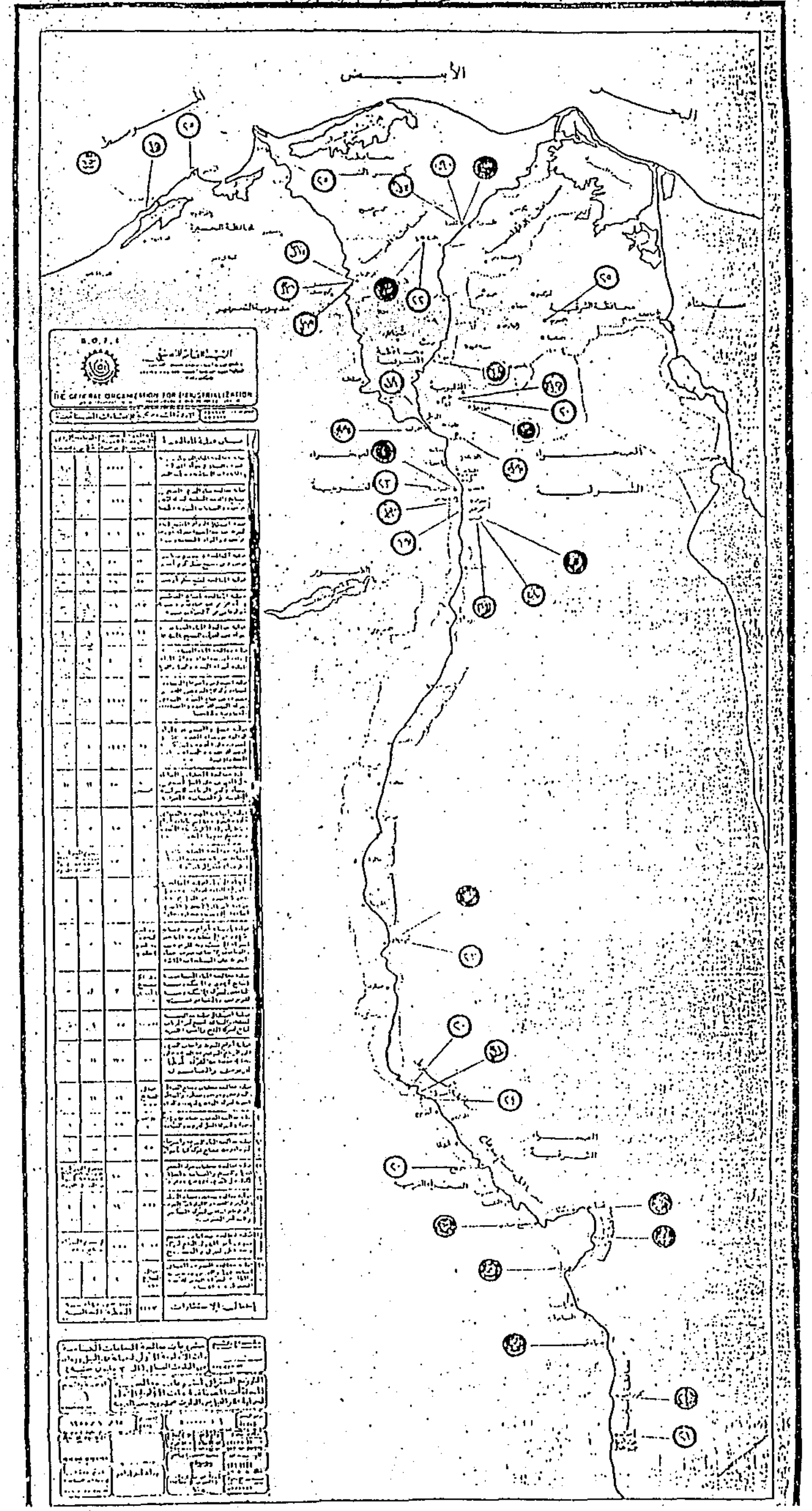
5. Detailed studies should be carried out for each industry to minimize the quantity and improve the quality of wastewater discharged. This could be achieved by in-plant measures and/or treatment of wastes.

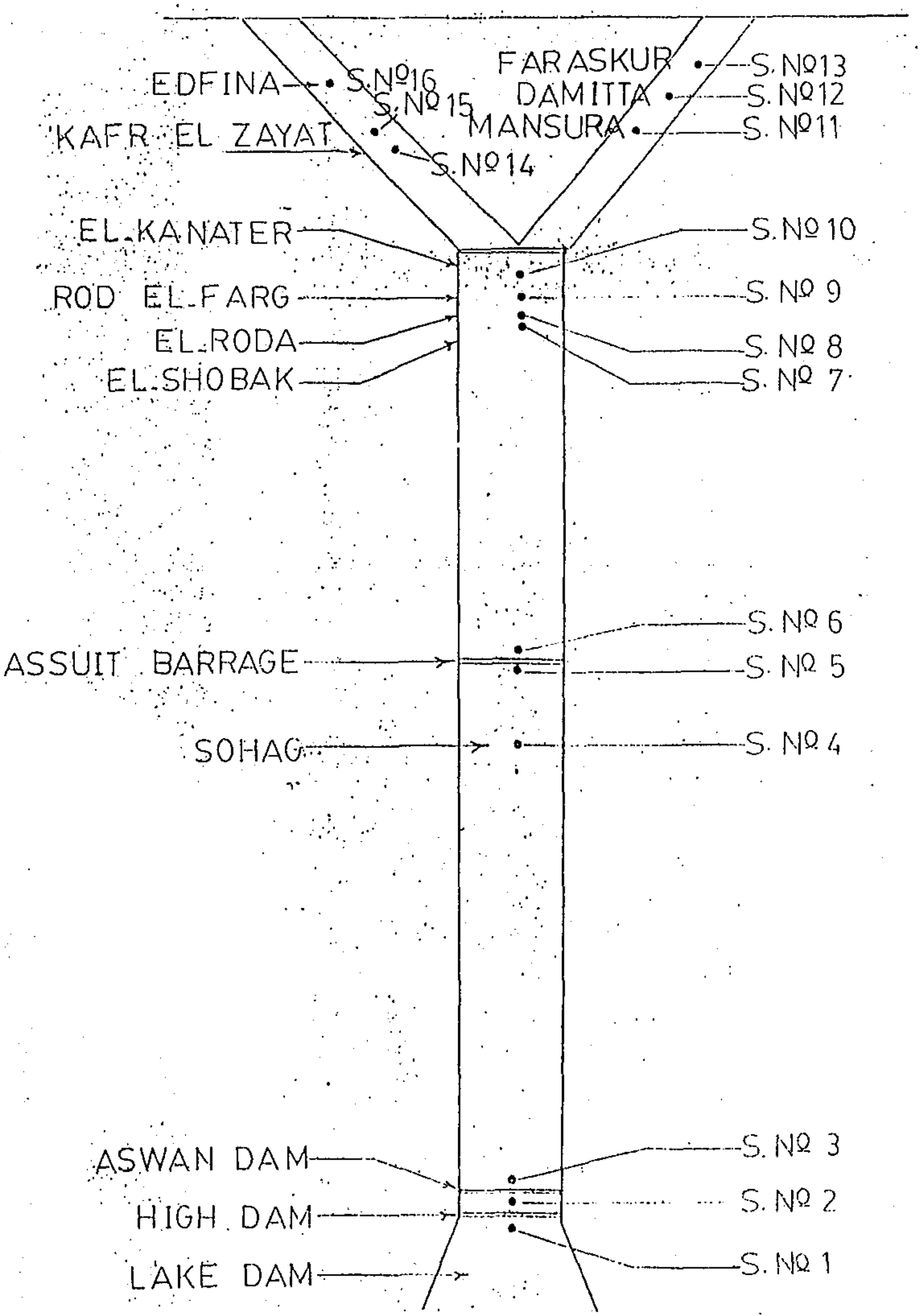
6. Extensive research work on an integral level to develop less hazardous structures and formulations should be propoted.

7. Toxicological research should be promoted towards early prediction of any chromic side effects of the new compounds particularly carcinogenisis. Guidelines for management of their use and disposal is required.

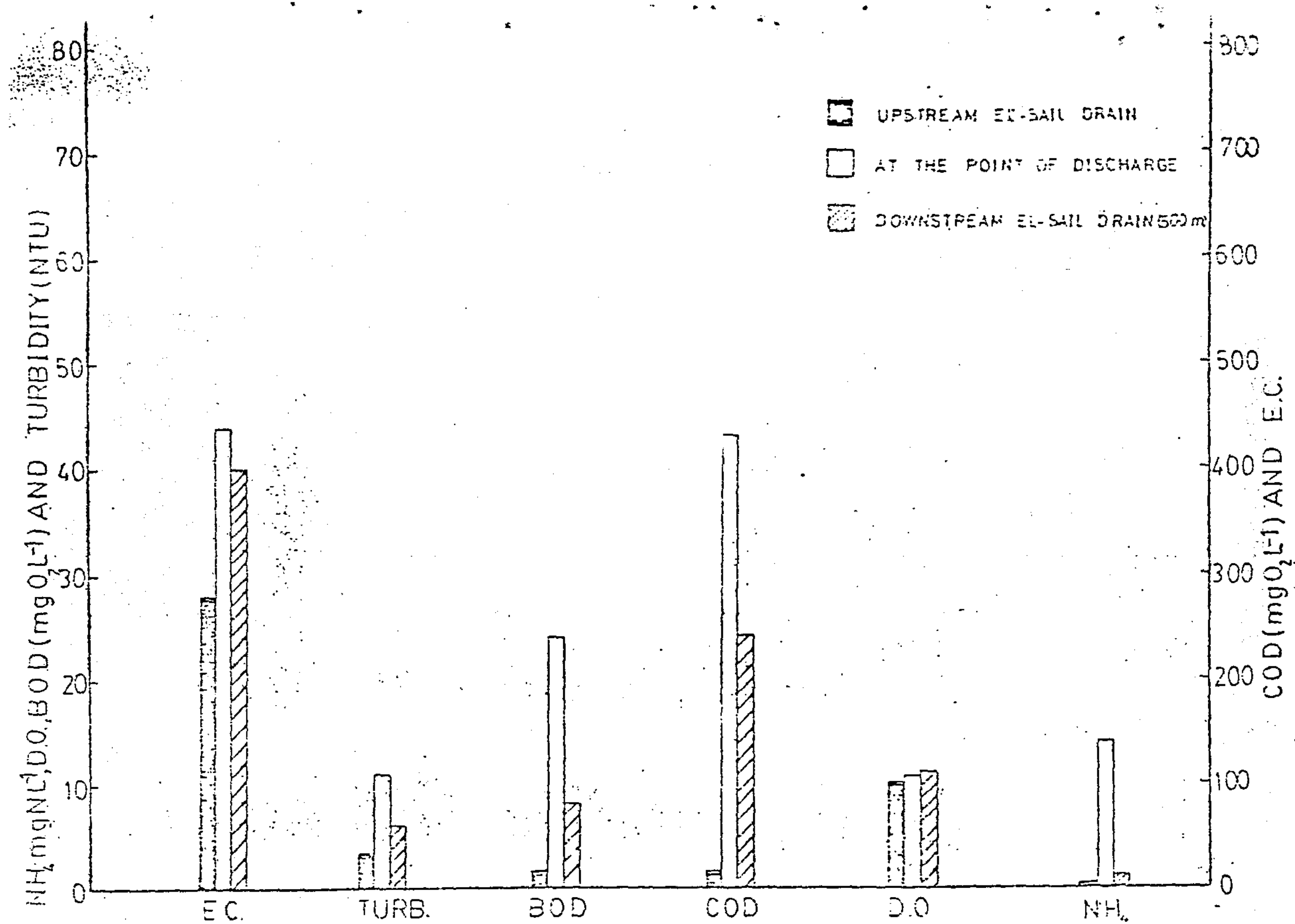
8. There is a need to link the enforcement mechanism with evolving environmental jurisdition through strengthening effective monitoring programms and enhancing research activities relevant to industrial waste control. A well defined monitoring programme has to be developed to standardize the analytical techniques and develop adaptive monitoring schemes depending on the magnitude of the industrial pollution level.

