Restricted
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Terminal Report

EGYPT

Aquatic