汚染源分布図

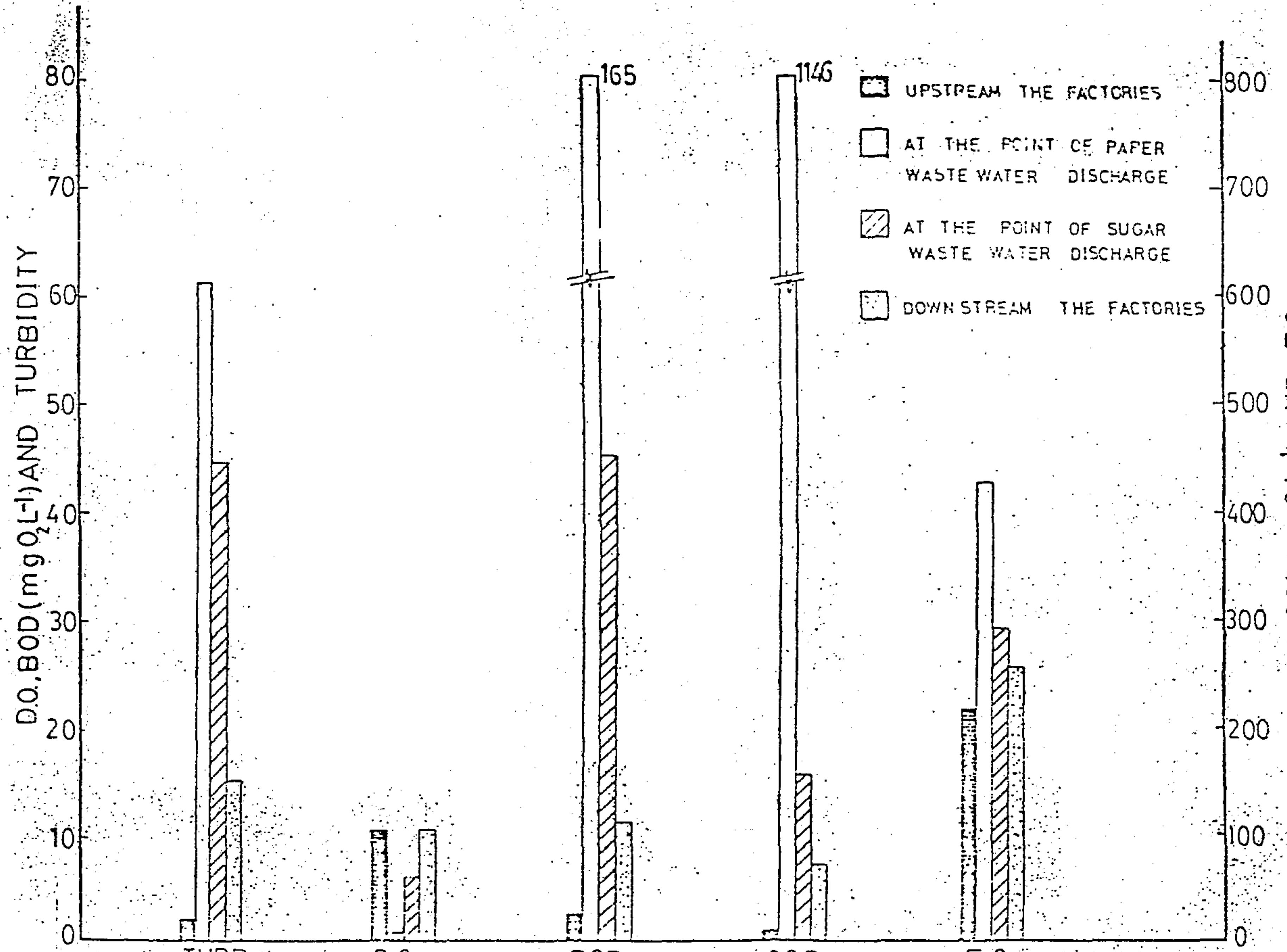




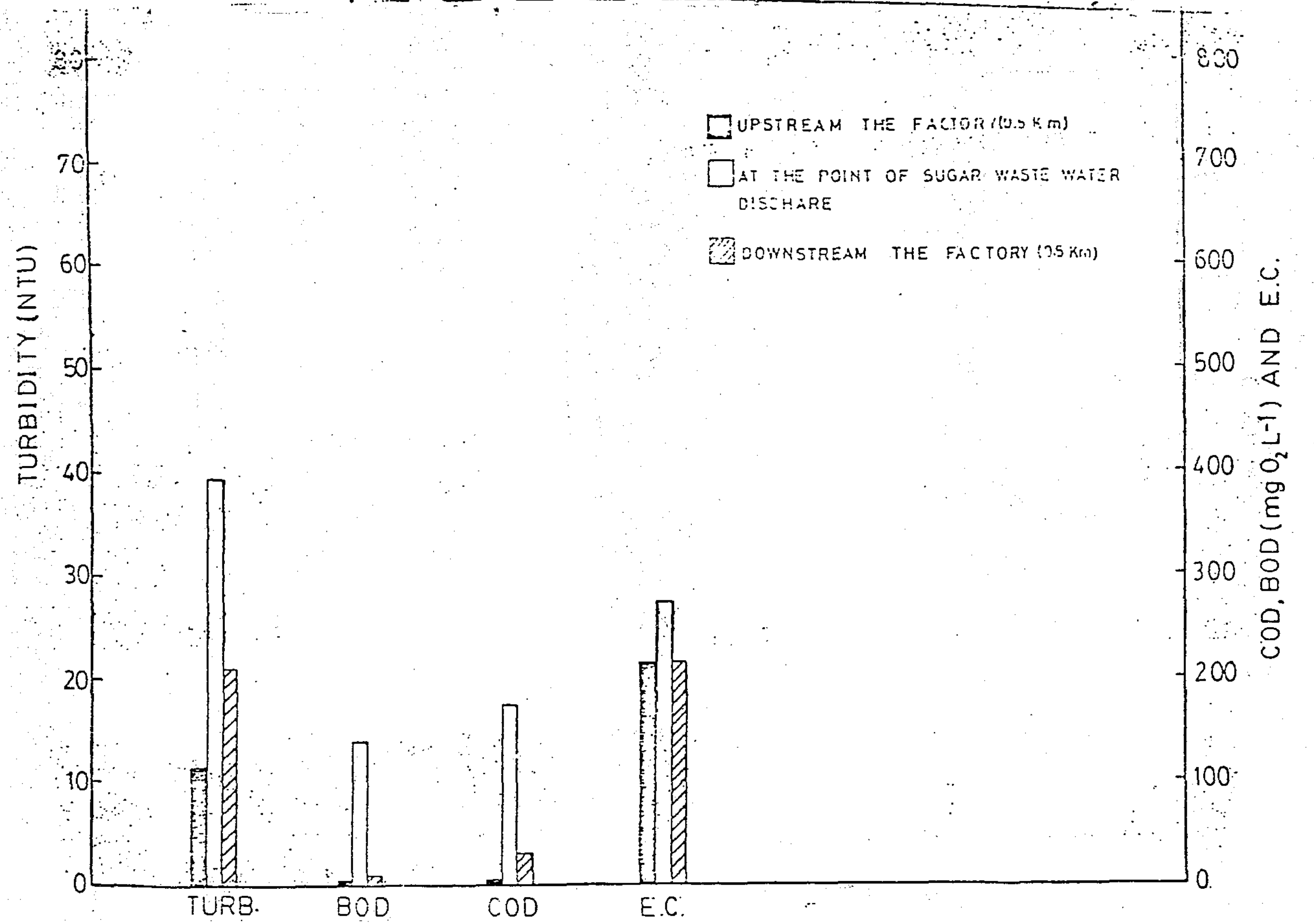
Fig(1)SAMPLING SITES



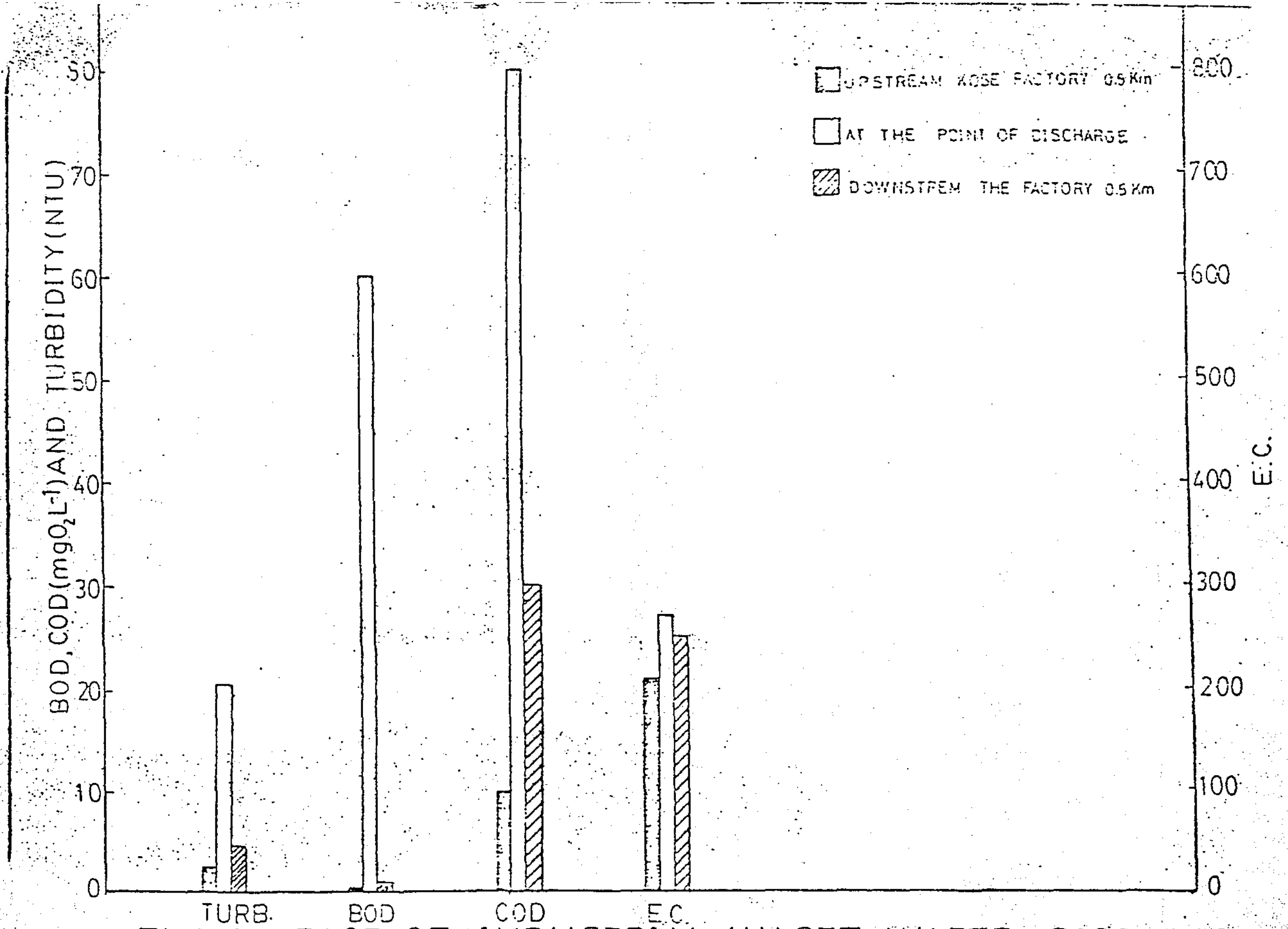
Fig(2) IMPACT OF EL-SAIL DRAIN ON THE WATER QUALITY OF THE RIVER



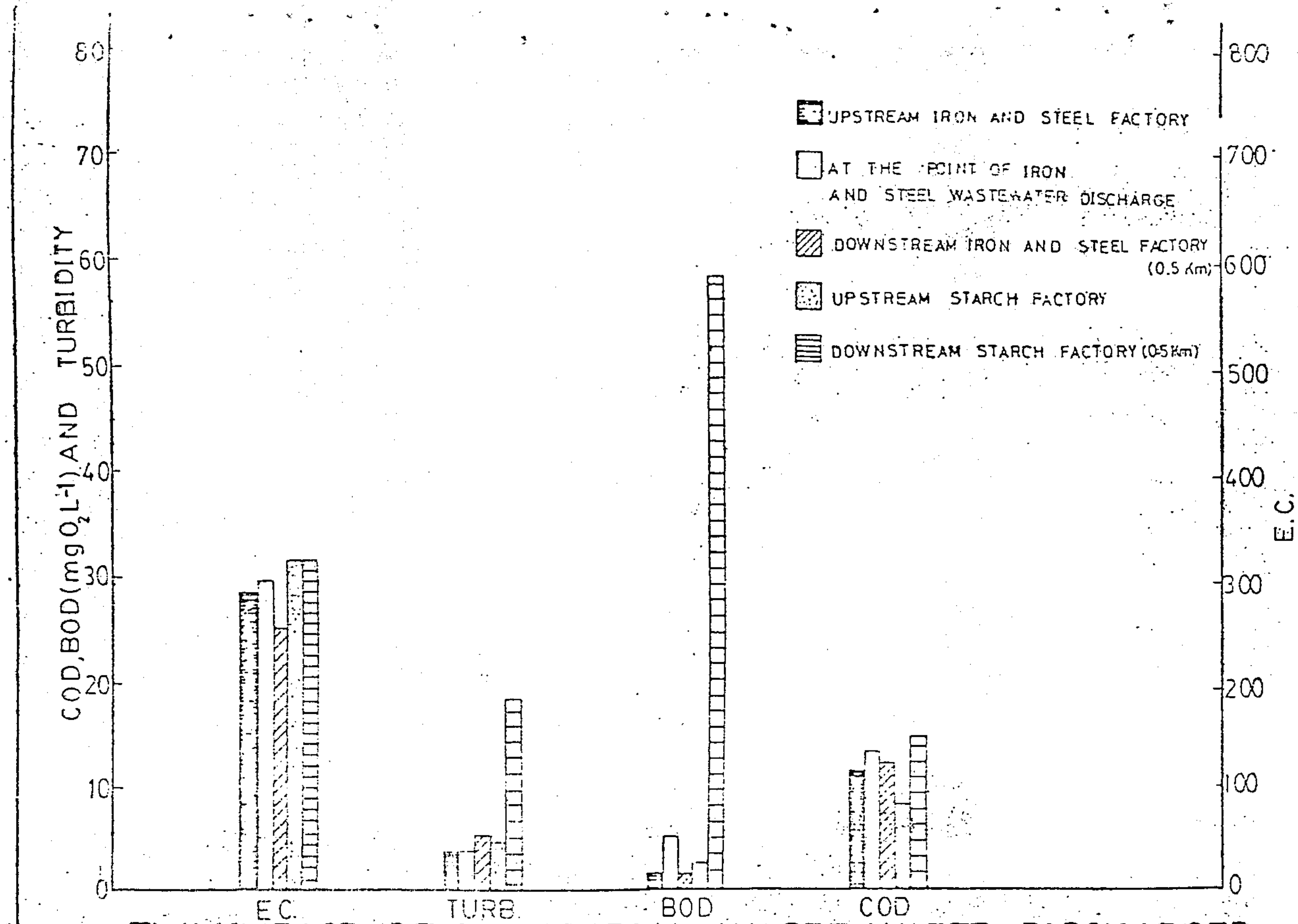
Fig(3) IMPACT OF INDUSTRIAL WASTE WATER DISCHARGE AT EDFO



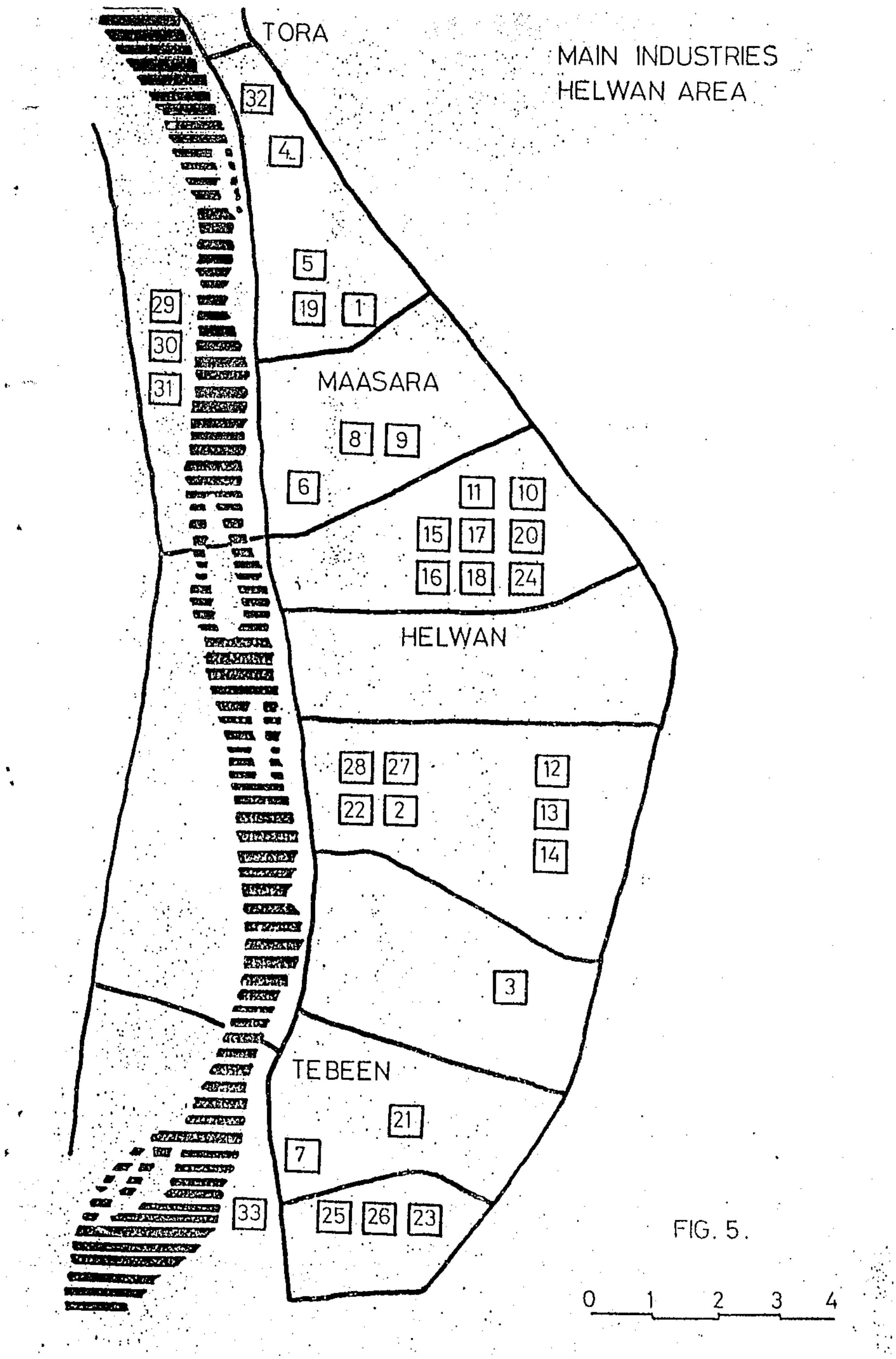
Fig(5) IMPACT OF INDUSTRIAL WASTE WATER DISCHARED FROM SUGAR FACTORY



Fig(4)IMPACT OF INDUSTRIAL WASTE WATER DISCHARGED FROM KOSE FACTORY.



Fig(6):IMPACT OF INDUSTRIAL WASTE WATER DISCHARGED FROM FACTORIES ON THE WATER QUALITY(HELWAN)


TORA
MAIN INDUSTRIES
HELWAN AREA
32
4
5
19
1
29
30
31
MAASARA
8
9
6
11
10
15
17
20
16
18
24
HELWAN
28
27
12
22
2
13
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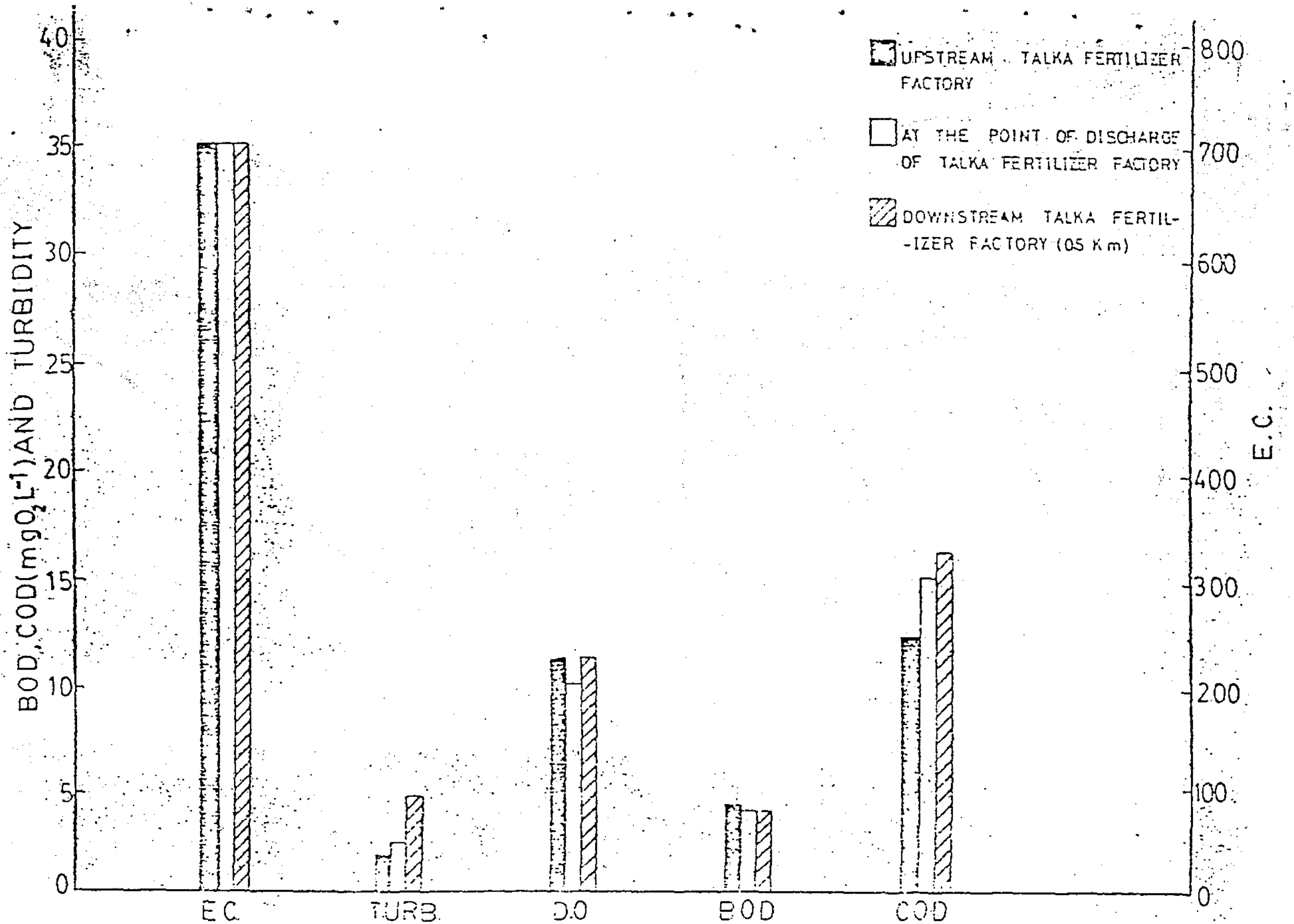
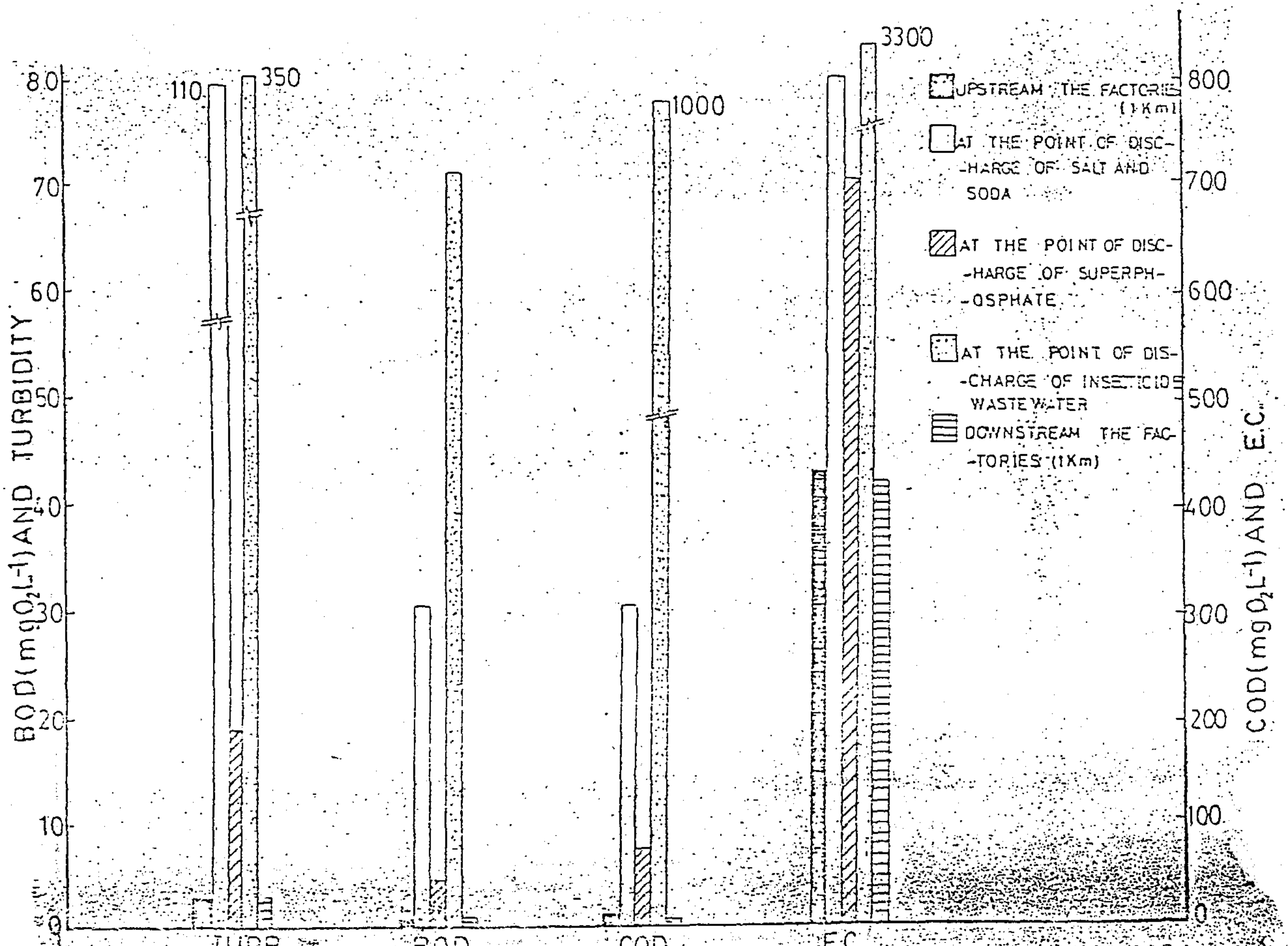
3
TEBEEN
21
7
33
25
26
23
0 1 2 3 4

FIG. 5.



Fig(7) IMPACT OF INDUSTRIAL WASTE WATER DISCHARGED FROM TALKA FERTILIZER FACTORY



Fig(9) IMPACT OF INDUSTRIAL WASTE WATER DISCHARGED

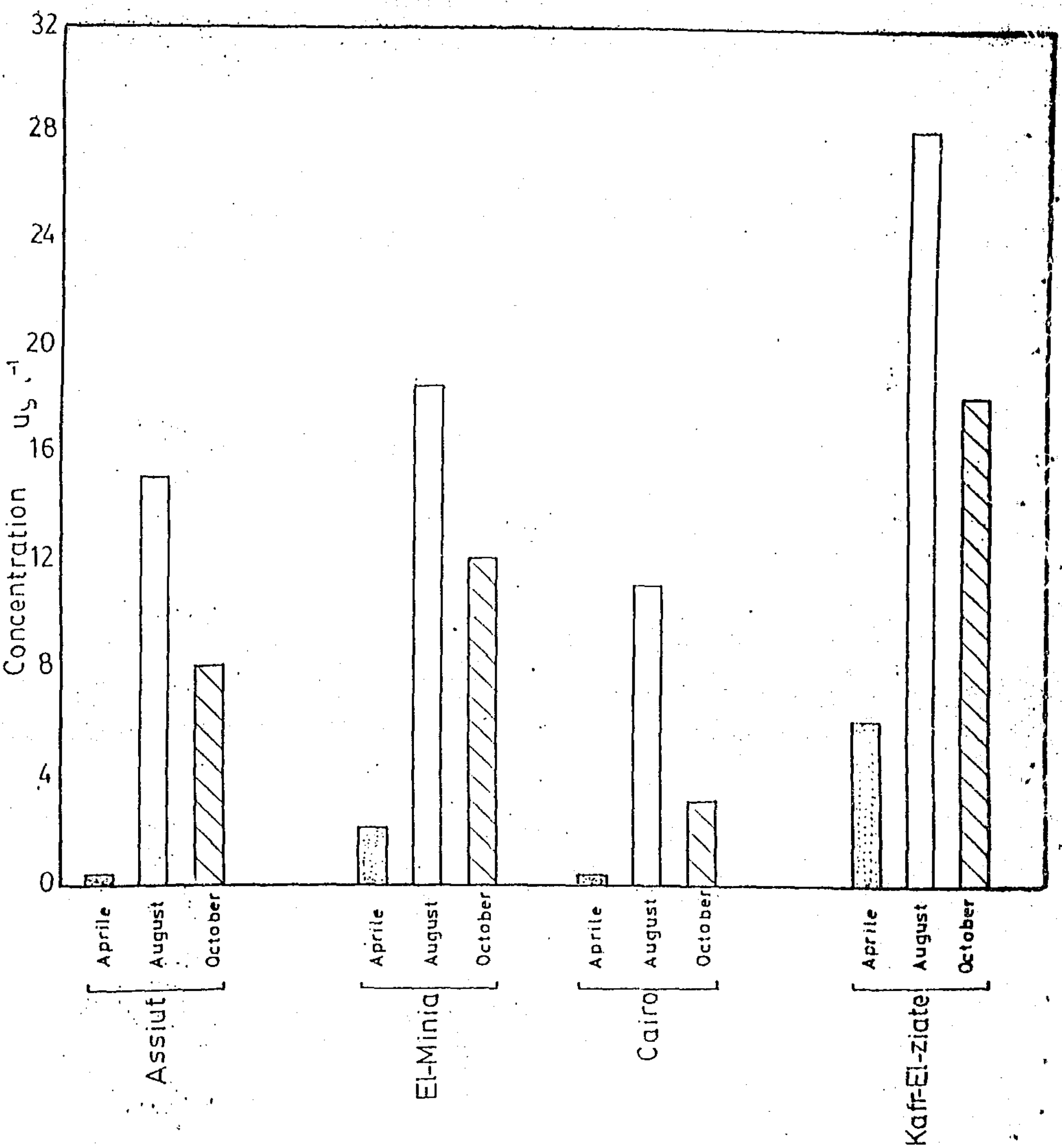


Fig (2) Concentration Of Organophosphorous Insecticides in River Nile Waters During (1979) $ug.l^{-1}$

(Ref. No. 8)

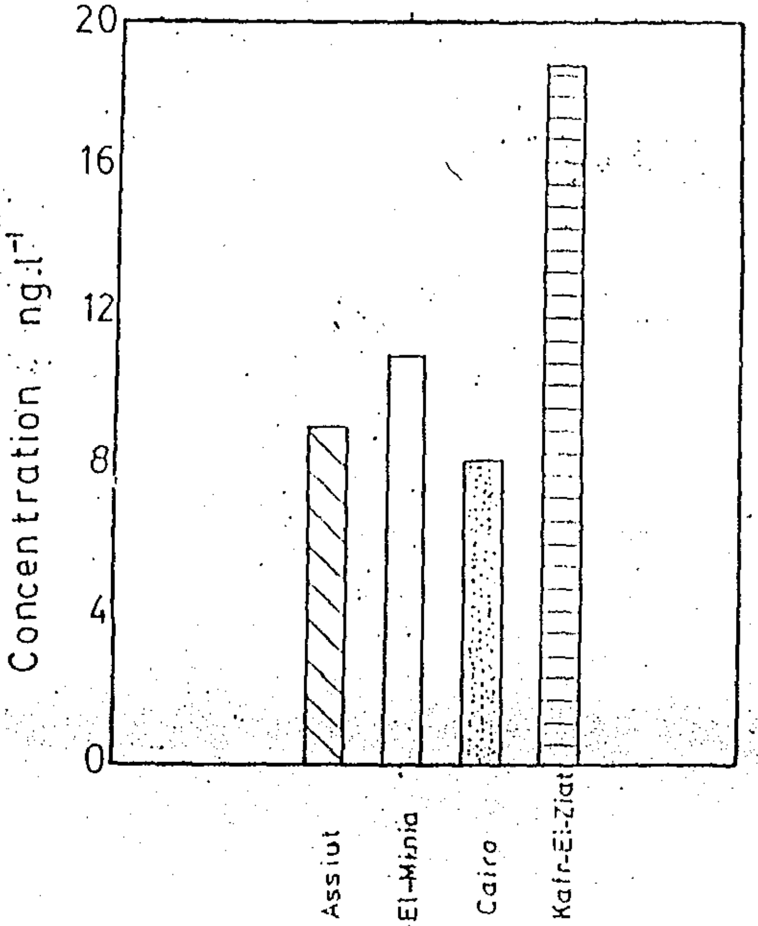


Fig (1) Concentration Of Total Organochlorine Insecticides in River Nile Waters (1979)

(Ref. No. 8)

Figure 1
PERCENTAGE DISTRIBUTION OF INDUSTRIES (NUMBER)

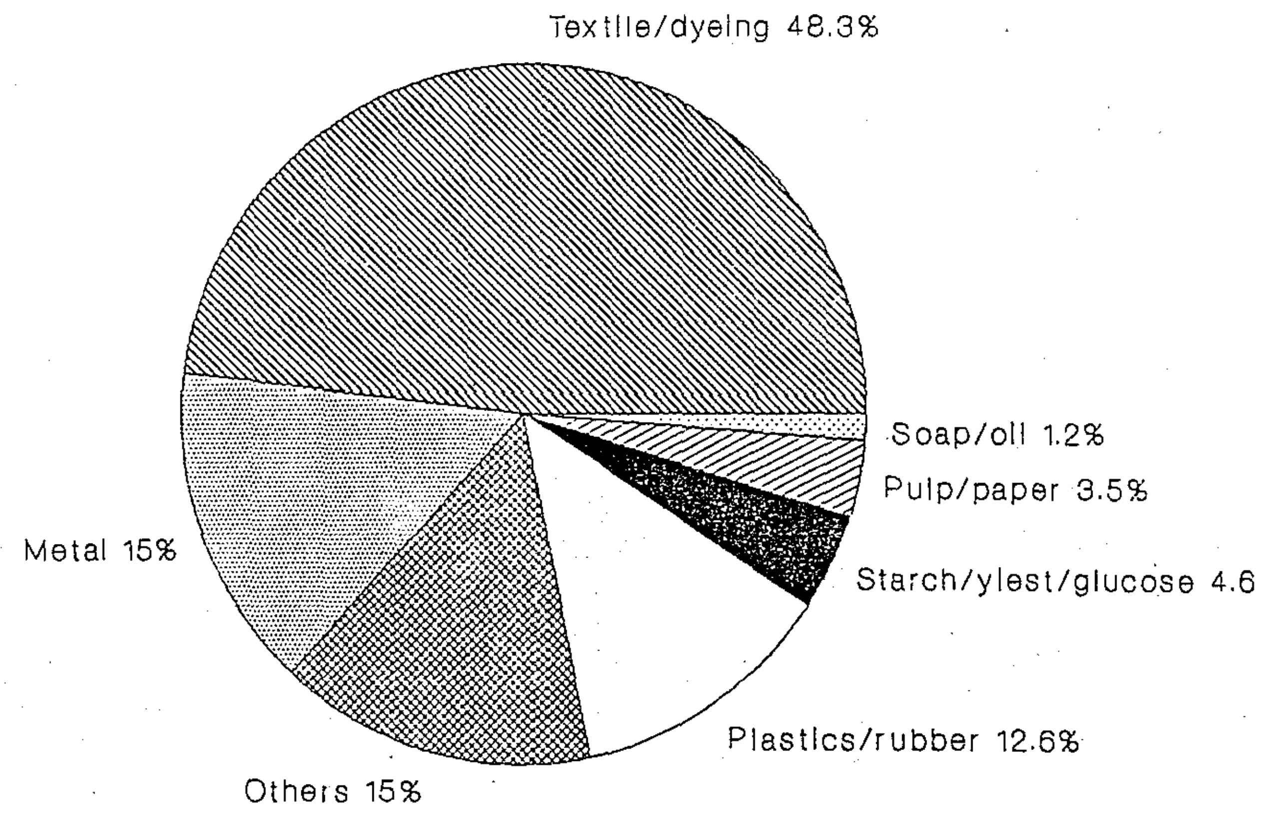


Figure 2
WASTEWATER DISCHARGED FROM DIFFERENT INDUSTRIAL SECTORS

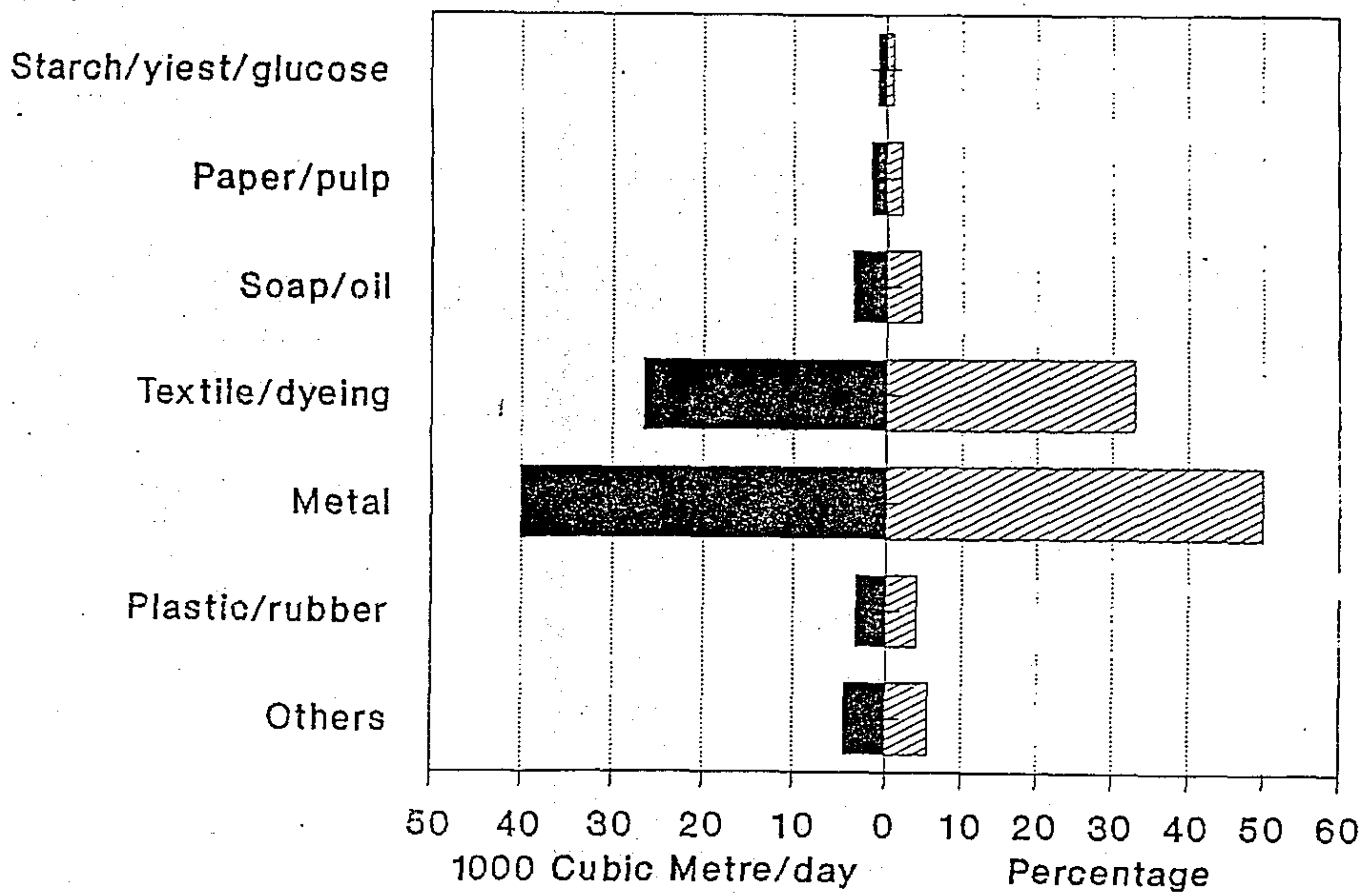
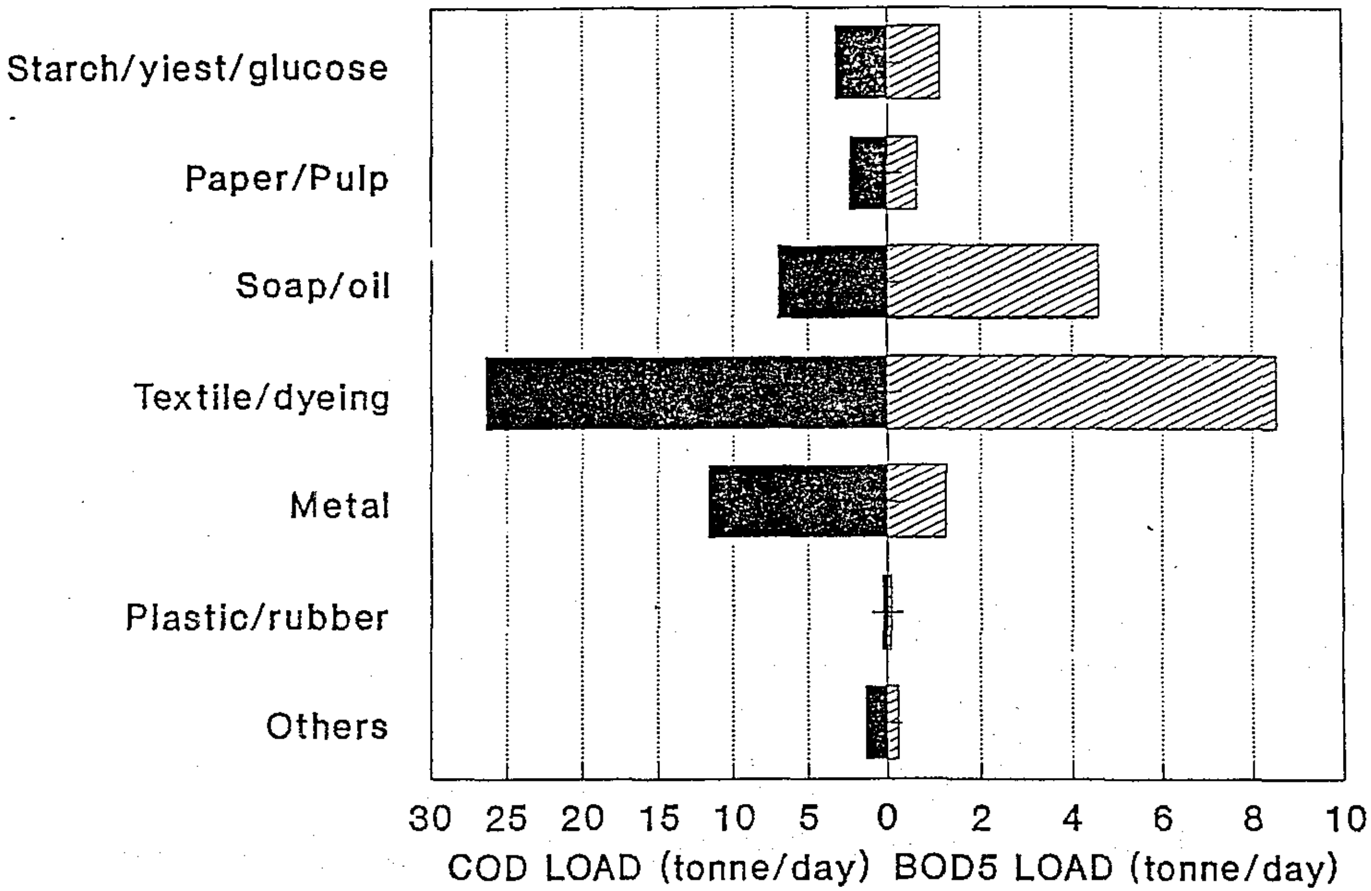


Figure 3
LOADS OF POLLUTION CONTRIBUTED FROM DIFFERENT INDUSTRIAL SECTORS



INSECTICIDES AND CHEMICAL FERTILIZERS
USED IN AGRICULTURE, BY TYPE AND YEAR

Year	Insecti-cides (Tons)	Azot and Ammonia Fertilizers (000 Tons)	Phosphatic Fertilizers (000 Tons)	Potassium Fertilizers (Tons)
1952	2143	648	92	--
83/84	16316	4815	1064	36400
84/85	16371	4123	1094	50506
85/86	23461	4999	1223	50767
86/87	20718	5013	1236	60177
87/88	17152	5104	1272	61441
88/89*	17997	4983	1204	56322

Central Agency For Public Mobilization And Statistics,1990.

大　気

AIR POLLUTION
IN EGYPT

Professor Dr. M. Nasralla
Head of Air Pollution Depart, NRC CAIRO

. Air Pollution:

Air pollution is the presence of foreign matter (particulate, gases, vapours.. etc) resulting from man-made activities in the outdoor atmosphere in such quantities and of such duration liable to cause harm to human, plant or animal life or damage to human-made material and structurs or interference with the comfortable enjoyment of life, property or other human activities.

With the rapid industrailization during the last 40 years, air pollution has become a serious problem in several industrial centers. Dust plumes and smoke haze are common phenomena in these areas such as Hellwan and Shoubra El-kheima close to Cairo and the industrial areas east and west of Alexandria. Expansion of urban areas such as the city of Cairo has been asociated with the rapid growth of the number of vehicles, bakeries, workshops and small industries within the urban area and the needs for more energy, consequently, a tremendous increase in fuel consumption. All these factors combine to impair the air quality. Photochemical oxidants are also common phenomena in the atmosphere of Cairo.

Air Pollution Sources:

The general concept of pollution as a consequence of human activity suggests a classification based on the type of activity resulting in pollution. The most important of which in Egypt are:

1. Combustion Sources:

a) Stationary sources, mainly power stations, furnaces and boilers using fossil fuel (coal, oil and gas), these produce sulphur oxides, nitrogen oxides and particulate which differ from place to place with respect to physical composition and chemical characteristics.

b) Mobile sources (mainly motor vehicles) which produce nitrogen oxides and hydrocarbons (photochemical oxidant type of pollution), carbon monoxide, smoke and lead, as found in many cities such as Cairo.

2. Industrial Activities: in addition to common pollutants such as sulphur dioxide and particulate matter, specific industrial activities produce pollutants related to the processes and products of the industry concerned. Examples of pollutant emitted from industrial activities are hydrocarbons, nitrogen oxides, particulates, ammonia, hydrogen sulphides, carbon monoxide, fluorides, chlorine, lead, cadmium, nickel, berylium... etc.

Industrial activities are the major sources of pollutants in many places in Egypt. The effects of these sources depend on many factors among which are weather conditions, stack height, location, the lack of control equipments and raw materials used.

ELECTRICITY POWER STATIONS

Thermal power stations are still the major source of electricity in Egypt. The increasing demand for energy and consequently electricity production in Egypt increased from 17177.8 KW hr during 1980 to 39580.4 KW hr during 1989. In other words, energy production has been increased by more than 130% within less than 10 years . This increase of electricity production depends mainly on the production from thermal power stations and consequently the increase of fuel consumption .

. The consumption of fuel was 2.5 million equivalent tons of mazout during 1980 to 8.1 million equivalent tons of mazout on 1990. This of course reflects the problem of steadily increasing in pollution emissions in the Egyptian atmosphere from thermal power stations with reference to nitrogen oxides, sulphur oxides and particulates.

INDUSTRIAL AREAS AND INDUSTRIAL ACTIVITIES IN EGYPT

Industries are distributed allover the country. However, these activities are heavily located in The Greater Cairo (Cairo, Giza and Kaliobea). The second area next to The Greater Cairo is Alexandria. Table (5) shows the types and number ofthese activities in each governorate individually. This table indicates that approximately all types of industrial pollution sources are taking place in Egypt. Furthermore, it may be seen that 64% of these activities are located in and around The Greater Cairo, and about 20% in Alexandria while only 16% of these activities are located in the other governorates according to the statistics of 1983 (Ministry of Industry 1983). Here, it should be noted that it was very difficult rather than impossible to get maps for each industrial area showing the locations of the industries. However, a map of The Greater Cairo showing the major industrial areas is shown in Fig. (3).

. . AIR POLLUTION FROM TRAFFIC (MOTOR VEHICLES) IN EGYPT:

Motor-vehicles are the major source of many pollutants such as lead, photochemical oxidant type pollutants and carbon monoxide in urban areas. Vehicles have been criminated by emitting several pollutants which are deletrious to human health. Air pollution resulting from vehicles in any urban situation is mainly dependent on the rates of emission from each car, vehicles density and meteorological conditions. Furthermore, it has been found that vehicles are polluting rural areas around traffic roads and highways.

The number of vehicles running in Egyptian cities and on roads are increasing exponentially during the last 20 years. Figure (3) shows the growth in the number of vehicles during the last 10 years. This causes serious air pollution problems in big cities such as Giza and Cairo (Greater Cairo) and Alexandria.

. IMPACT OF AIR POLLUTION SOURCES ON THE EGYPTIAN ENVIRONMENT:

Particulatres:

Sources ofair pollution (combustion and industrial) impaired the air quality in most of the big cities in Egypt. Table (1) shows that the concentration of suspended particulates reached intolerable limits in most of urban and industrial areas of Egypt especially in Helwan and Shoubra El-Kheima industrial areas, Cairo city and Alexandria. The figures in table (1) may be compared with the 150 ug/m3, the Egyptian air quality standard for particulates. Table (2) shows that smoke concentrations exceeded the WHO recommended limit of 40 ug/m3 in the investigated areas of Greater Cairo, Gharbia, Beheira and El-Menia. Concentrations of smoke in Shousbra Elkheima, and Imbaba industrial areas as well as Cairo downtown reached 4 times the air quality standard.

The increase in man's activities without control of industrial emissions has resulted in steady increase in pollution load in the Egyptian centres. For example, the particulate concentrations in Helwan atmosphere has been increased by 100% during the last 10 years *[Nasralla, 1990]*. Moreover, dustfall over Cairo city has been doubled during the last 20 years.

Sulphur Dioxide:

Sulphur dioxide concentrations recorded in the industrial area of Shoubra Elkheima close to metallurgical and ceramics work revealed a mean concentration of 3 times the air quality standard and exceeds those recorded in similar industrial areas around the world The area of Cairo city is also highly polluted with SO_2. Measurements show high concentrations exceeding 2-4 times the air quality standards in residential areas and city centre

Carbon Monoxide (CO):

In urban areas, motor vehicles are the major source of carbon monoxide. Carbon monoxide, as a primary pollutant is known to be toxic at high concentrations. Carbon monoxide concentrations in the outdoor atmosphere is very important, since it affects children, unhealthy and eldery people. CO has the affinity to combine with the blood forming carboxyhemoglobin. Its concentration is dependent upon the duration of the exposure and pulmonary ventialtion.

Carboxyhemoglobin has been found to be high in Cairo traffic policemen's blood after duty reaching sometimes 14% *[Emara, 1987]*.

The WHO recommended long term goals which have been set at 9 ppm maximum concentration over 8 hours and 35 ppm as a maximum concentration over 1 hour. These concentrations have been exceeded in Cairo central streets during 1978 *[Nasralla et al. 1978]*. Figure (23) shows the diurnal concentration of CO in a Cairo city street where max 1 hr reached 40 ppm and 8 hours average reached more than 20 ppm. These concentrations exceed the WHO recommended limits and California air quality standards.

Photochemical Oxidants in Cairo Air:

Photochemical oxidants were found to exceed the 0.1 ppm air quality standard as an average over 1 hr on 74% of the measurd days during 1979 in the atmosphere of the city centre.

Recent work shows that ozone concentrations exceeded the 0.1 ppm, max 1 hour in city centre, Imbaba, Shoubra and Dokki residential area *(Ali et al. 1991, under publication)*. Moreover, the measurements over the roof of NRC in Dokki revealed maximum concentration, average over 1 hr, of 110 to 130 ppb during the months of measurements during 1989.

Photochemical appearance in Cairo atmosphere was dependent on the nitrogen oxides cycles in Cairo atmosphere. The peak of NO concentration was in turn highly dependent on traffic emission

Lead:

Spacial and seasonal variation of lead concentrations were investigated in Cairo atmosphere *[Nasralla et al, 1986]*.

It was found that the annual mean lead concentrations in the central and densely populated parts of Cairo exceeded the 2 ug/m3 recommended limit ,

Concentrations of lead at street levels in Cairo ranged between 2.8 - 12.5 ug/m3. These concentrations decreased with heights above the ground,

[Nasralla, 1985].

These high lead atmospheric concentrations resuted in high concentrations in blood of Cairo residants. Lead concentrations in normal Cairo residents were found to be 30.5 ug/100 ml blood *[Nasralla et al.1985]*. Much higher concentrations of lead were found in blood of traffic policemen reaching 37.6 ug/100 ml in moderately exposed policemen, and 63 ug/100 ml blood in heavily exposed subjects (Table 35).

Conclusions and Recommendations

1 - Air pollution in Greater Cairo and some other urban centres become a serious problem which need an urgent air quality management programm to improve air quality .

2 - Industrial pollution sources are distributed all over the country but heavily concentrated around Cairo and Alexandria where 85% of industrial activities are located .

3 - Source inventories should be conducted to evaluate rates of pollutant emissions from different sources .

4 - Emissions of industrial pollution should be controlled. Priority should be given to dust emissions, for example cement industy, iron and steel industries, smelters and faunderies .

5 - Using of natural gas instead of heavy oil in electricity power stations and industrial work should be encourged. This will result in reducing sulphur dioxide emissions as well as particulates.

6 - Improve planning controls by introducing industrial zoning, Relocate polluting industries away of residential areas .

7 - Vehicles should be inspected for their pollutant emissions.

8 - Petrol lead additive should be reduced .

9 - Mass transit should be encourged over private cars in Urban Areas.

10 - Traffic management measures to improve traffic flow and reduce congestion should be considred. This may include one way systems and parking control .

11 - Tax incintive and disincintive should,be considered for pollution sources to use control equipment.

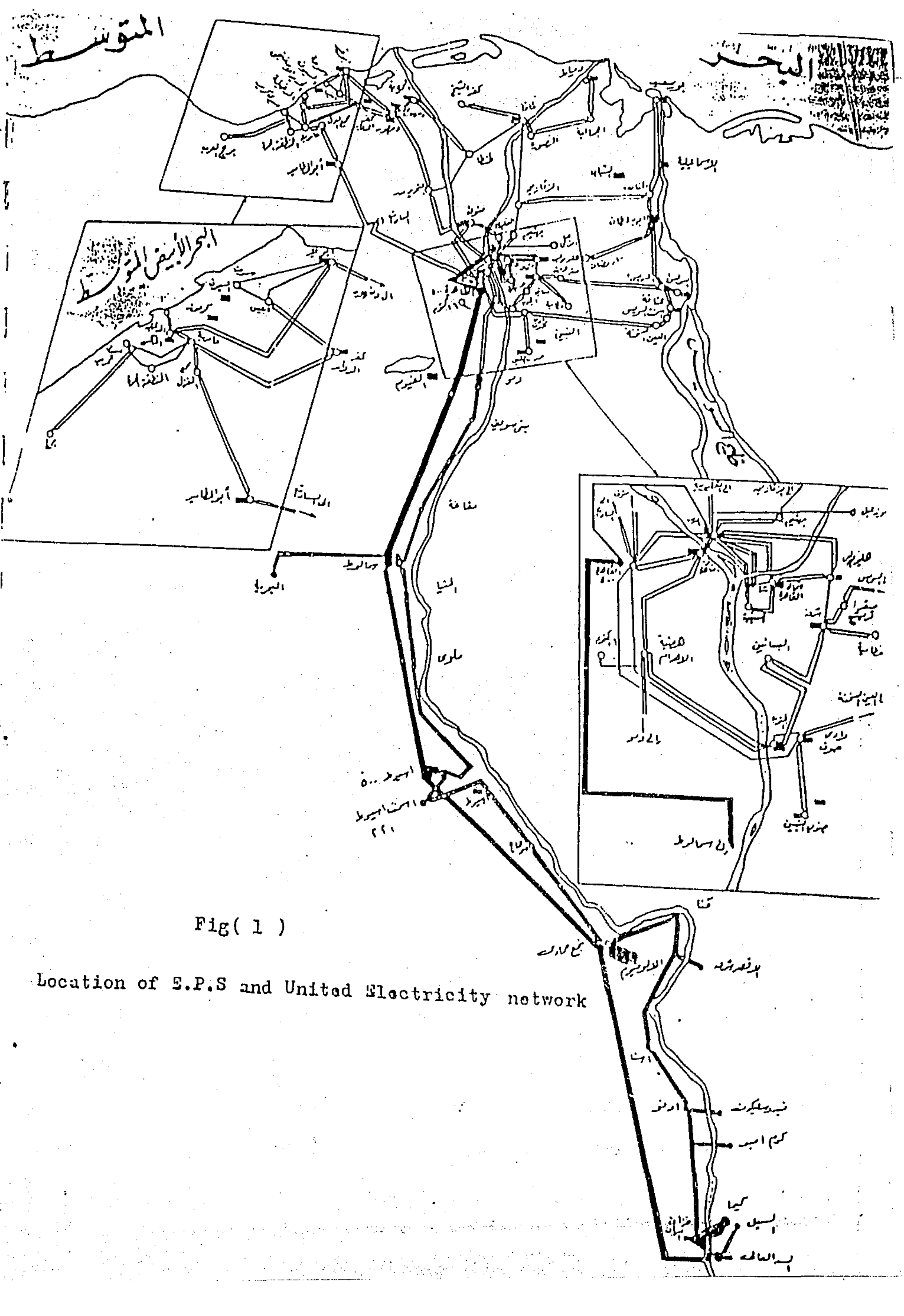
12 - Legislatren should be implemented and enforced.

13 - Responsibilities of air pollution control should be clearly defined for the various organisations.

14 - Research and training programmes should be strengthened.

15 - Environmental Impact Assessment should be considered for new projects.

16 - Awarness among general population and dicission makers should be raised.



Fig(1)

Location of E.P.S and United Electricity network

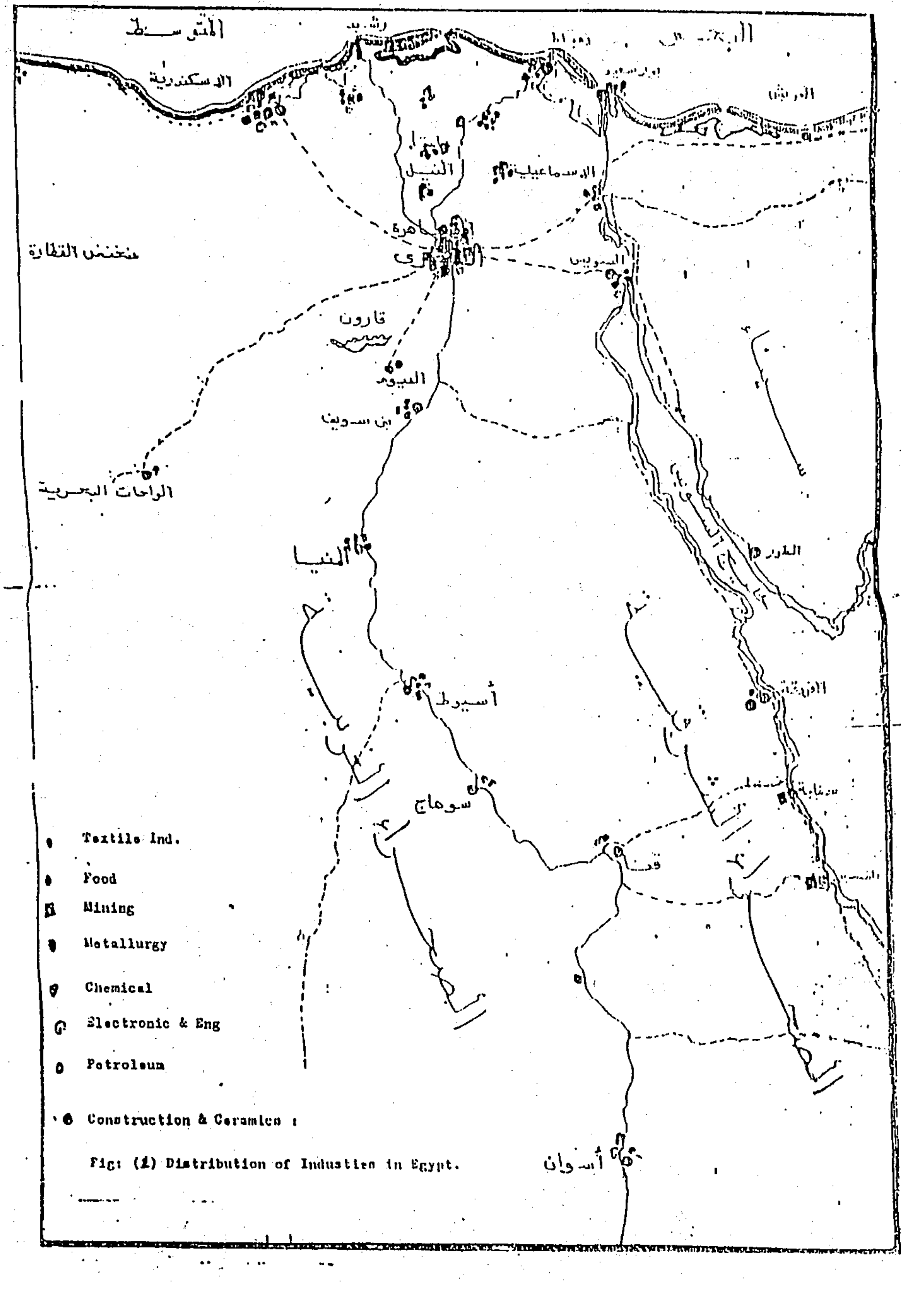


Fig: (1) Distribution of Industies in Egypt.

NO.OF VEHICLES IN EGYPT
1980 - MAY 1991

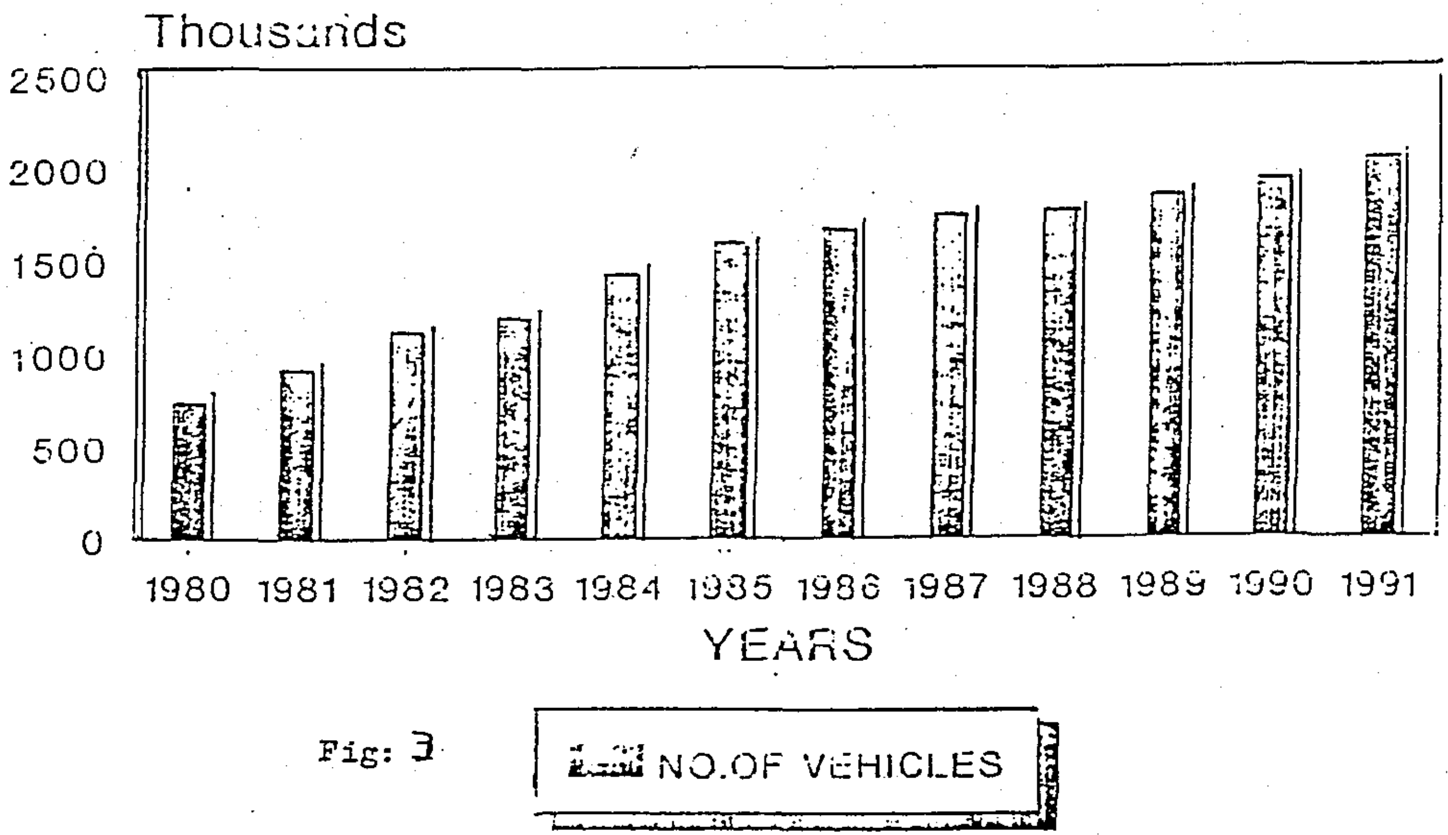


Fig: 3

Results of Clinical Examination of Chest among schoolchildren in the different Studied Areas

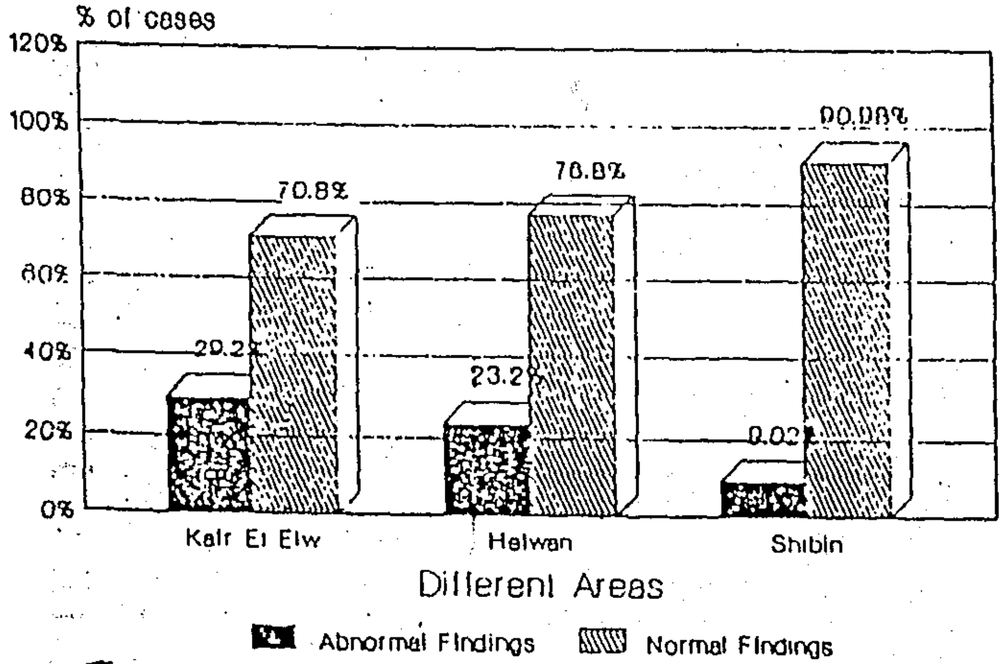


Figure (12)

Table 4:- TOTAL SUSPENDED PARTICULATES MONTHLY AVERAGES 1988

METHOD: Gravimetric-high volume sampler.

M.UNITS: MICROGRAM/CUBIC METER.

Governorate	Site	An.Av.		JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
Cairo	01. M. of Health	649	27	473	2	925	2	549	2	656	3	570	2	659	2	725	2	298	2	715	3	698	2	759	2	789	3
	02. Attaba Sq.	704	29	753	2	786	2	622	3	194	3	808	2	691	3	1120	2	645	2	577	3	665	2	834	3	661	2
	07. Heliopolis	602	27	718	3	694	2	684	2	***	*	531	3	842	2	583	2	337	2	530	3	474	2	610	3	612	3
	11. Helwan	838	31	519	2	833	3	666	2	978	3	663	3	945	3	445	2	1067	2	948	3	635	2	1055	3	960	3
Kalyobia	13. Banha	487	29	336	4	271	4	236	4	582	4	1228	2	465	3	***	*	327	3	929	4	251	1	***	*	***	*
	14. Abou Zaabal	763	30	251	3	479	3	722	3	970	3	597	4	834	3	295	1	232	1	1121	2	1433	3	727	2	1024	2
Giza	16. Dokki	591	30	652	2	709	2	555	2	621	2	670	2	670	3	678	3	214	2	365	3	532	3	577	3	710	3
	17. Talbia	884	28	955	2	1196	4	1092	2	769	3	774	2	972	2	926	3	***	*	770	2	825	2	696	3	683	3
	18. Hawaadia	541	25	***	*	***	*	***	*	835	3	621	3	504	2	448	3	544	2	453	3	434	3	422	3	567	3
Gharbia	19. Tanta H/3	802	42	756	4	717	4	793	4	870	4	800	4	820	3	827	4	950	4	810	2	793	3	797	3	797	3
	20. Tanta H/5	788	41	773	4	704	4	743	3	736	4	860	4	817	3	807	4	746	4	785	2	790	3	743	3	713	3
	21. K. Zavat	814	35	767	4	***	*	732	1	836	4	847	4	823	3	795	4	810	3	839	3	810	3	827	3	823	3
	22. Mehala	860	25	***	*	***	*	***	*	882	4	878	4	870	3	890	3	860	3	829	3	815	3	843	3	870	3
Behira	24. Damanhour	455	40	219	3	390	4	647	4	508	4	458	4	502	3	383	2	419	4	415	4	***	*	450	4	527	4
	25. Kafr El Dawar R.	343	40	822	1	298	4	533	4	390	4	565	4	389	4	207	2	303	4	253	4	287	4	257	2	312	3
	26. El. Beida	299	39	228	4	253	3	231	4	364	4	580	4	384	4	336	3	***	*	213	1	226	4	182	4	228	4
	27. Kafr El Dawar In.	272	32	***	*	***	*	***	*	582	2	549	4	212	4	227	3	200	3	177	4	208	4	135	4	280	4
Menia	28. Menia Chest H.	560	8	505	4	***	*	614	4	***	*	***	*	***	*	***	*	***	*	***	*	***	*	***	*	***	*
	29. Menia End. D.H.	409	9	***	*	***	*	***	*	***	*	***	*	657	3	***	*	***	*	***	*	310	3	231	2	380	1
	30. Abu Girkas	640	9	***	*	***	*	953	2	952	2	639	3	***	*	***	*	***	*	511	3	608	2	371	2	514	2
	31. Malawi	525	9	***	*	***	*	637	3	637	3	***	*	***	*	***	*	***	*	***	*	***	*	300	3	***	*
Alexandria	32. Semoha	510	48	734	5	343	4	478	4	427	4	282	5	320	4	***	*	271	5	228	4	438	5	462	4	465	4
	33. Bab Shark	282	47	442	4	368	4	269	4	207	4	426	5	407	4	154	2	232	5	124	4	160	5	200	4	396	2
	34. Abu Derdar	446	50	564	5	619	4	420	4	276	4	628	5	399	4	297	2	237	5	418	4	323	5	576	4	648	4
	35. Wadi Kamar	1061	38	1669	3	2997	2	1379	4	668	1	1454	2	1524	4	708	2	650	5	583	3	448	4	609	4	870	4
Ismailia	36. Ismailia	218	31	***	*	***	*	***	*	***	*	239	4	228	4	***	*	233	5	207	4	206	5	205	5	208	4
Suez	37. Suez	382	28	***	*	***	*	***	*	***	*	464	2	572	3	368	4	309	5	371	5	367	5	***	*	338	4
Sharkia	38. Zagazig	294	34	***	*	***	*	186	2	221	4	310	5	267	4	294	5	299	4	276	4	353	4	463	2	***	*
10th Ramadan	40. 10 Ramadan	313	19	***	*	***	*	291	3	225	4	581	4	243	5	241	2	156	1	***	*	***	*	***	*	***	*

Table 9:

SMOKE DAILY MEAN DATA 1988

METHOD: Smoke Shade, Reffectance
M.UNITS: Microgram/Cubic Meter.

SITE	TOTAL SAMPLES No.	Ar.M	G.M.	St.D.	SITE Description
Cairo Governorate:					
01. M. of Health	202	68	47	55.9	C.C.
02. Attaba Sq.	221	139	104	90.3	C.C.H.T.
03. K. El Nil st.	211	68	55	38.2	C.C.C.
04. Azbakia.	209	103	72	80.8	H.T.R.H.
05. El Sahel.	171	76	59	41.9	R.C.
06. Abbassia	196	151	115	103.5	R.C.
07. Heliopolis	213	70	45	72.5	R.C.
08. Nasr City	171	79	61	51.8	R.H.T.
09. Abu Sood	209	75	63	43	R.C.
10. Massara	178	76	48	68.8	R.In.
11. Helwan	243	61	46	43	R.In.
Kalyob Governorate					
12. Sh. Elkh.	208	123	105	71.5	S.urban In.
13. Banha	294	37	31	25.7	R.
14. Abou Zaabal	203	36	28	26.2	R. SubUrban Ind.
Giza Governorate					
15. Imbaba	141	176	142	102.3	R.In.
16. Dokki	178	136	100	92.7	C.C.C.
17. Talbia	210	69	53	49.4	Sub urban H.T.
18. Hawandia	215	79	52	69	Sub urban Ind.
Gharbia Governorate:					
19. Tanta H/3	315	57	54	16.9	R.C.
20. Tanta H/5	323	52	48	21.1	R.C.
21. K. Zayat	319	55	51	20.3	Sub urban In.
22. Mahala	215	60	53	38.8	Sub urban In.
Baheira Governorate:					
23. Daman	347	47	43	10.4	R.
24. Daman.	339	34	32	13.1	C.C.
25. Kafr El Dawar	297	23	18	15.1	Sub urban In.
26. El. Beida	339	17	14	10.4	Sub urban In.
27. Kafr El Dawar	324	20	17	11.3	Ind.
Menia Governorate:					
28. M.Chest H.	163	84	67	50.4	C.C.C.
29. M.End. D.H	295	96	74	63.2	C.C.C.
30. Abu Girkas	290	80	46	68.7	Sub urban In.
31. Malawi	326	55	42	38.6	Sub urban In.
Alexandria Governorate:					
32. Semoha	329	15	10	16	R.
33. Bab Shark	326	21	14	19.3	R.C.
34. Abu Derdar	291	33	21	33.8	R.C.
35. Wadi Komar	330	25	18	18	Sub urban In.
Ismailia Governorate					
36. Ismailia	283	20	11	23.5	R.
Suez Governorate					
37. Suez	225	22	17	15.3	R.
Sharkia Governorate					
38. Zagazig	254	26	24	11.8	C.C.C.
39. K.Zanad	188	20	17	9.9	Sub urban
40. 10 Ramadan	160	17	14	9.2	Sub urban In.

C.C. - City Center
C.C.C. - City Commercial Center
C.R. - Commercial Residential

H.T. - Heavey Traff
In. - Industrial
S. Urb. - Sub-Urban

Table 13

Seasonal Variations of SO_2 Concentrations (ppm) in Cairo Atmosphere

Year / Site	1979		1983/1984	
	1	3	1	2
Winter	0.05	0.03	0.06	0.03
Spring	0.08	0.05	0.08	0.03
Summer	0.15	0.05	0.11	0.05
Autumn	0.12	0.04	0.09	0.02
Mean	0.1±0.07(SD)	0.04±0.01 (SD)	0.09±0.06 (SD)	0.03±01 (SD)
Summer/Winter	3	1.7	2.2	1.7

Site 1, City centre

Site 2, Heavy residential.

Site 3, M. Residential area

Table (12) Summary of significant concentrations of sulphur dioxide and smoke found in Shoubra El-Kheima during 1988

	SO_2 (ull/l(ppm)	Smoke ug/m^2
Annual mean	0.06	150
Highest monthly concentration	0.10	218
Maximum 24hr.	0.23	550
50 percentile	0.1	128
98 percentile	0.3	510

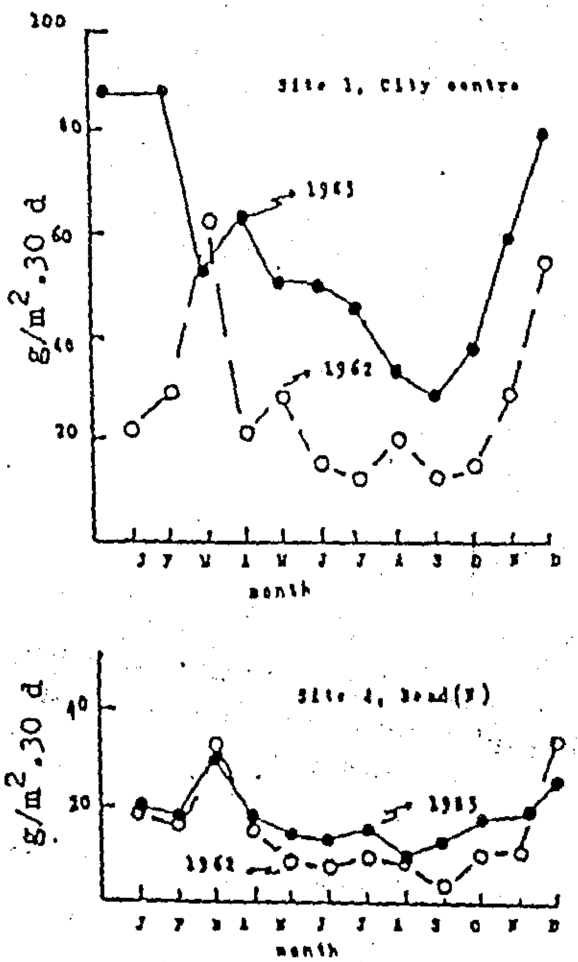


Fig.6 Monthly rates of dustfall at sites 1 and 4 during 1983 compared with 1962.

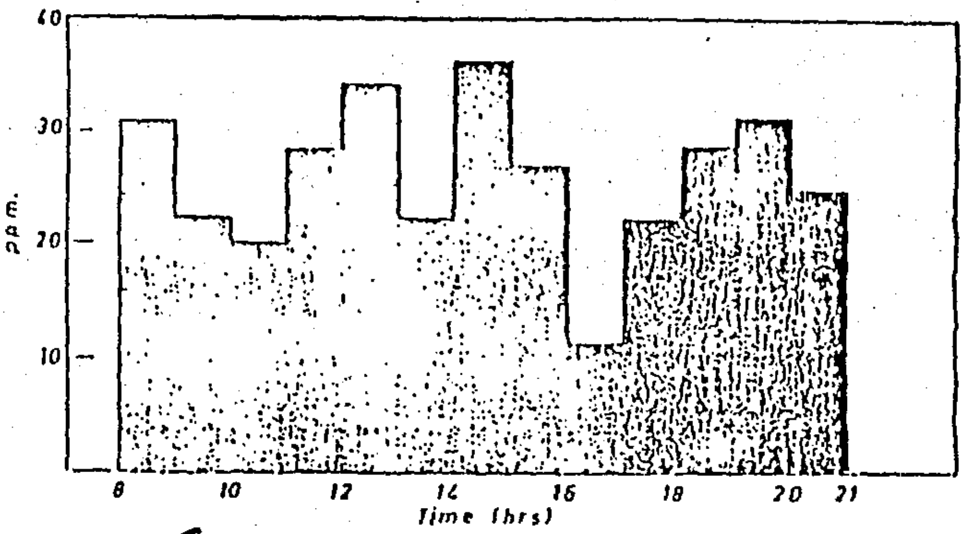


Fig: 6 DIURNAL VARIATION OF CO AT CITY CENTRE (Ramsis St) (1979)

TABLE [74]

Seasonal Concentrations of Lead in the Atmosphere of the Different Sites Investigated (1983 1984)

Season	*Site*				
	1	*2*	*3*	*4*	*5*
Autumn	2·6	1·2	0·5	1·9	—
Winter	2·2	1·4	0·6	2·1	—
Spring	2·3	1·3	0·5	2·0	1·2
Summer	4·9	1·8	0·7	2·6	1·4
Mean	3·0	1·4	0·6	2·2	1·3

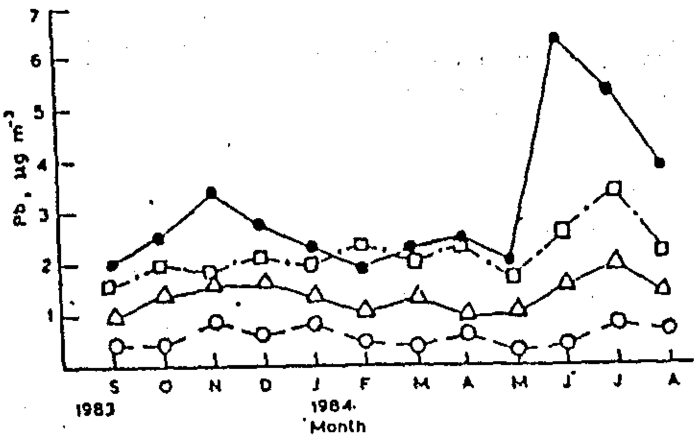


Fig. 26 Mean monthly lead concentrations in Cairo atmosphere (1983–1984). ●, site 1; △, site 2; ○, site 3; □, site 4.

General Nature of the Air Pollution Problems in Egypt

by

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Introduction :-

The population of Egypt is growing very rapidly. As a result of this, The limited amounts of natural air and water available per person are decreasing.
The population of Egypt has increased from about 10 millions at the beginning of the present century to almost 57 millions at present time, and it is expected to reach about 70 millions by the year 2000 . About or slightly less than one half of the population are living in urban centers (cities and towns) . Such urban centres only occupy less than 0.5% of the total area of Egypt.

The problems

As a result of this vast increase in population, industrialization and utility services, such as power generation and Sewage etc, has been increasing very rapidly throughout the different governorates of Egypt during the past 40 years. Industrialization usually creates new health problems and leads to cultural changes due to the transfer of some workers from agriculture to industry and from ruaal areas to industrial and/ or urban environs.

In some parts of Egypt., air pollution has already become a problem and its abatement and control receive too little attension. The nature and magnitude of the air pollution problem in Egypt is very complicated, as it originates from two major sources, namely sources due to man's activities and from natural sources.

The day-to day chores of living, playind and working in such a rapidly growing community, besides the corresponding increase in traffic density and the necessary industrial and services activities have no doubt an effective role in intensifing the problem of contaminating our environment with various chemical impurities.

Egypt has its own characteristic climatic and topographic features. It is characterized by its huge eastern and western desert areas,,from where dust and sand storms frequently blow especially in winter and spring. The spring season of the year is characterized by the passage of a number of hot atmosphereic depressions known in the area as the "Khamasin Depressions". The passage of such depressions is always associated with fresh to strong hot southerly winds loaded with dust and sand.

Although dust and smoke haze are frequently observed in the air of some big Egyptian cities and industrial centers e.g. Cairo, Helwan , Shobra El-Kheima, Alexandria and Mehalla, no pollution disasters comparable to those experienced in the other parts of the world, have occured. It is already recognizable that increasing human activities had lead to problems of suspended particles and gaseous pollution in Egypt's big cities and industrial environs.

Traffic air pollution is a major source of nuisance especially in Cairo and other big cities. As the number of cars is still growing rapidly, It must be expected that this problem will become more important in the near future.

The total number of registered motor-vehicles in greater Cairo during the year 1969 was about 85,800 Cars. These cars have consumed about 160,000 tons of different grade fuel. It was estimated that the minimum over all emissions from these automobiles amounted to 35 tons/day, this was emitted into the streets and the open spaces of Cairo, the area of which is less than 12 % of the total area, in the from of smoke, carbon monoxides ~~& dioxides~~, hydrocarbons, aldehydes, oxides of nitorgen and sulfur and particulate matter especially lead. By the year 1974, the number of registerd cars reached the figure 133500 cars, and the figure for the present time is estimated at about ¾ of a million cars. These cars has consumed 1.5 million tons equally divided between gasoline and deisel during the year 1986. This amount of burned fuel have resulted in the emission of 1105 tons/day exhaust pollutants. In other words, traffic air pollution in Cairo have increased by more than 30 folds during the last 17 years.

The emission of such quantities in restricted space with tall buildings prevailing represents a serious problem.

As the climate during most of the days of the year is very sunny; it must be expected that photo-chemical smog will be fromed, resulting in large concentration of oxidants. These oxidants constitute a puplic nuisance and can inflict considerable damage on plants, So that traffic air pollution may result in economic losses too. In one of our recent and short studies, it was found that such smog was encountered during 8% of the hours of the month of July 1989, in a relatively clean residential district in Cairo.

Industrial air pollution is also a major source of complaint in Egypt. Many problems arise becouse of the use of relatively old techologies in specific industries and bad zoning and planning, in many cases houses are being built close to existing industries. The fact that the Egyption municiplaities did not have services for the study of environmental problams was one of the main reasons for bad plaming.

The cement industry represents a major air pollution problem in Egypt. Egypt's production of portland cement amounts to about 13 million tons at present. A major part of this quantity is produced in 3 factories situated in Helwan industrial area. The remaining part is produced in Alexanderia, Assiut, and Suez. It is estimated that the 3 Hellwan factories emitt more than 500 tons dust daily to the surrounding atmosphere. Added to this, significant amounts of gaseous pollutants are also emitted.

Because of the relatively hot climate, sources of odours, that would be negligible in more temperate climate, are posing difficult problem in Egypt. Special care is urgently needed in the processing and removal of solid and liquid wastes.

Previous Studies:

The Air Pollution Research Department of N.R.C. Egypt has carried out numerous research studies regarding the ~~prob~~ problem of air pollution and its impacts on human health, materials, and plants during the last 30 years. These were mainly intermittent studies conducted in Greater Cairo, including the two big industrial centres of Hellwan and Shobra El- Khima, cities in uppen Egypt and cities in the Suez canal Zone. The department has also conducted few research studies abroad of which is the study dealing with air pollution and noise problems in Mecca, Saudi Arabia, during the pilgrimage seasons 1978 & 1979.

The work undertaken dealt with both indoor and out-door (atmospheric) pollution. In the former, the studies dealt with exposure of workers to hazards pollutants in industries such as foundaries, iron and steel, cement, asbestos, Spining and weaving, Soap and artificial cleaners, plastics, manufacturing process libarating lead fumes and so forth. The results of these studies have clearly shown that the environment of the majority of these industries is highly polluted, and the exposed workers were suffering from different occupational diseases. Solutions to such problems were recommended.

Outdoor pollution studies have been undertaken to investigate deposited and suspended dusts, smoke, and gaseous pollutants in relation to sources and variation in the atmosphere. Also, air contaminants originating from the exhaust of motor-vehicles in the city of Cairo has been studied. The results regarding carbon monoxide, hydrocarbons, oxides of nitrogen and sulfar, and lead concentrations showed that motorvehicles are a major source polluting the air of our city and that diesel smoke is a major problem.

The results of the above mensioned studies appeared in more than 200 specialized research papers printed in scientific periodical in Egypt and abroead, local and inter-national conferences and symposiae, 15 M. Sc. and

and 10 Ph.D. thesis, Several technical reports, for contracts betwwen the department and other establishments suffering from specific air pollution problems, were also made.

The following table give an example about the levels of air pollutants studied in Greater Cairo by the department. The figures clearly indicate that these levels highly exceed the ambieut air quality standards adopted by Egypt and other countries of the world. Also , it stresses the severity of the air pollution problem in Cairo.

The air contaminants at both Hellwan and Shobra El-Khema have resulted in an average loss of the value 10 - 30 % in the amounts of direct solar radiatin received. These losses were mainly in the benificial ultra-violet part of the solar spectrum, which is responsible for the synthesis of vitamin D in the human body.

Also, horizontal air visibilities are deteriorating intensively at both localities.

Some Selected Air Pollution Levels in Grater Cairo.

		Annual mean	Maximum monthly	Maximum daily	Maximum hourly
a - Hellwan:					
Dust-Fall (gm.m.$^{-2}$ month)	1967	57			
	1974	123			
	1978	144			
T.S.P. $\mu g.m^{-3}$ (Res.)	1982	740	1000	1800	_
b-Shobra EL-Khema:					
T.S.P. $\mu g.m^{-3}$	1979	434	1112	1400	_
	1983	567	895	1652	_
Smoke $\mu g.m.^{-3}$	1978	195	260	1043	1200
So2 $\mu g.m.^{-3}$	1984	96	111	334	
Dust-Fall gm:m.$^{-2}$month	1977	64	155	_	_
	1983	46	106	_	_
c- Cairo, City centre:					
T.S.P. $\mu g.m.^{-3}$	1979	611	743	1300	_
Smoke, $\mu g.m.^{-3}$	1984	240	325	995	_
Lead in air, $\mu g.m.^{-3}$	1983	3	6.5	15	_
Dust-Fall, gm.m^{-2} month	1962	27	59	_	_
	1983	57	97	_	_
So2, $\mu g.m.^{-3}$	1984	230	500	900	
Nox , ppm	1979	0.38	0.76	0.96	2.21
NH3, ppm	1979	0.38	0.82	0.99	1.60
Co, ppm	1978	20	_	_	50
Ozone, ppb (Res.)	1989	_	70	90	140

Future Prospects and Recomendations:

In order to minimize the hazards nature of the air pollution problem, Egypt is in urgent need for area-wide air pollution investigations. The aim of such investigations is generally the abatement of the pollution. Theoritical solutions to the problem may appear simple-eliminate or control all significant pollution sources. However, the practical application of such solution in some cases is most difficult,since economic cost of essential changes in fuel usage , energy conversion systems, waste disposal methods and modes of transportations may not be feasable. What is needed therefore is a sensible basis for determining the degree of constraints nesessary to reach satisfactory levels of clean air. This involves an estimate of the maximam degree of pollutant emission suitable with the natural self-purification capacity of the atmosphere. The best we can hope for at present is some sort of brake on the current accelerating rate of deterioration of our air. This can be done through the development of an air resource mangenent plan, which in turn is impossible without area-wide studies. Area-wide studies can secure data from which authorities can determine the need and scope of future plan or activity in order to conserve the vital air resources.

Finally, Japan can help Egypt in starting and executing the above proposed area-wide studies which aims at :-

1 - Development of national standards, especiolly emission standards, using existing knowledge of statistical aproaches.

2 - The choice of sensible control methods for pollution emissions from selected industrial activities.

3 - The choice of proper solutions for the traffic pollution and Noise problem in Cairo. Note ;number of Japanese cars are currently rising in Egypt.

4 - Minimizing pollutant's emission from thermal power stations.

5 - Disposal of indusrial and domestic wastes which contributes to the air pollution problem.

As Japan is a highly advanced and industrialized country, she (i.e. Japan) could secure aid to Egypt through the following:

1 - Establishment of a net-work of monitoring stations in Cairo .

2 - Training in the field of air pollution contral.

3 - Supplying standard laboratory equipment.

4 - Conducting mutual research between Japanese and Egyptian Scientists in the field of air pollution and its hazards impacts.

5 - Transfer of relatively clean technologies for selected industrial activities, to be defined through the proposed area-wide studies.

マンザラ湖

THE ENVIRONMENTAL DETERIORATION OF LAKE MANZALA

as example of the Northern Lakes in Egypt

by

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to the Port Said Governorate

For Environmental Affairs

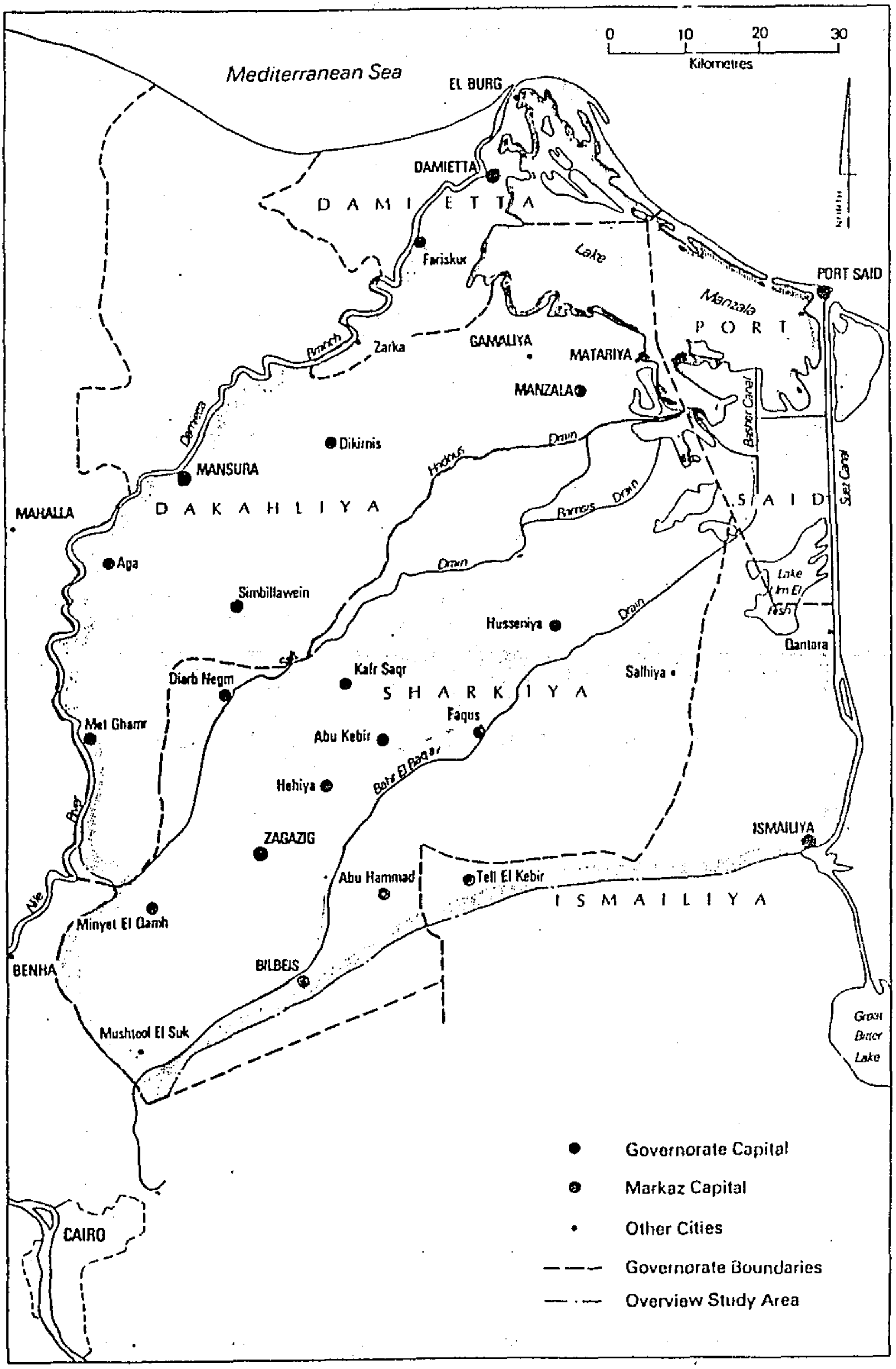

Figure E.2.3 Distribution Of Cities In The Overview Study Area

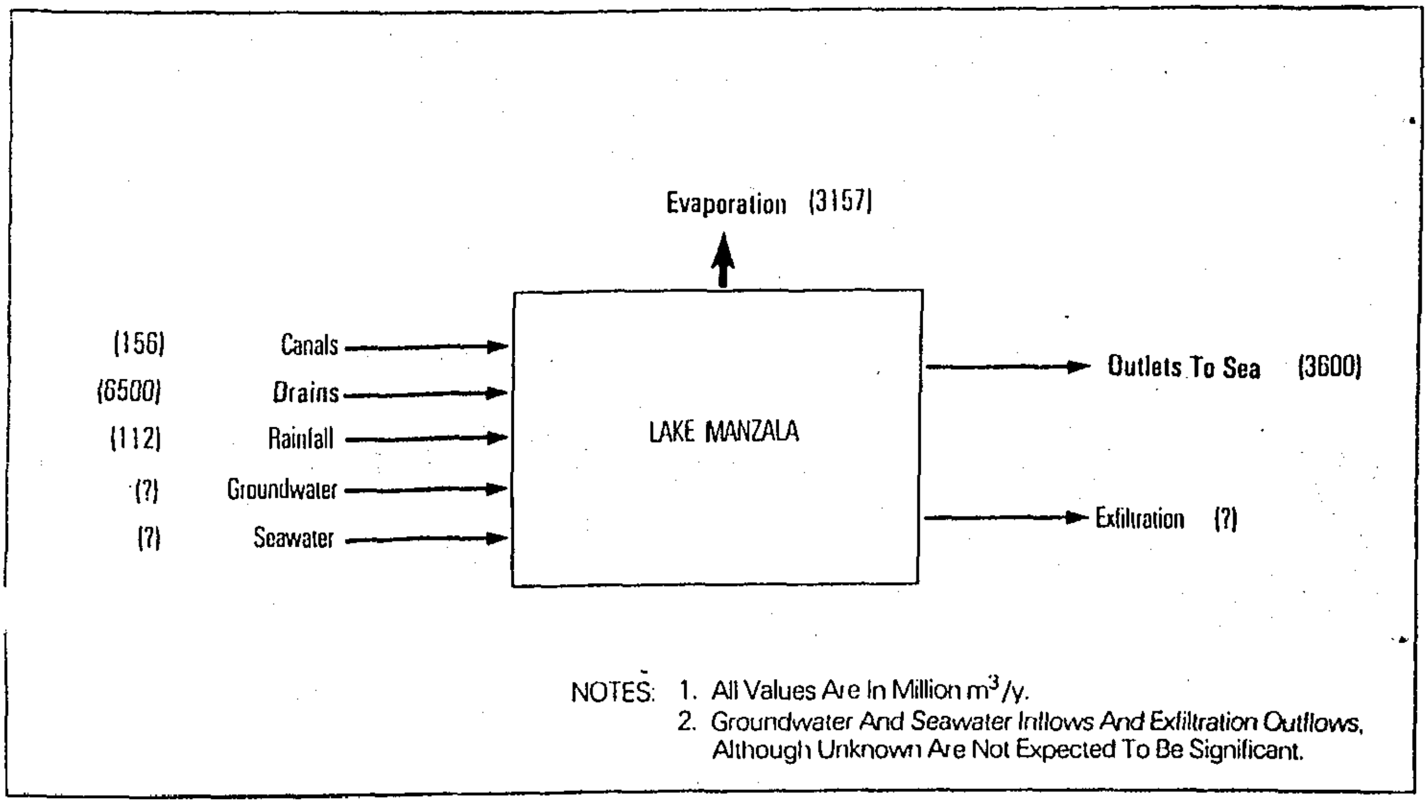

Figure C.4.4 Lake Manzala Water Balance

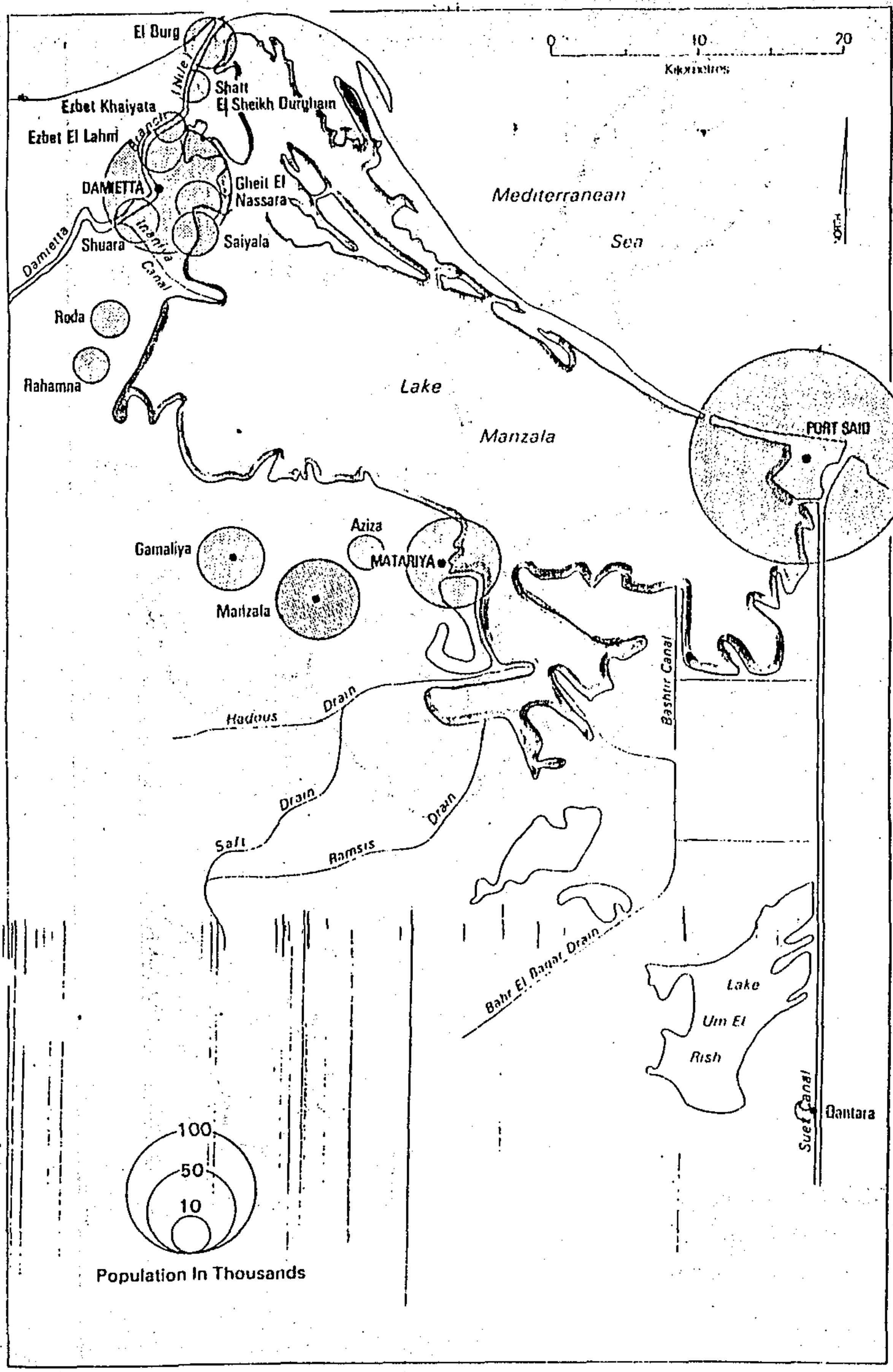

Figure E.3.2

Population Size And Location Of Major Settlements In The Detailed Study Area

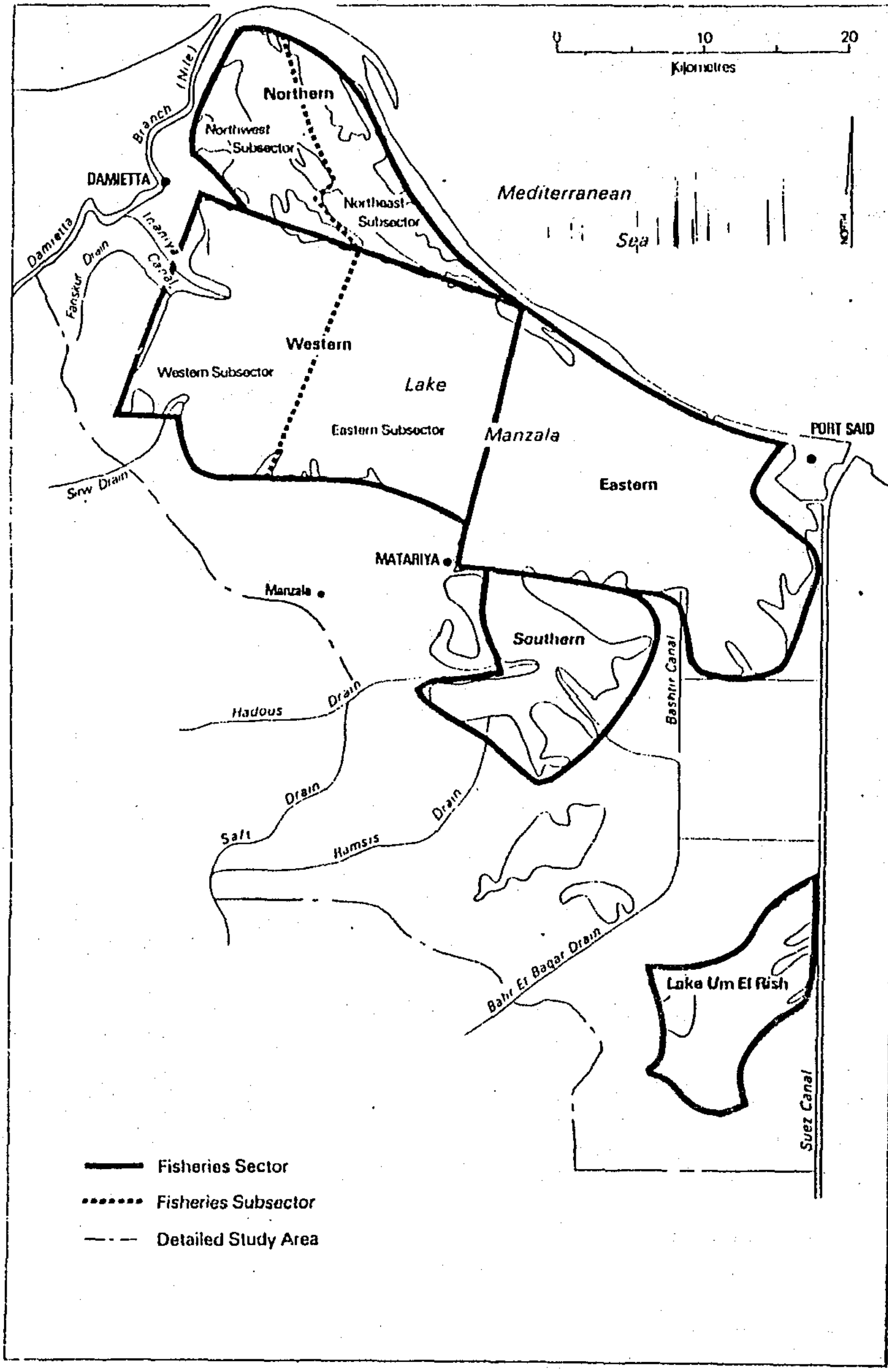

Figure D.1.1 Study Area And Lake Based Fisheries Sectors

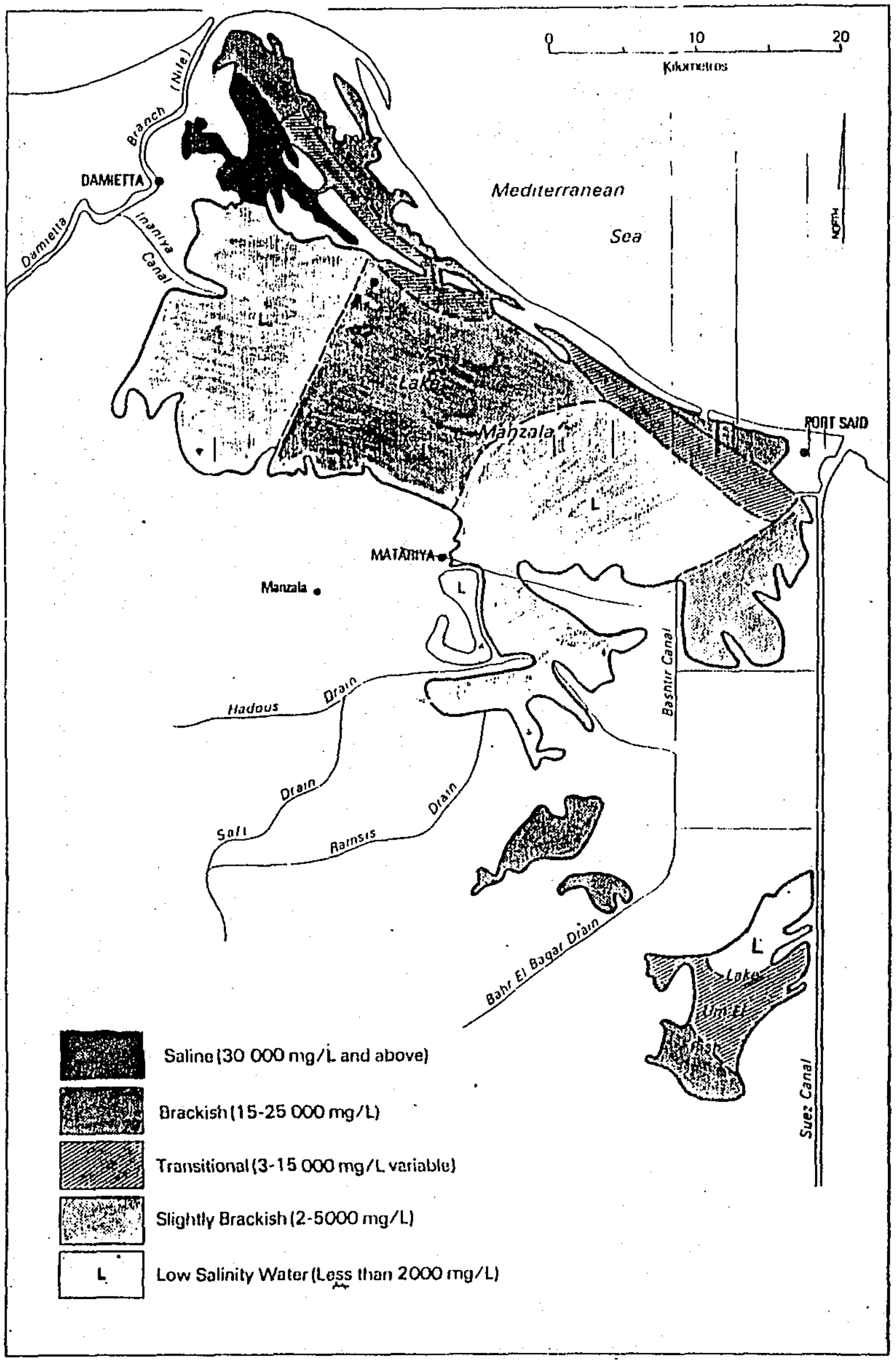

Figure D.1.2 Salinity Regimes

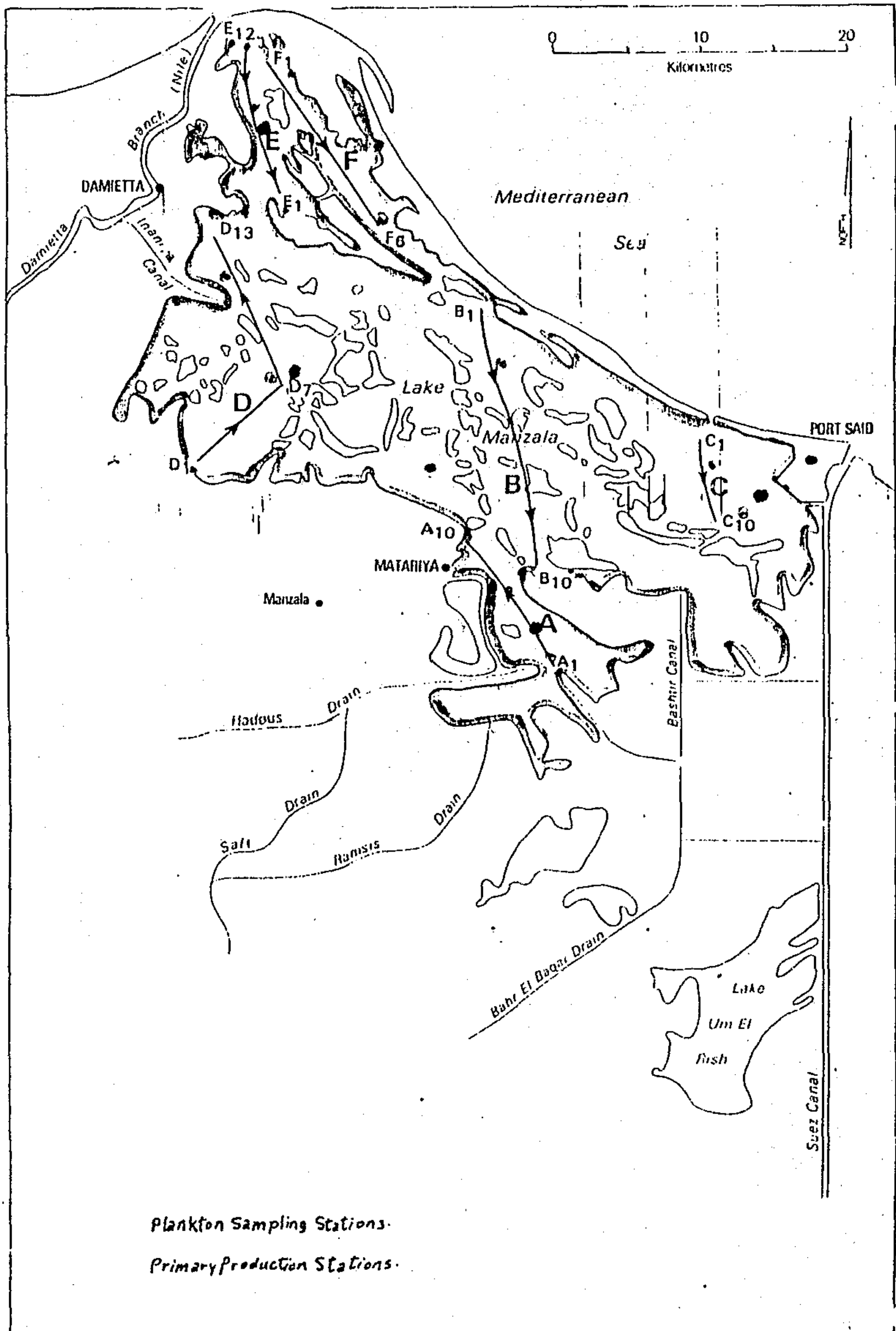

Figure D.2.8 Location Of Benthic Sampling Transects

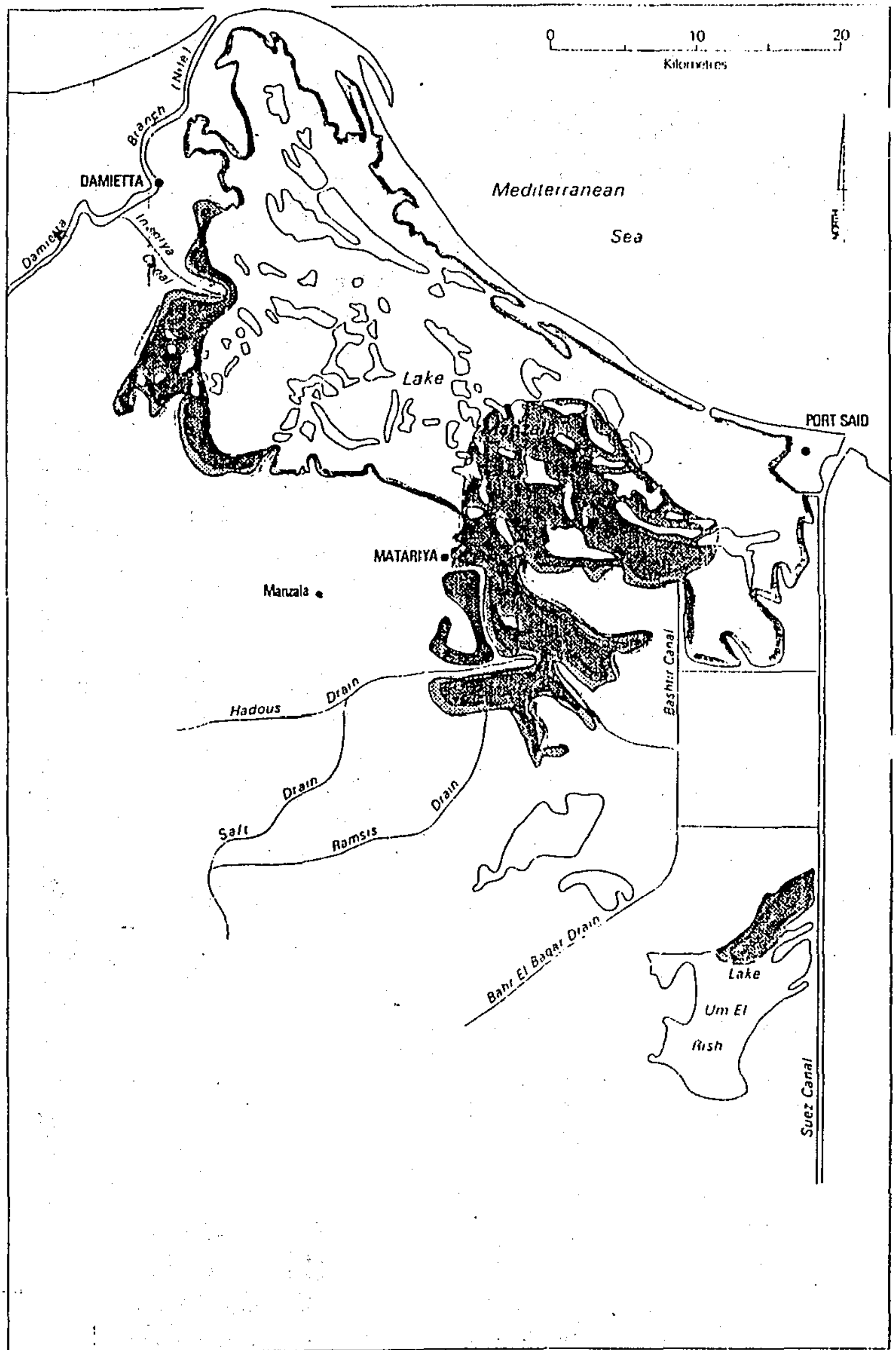

Figure D.2.15 Distribution of Eichornia crassipes on Lake Manzala

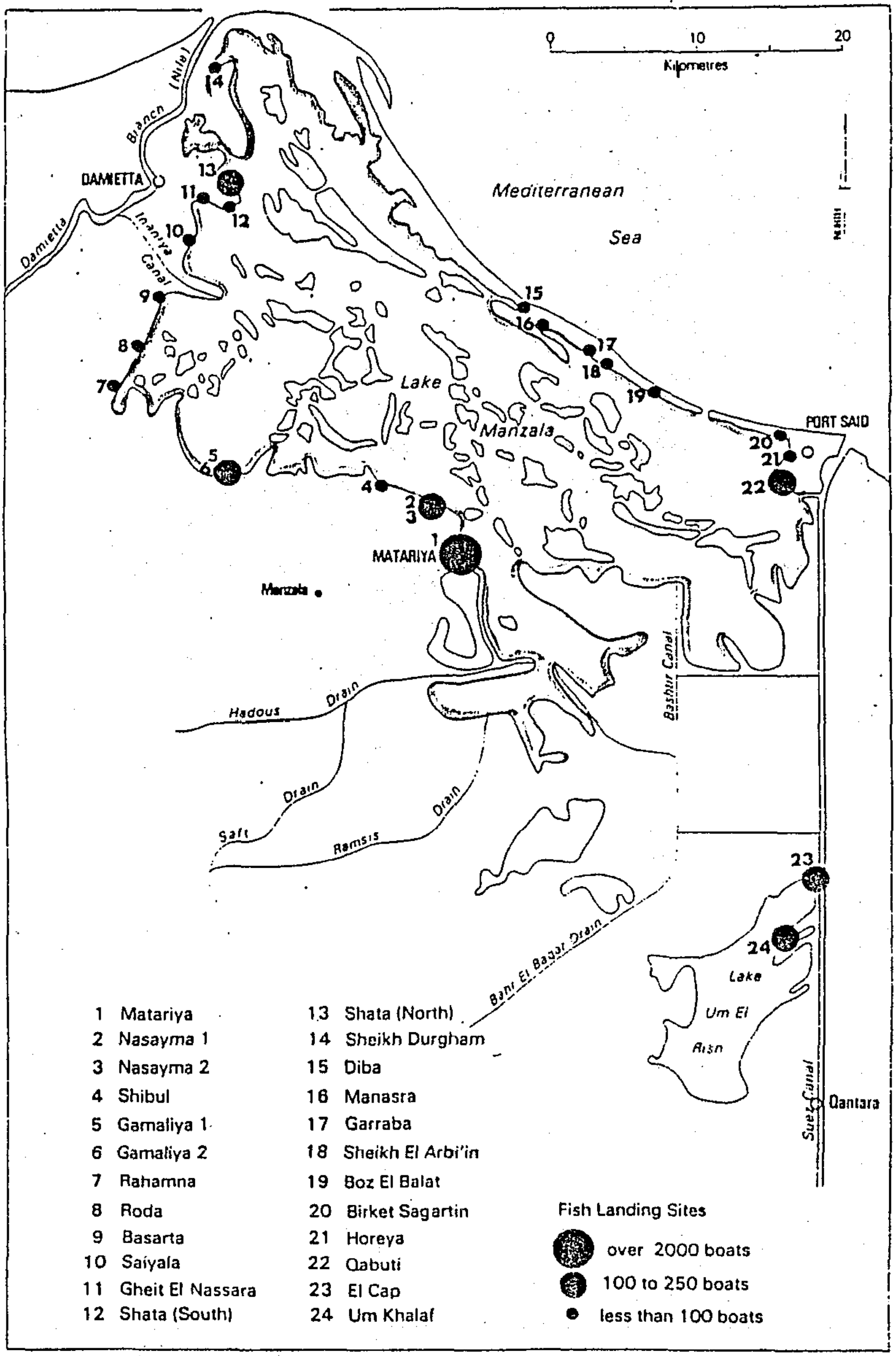

Figure H.3.1 Distribution Of Ports Or Fish Landing Sites

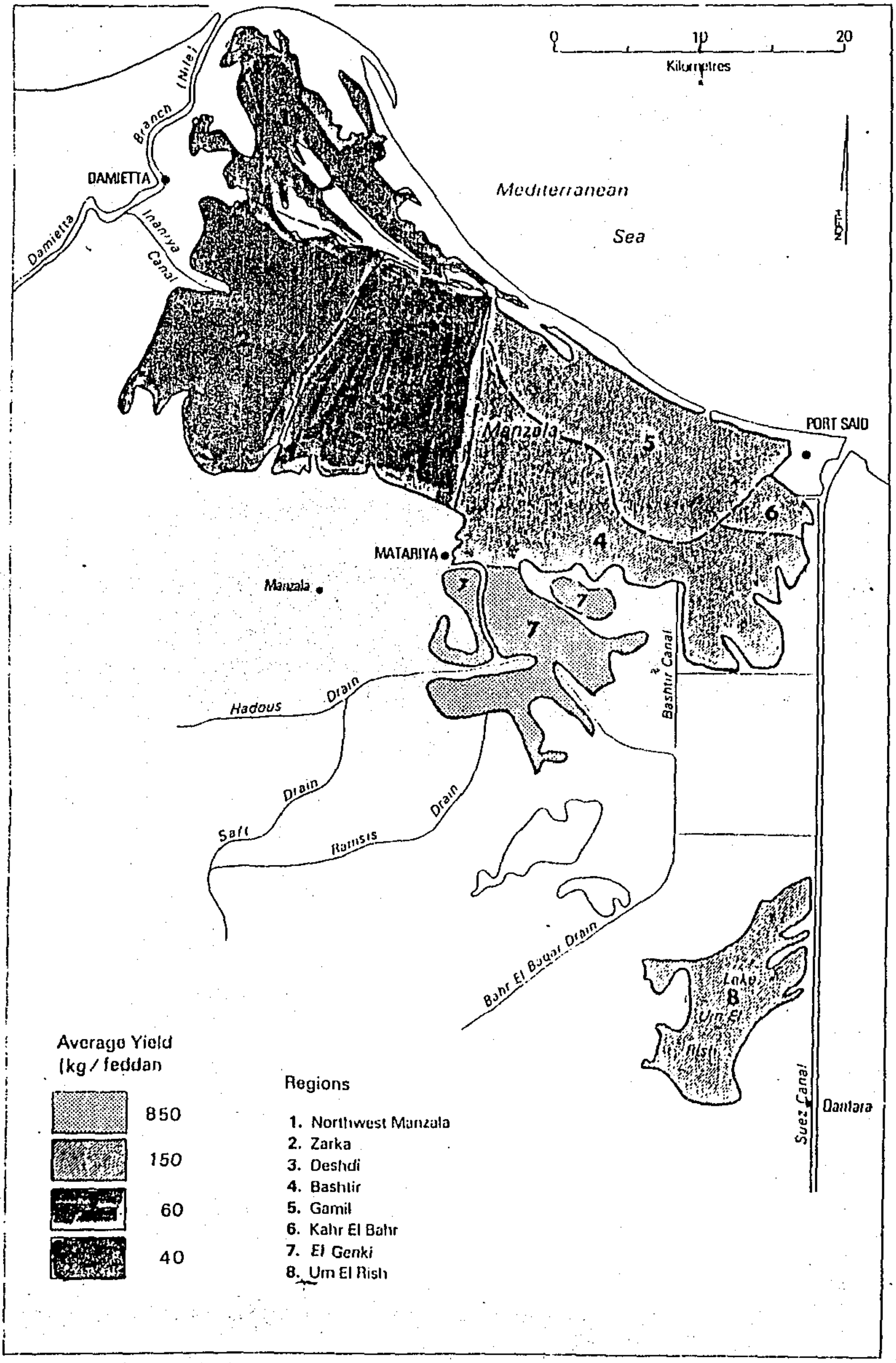

Figure D.1.4 Open Fishing Regions And Yields

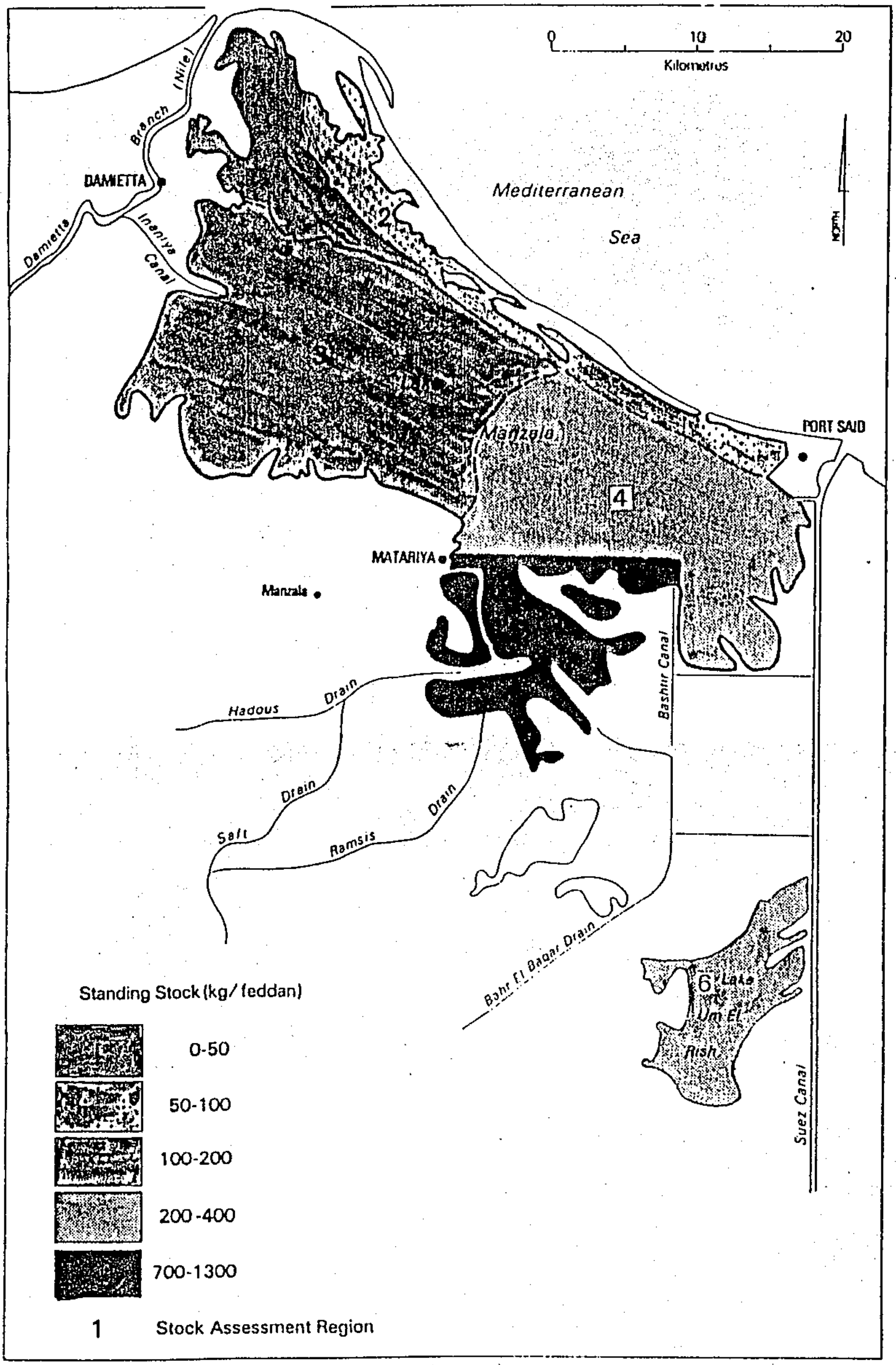

Figure 4.1 Fish Standing Stock Densities

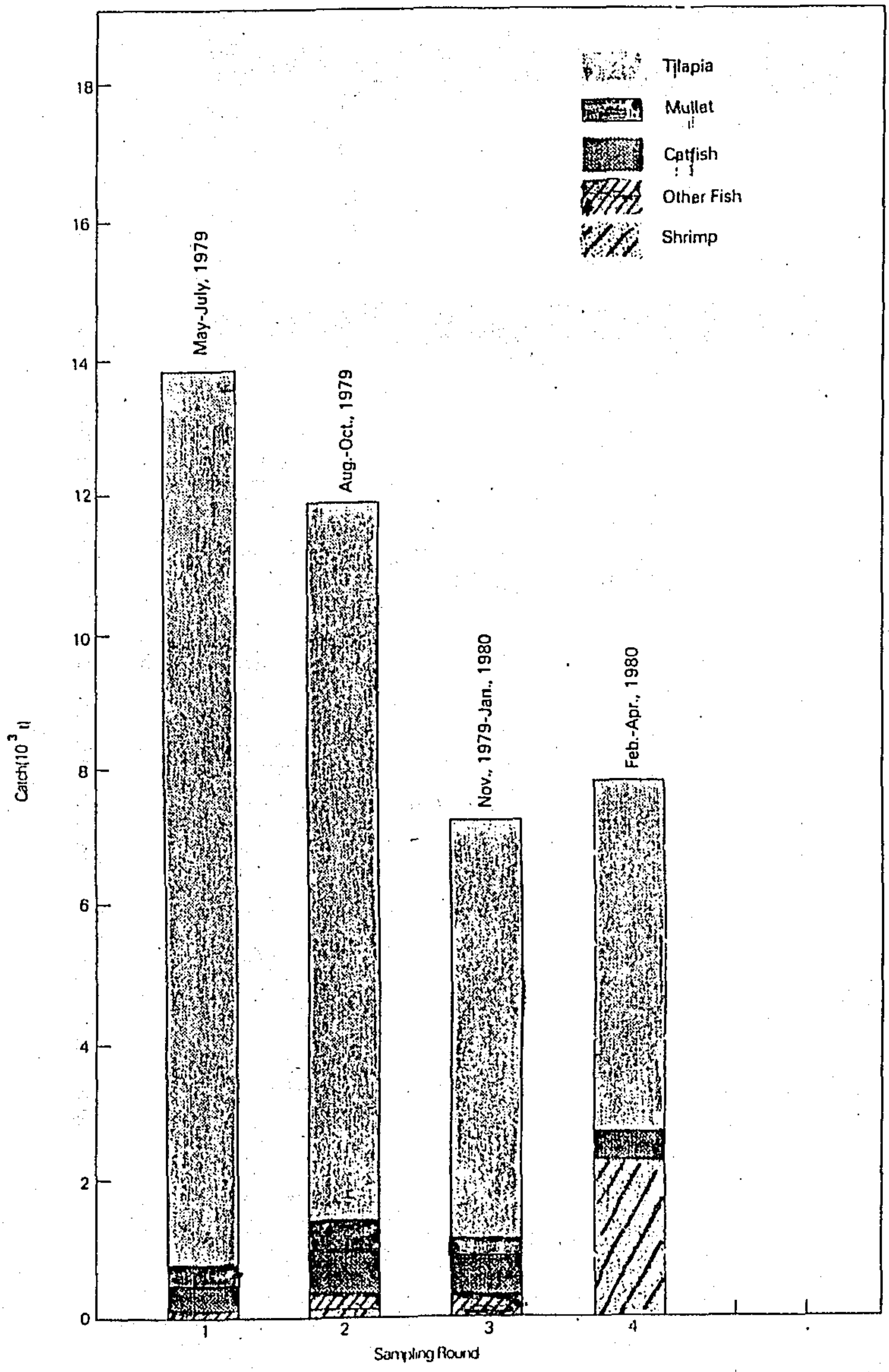

Figure H.3.4 Quarterly Catch Of Major Species In Lake Manzala

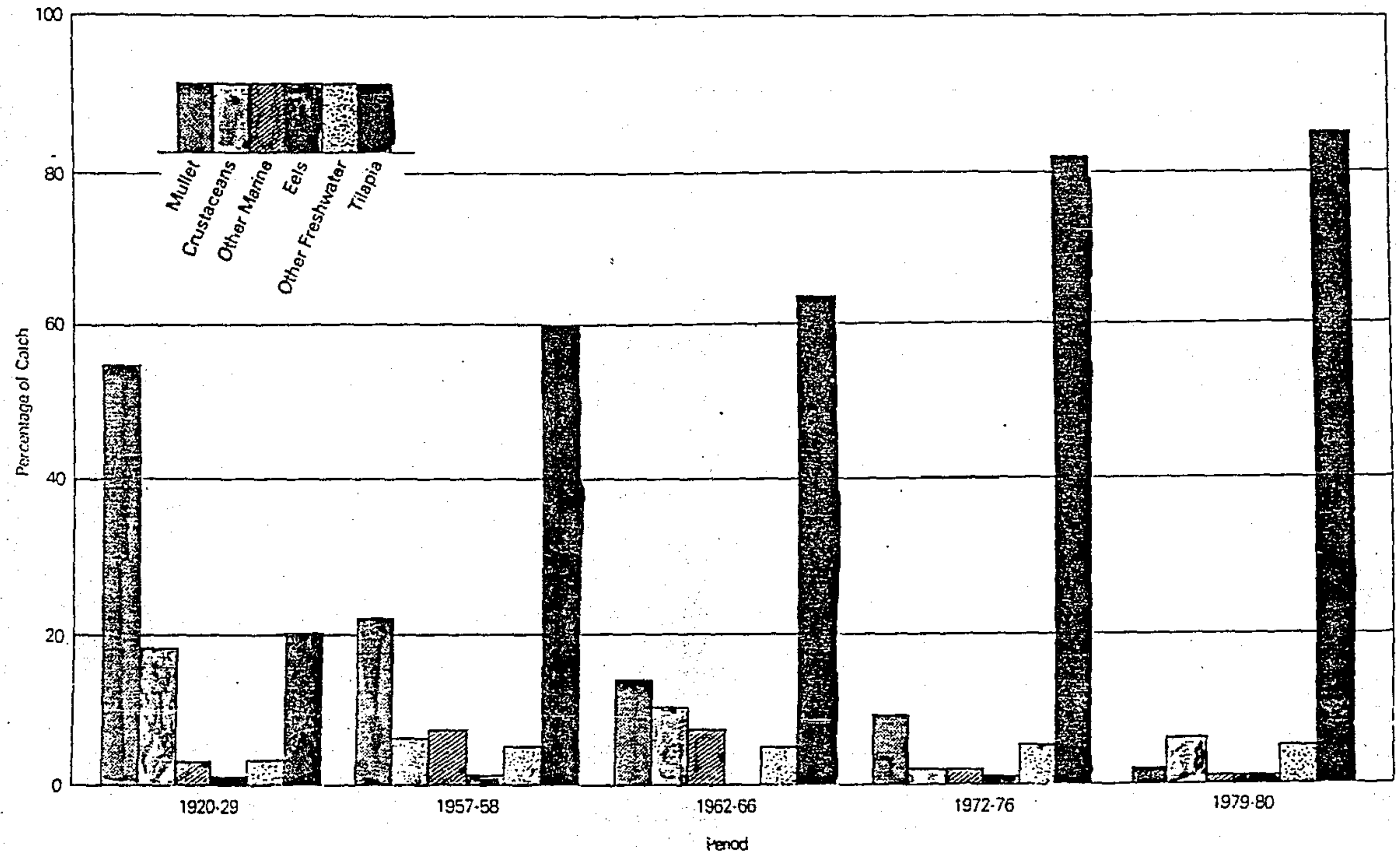

Figure H.2.6 Species Composition Of The Lake Manzala Fish Catch From 1920 To 1980

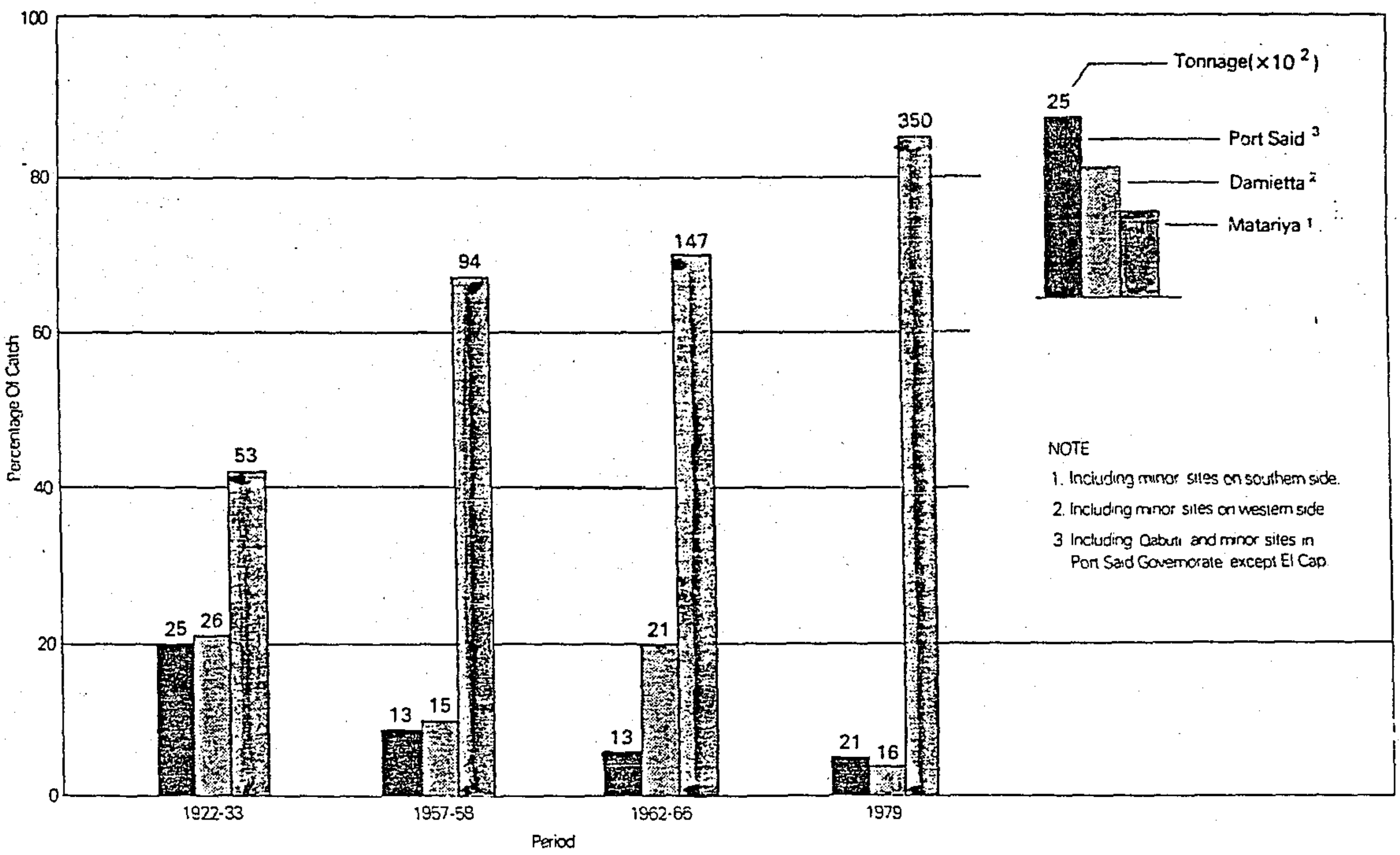

Figure H.2.4 Percentage Of Total Fish Catch Landed At Matariya, Damietta And Port Said On Lake Manzala

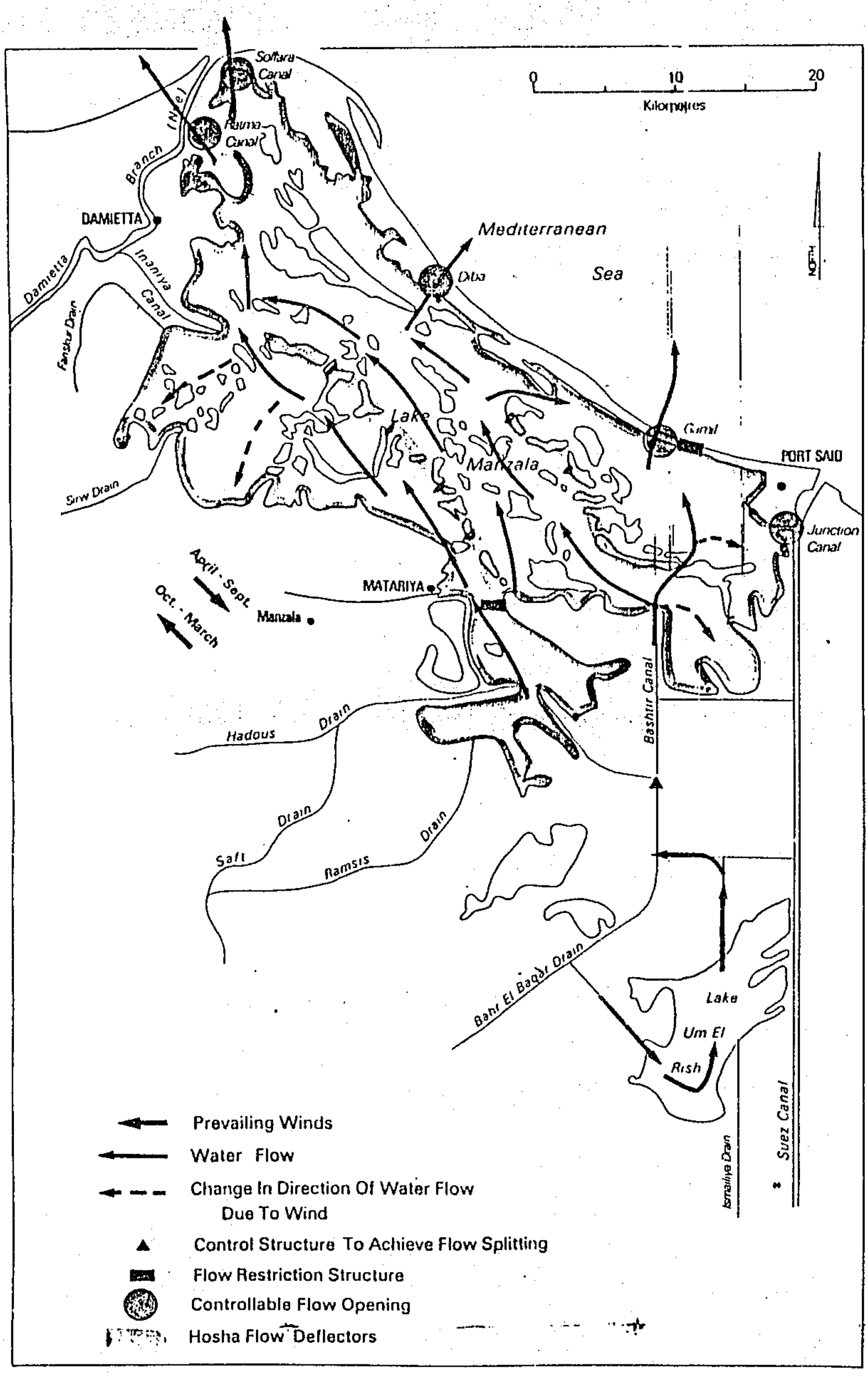

Figure C.5.1 Model 1, Maximum Dispersion Of Drain Water

海　洋

MARINE POLLUTION

Dr. Ahmed Sayed Moursy
Prof.,Water Pollution Control
National Research Centre

Environmental pollution is generally classified into air, water and land pollution according to the media recieving the pollutants. In fact, almost all pollutants will find their way to the sea or ocean. Needless to stress the importance of the economic uses of seas and ocean as a source of fishery, as a medium for transportation and recreation, and aspotential resource for potable water.

The marine environment is important from political point of view. The important attached to the sea by different countries has been demonstrated on many occassions in their attempts to secure an outlet to it in order to safequard political independence and their desired to extend their control over coastal waters and areas of the high seas.

POlluting substances may cause changes in the physical-chemical environment, e.g., in temperature, salinity, pH, colour or turbidity of the water, chemistry,...etc,which in turn may influence the marine life in different ways. Pollutants may also cause direct damage to organism,e.g, on physiological processes, including alimenation and reproduction, after having reached a certain threshold concentration. No body know how many pollutants there are, but already the new compounds can be counted in tens of thousands.

The use of oil or of other natural resources without losses is practically impossible. Oil enters the marine environment by number of different routes as a result of both human activities and natural processes. The biggest contribution comes from municipal and industrial wastes, accidental spills from ships with affshore exploration and production activities and transportation. During tank cleaning and de-ballasting operation, much of this can be lost overboard unless precautions are taken to retain oily slops on board. Recent developments such as Segregated Ballast Tank (SBT) arrangment and Crude Oil Washing (COW) systems together with established "Load On Top" (LOT) procedures have reduced operational pollution from tankers .

Coastal refineries that utilize water cooling, discharge oil in cooling waters. Surface waters discharged through storm sewers and rivers also contain small concentrations of similar refined and partly weathered oils but may contribute large amount. The total input of oil to the marine environment from all sources is about 3 million tonnes per year. Although the quantities of waste oil discharged to the sea from ships can be controlled through strict management, great importance is also attached to the provision of adequate shore reception facilities for tanker slops, dirty ballast water and oily residues from machinery spaces.

Oil spilled in the marine environment can exist in the following forms:

- Floating and partially weathered oil.
- Dissolved in water.
- Water in oil emulsion (chocolate mousse).
- Adsorbed on suspended matter.
- Microparticles (fine droplets).
- Large particles (tar balls).
- Bottom deposits of heavy residues.

Fates of Oil

Oil spilled in the sea is subject to a series of diverse processes that distribute the product in the environment and at the same time cause it to age or gradually convert, thus changing its physical and chemical characteristics

- Spreading

The first process after the spill of oil is that of extension, or spreading, of the product over the surface in the form of a thinning film.

For most spills, after the first hour or two, slick size is generally controlled by a surface tension-viscosity relationship which is in dependent of spill volume. Spreading is a self-retarding process, it accelerates evaporation and leads to increased viscosity and increased pour point of the oil.

- <u>Evaporation</u>

Evaporation is the process by which the low to medium molecular weight components of low boiling point are volatilized into the atmosphere. Thus it can be an important means for preventing toxic components from entering the marine ecosystem.

Spreading out on the surface is initially the dominating process. Evaporation of volatile compounds proceeds rapidly and this is highly temperature dependent. The formation of emulsions of water-in-oil and oil-in-water depend on turbulance, but are of importance during the period days to weeks after the introduction of oil into the marine environment. The dissolution of oil components in water progresses continuously, but being dependent on the surface area of the oil and when a dispersion of oil-in-water is formed.

Photochemical and other oxidative processes are at their greatest relative importance during the first weeks after the incident.

The most significant initial effect upon oil discharged into the marine environment are spreading, evaporation dissolution , emulsification, sorption onto particulate matter and settling of the oil. Biodegradation processe is only significat after a period of weeks. The rate of degradation varies widely with the type of oil and the local conditions.

Tar balls are distrebuted throughout the water column, from the surface to the sea bed. Some are formed soon after oil is discharged from tanker washinges,others from crude oil and heavy oil products over a longer period of time in the marine environment.

Effects on Marine Environment

The presence of floating oil on surface water the most serious being a major decrease in the oxygen content and the presence of toxic substances. A great number of factors, acting both individually and in combination,govern the effects that an oil discharge may have on marine life. In general the biological damage is more severe if the discharge occurs in a coastal or estuarine environment, especially if the intertidal zone is affected, than if it occurs in the open sea.

Effects may be lethal or sublethal, acute or chronic with different organisms reacting in different ways.

Sea birds are the only known group of marine organisms that have so far been affected by oil pollution. Crude and heavy fuel oils appear to cause extensive mortalities of adult fish. Light and refined oils have led to extensive mortalities. Kerosene-based dispersents with high aromatic content are especially dangerous in this respect and this type of dispersant has therefore been banned in many countries. Any pollutants imparting taste and adour to the water may make it less suitable or even unsuitable for preparing drinking water.

Oil spills can have a serious economic impact on coastal and sea activities. The impact on marine life is compounded by toxicity and tainting effects resulting from the chemical composition of oil, as well as by the diversity and variability of biological systems and their sensitivity to oil pollution.

Contamination of coastal amenity areas is a common feature of many oils spills leading to public disquiet and interference with recreational activities such as bathing, boating, and diving.

Industries that rely on a continuous supply of clean seawater for their normal operations can be adversely affected by oil spills. Power stations and desalination plants may be disrupted by oil, causing water supply problems for consumers.

The effects of oil on marine life can be considered as being caused by either its physical nature or by the chemical components of the oil. Marine life may also be affected by clean-up operations or indirectly through physical damage to the habitats in which they live. Populations of plants and animals in the sea are subject to considerable natural fluctuations in numbers brought about, e.g., by changes in climatic and hydrographic conditions and the availability of food. The different life stages of a species may show widely different tolerances and reactions to oil pollution. Usually the eggs, larval and juvenile stages will be more susceptible than the adults.

An oil spill can directly damage the boats and gear used for catching or cultivating marine species. Floating equipment and fixed traps extending above the sea surface are more likely to become contaminated by floating oil whereas submerged nets, pots, lines and bottom trawls are usually well protected, provided they are not lifted through an oily sea surface.

Red sea and Mediterranean sea are an important recreation areas and for source of fishery and have a potentional economic value that the national levels. The species of fish and natural marine resources are to numerous to mention. However, oil spills have deteriorating effect on these food sources as well as fouling the fishing gear of fishermen. The Red Sea is one of the most important areas in the world, for it is the route for ships using the Suez Canal. Many vessels transit the Suez Canal daily. and each of these vessels may pumps its bilges and disposes of its garbage in the most convenient way directly into the sea. Oil production and transportation in the Gulf of Suez is among the most extensive of region in the world. This is due to the presence of Suez Canal and used it as a pathway. The shipping density in the Red Sea and Mediterranean sea is undoubtedly among the highest in the world. This obviously influences the amount of waste oil spilled and it increases the risk factor associated with ship to ship collision and groundings. Collision and groundings are considered to be the main contributors to large quantity accidental spills.

Monitoring is an important method to observe,measure evaluate and analyse the riske or effects of pollution on the marine environment. Monitoring data form a part of the background information for an appropriate assessment of the state of the marine environment and for a forecast of possible man-induced changes. In order to register such man-induced changes, the natural changes of the different elements of the ecosystem must be known.

Monitoring of water quality and of sediment and living organisms is in general quite recent and is not yet sufficiently developed to show whether pollution is increasing or decreasing, except in specific cases where vigorous pollution control measures have been applied.

Oil spills in the Gulf of Suez may cause serious damage to the marine ecosystem. If left unchecked , they may not only affect the Gulf fish resources and aquatic life, but it will also cause widespread shoreline pollution.

In the case of the Red Sea, monitoring of oil pollution in Egyptian territorial waters was carried out. It was reported that the oil content reached to 5 ppm in the Gulf of Suez. Results reached by these studies clearly indicated that the pollutional load reaching the sea water have increased . The level of coastal pollution gradually diminshes and almost disappears in the most southern part of Egypt. The degree or the intensity of pollution varied according to locations. The Red Sea is one of the seas where large amounts of crude oil are produced and transported. It is a common concept that the use of natural resources without loses is nearly impossible. Thus Egyptian coastal waters are especially subjected to serious oil pollution problems on behalf of the heavy traffic of tankers passing through Egyptian territorial waters in their way to the Suez Canal. The adoption of various means of prevention and control could greatly reduce pollution of the Egyptian coast. It is desirable that the degree of pollution and the extent of its ecological,effects should be monitored at regular intervals to evaluate the success of recommended oil pollution preventive measures.

Base studies to monitor pollution should start in order to be able to formulate levels for detection of any environmental changes and to monitor any degradation in the living resources.

Pollution studies on the Red Sea should be correlated to studies on the Mediterranean Sea. Appropriate measures, to safeguard the marine environment, should be taken when planning for industrialization or urbanization through local or regional legislation and through measures for surveillance and abatment.

The programme for Pollution Research and Monitoring forwards two plans of action: a long term plan and a short term plan.

The Short Term Plan:

This plan consists of:

- Baseline studies for continuous monitoring of oil in sea water.
- Effects of oil on marine organisms and their ecosystems.

The Long Term Plan:

This plan aims at monitoring of pollutants and evaluating their effects on the marine organisms and their ecosystems.

Implementation of such programme would require the establishment of a network of stations for research and monitoring and the convening of seminars and workshops of scientific experts to elaborate the necessary detailed document and the operational plants.

With a view to assist the developing countries in order to combat massive pollution by oil in cases of emergency, as well as to respond to request of the countries which are almost exclusively buyers of equipment and products, the develop countries should be prepared an objective and comprehensive list of pollution control materials available on the market, regardless of its country of origin. This list is aimed at helping Authorities in the countries to obtain a better picture of what is offered by manufacturers of equipment and products from various countries. This document is a useful tool in the preparation of contingency plans and in cases of emergencies. Whenever assistance is requested it will help the requesting party to make its request clear and precise in indicating the type of equipment and products needed. This document is conceived as a supplementary source of information to the "Guide for combating Accidental Marine Pollution",which is also regularly updated and published by the international centers. The Guide gives basic information for decision taking (either at the stage of contingency planning or in cases of emergency)and the catalogue provides information on equipment and chemical products specially designed for accidental oil pollution control and combating, that is, specifically developed equipment and purposely formulated chemicals. Any user of this catalogue need some additional information, manufacturers and distributers should be provide it.

As the problem of dealing successfully with oil spills at sea is not only a matter of techniques,but even more a matter of putting available techniques into action at the right time, in the right place and in the right way.

Dealing with oil spillages at sea, especially major spills, calls for an integrated system comprising the following characteristics:

1- Appropriate equipment for combating oil spills at sea of different kinds and sizes.

2- Suitable means of transport for application on the spot supporting activities.

3- Trained personnel that know when, where and how to choose and use the best method available and acceptable in each special case.

4- An organization and routine permitting swift and adequate action.

5- Designation of responsibilities by co-operating parties.

6- Mean for following up scientific and practical progress in the field.

7- Preparations for international co-operation.

Methods of pollution treatment which are recommended in the international publications can not be claimed to be applicable in all countries and in all situations. The quantity of oil involved in a pollution incident is very important in deciding what remedial measures should be under taken. Methods which are relevant for spills of thousands of tons of oil, could be completely inappropriate for dealing with a ton or two of oil, and vice versa. In some instances, national, state and local laws may prohibit or restrict the use of one or more of the anti-pollution measures suggested. Local conservation, fishing, recreation and other interests also have to be considered before deciding on the most appropriate course of action for dealing with a particular oil spill.

There are three oil pollution combating centers in Egypt, one in Alexandria and two in the Gulf of Suez. Their financial resources are coming from the Ministry of Petroleum. Also the Ministry of Petroleum decided to create an oil combating centre in Hurghada (Red sea), and gave the following immediate objectives to the all centers.

- To strengthen the capabilities of them and to facilitate co-operation among them in order to combat massive pollution by oil, especially in cases of emergency in which there is danger to the marine environment.

- To assist the oil companies and the tankers passing through Egyptain territorial waters in the Red Sea and Mediterranean Sea, which so request, in strengthen of their own capabilities to combat oil pollution.

There are a number of basic capabilities which need to be established in order to apply an effective oil pollution control programme. The most important are the measurment and laboratory capabilities. These include laboratory analyses and field surveillance and monitoring required to identify the type, extent and location of the problem, and the implementation of any control measures.

There is a pressing need to upgrade laboratory facilities with adequate instruments for sampling and analysis. Furthermore, laboratory personnel need to be upgraded by conducting short or long training courses.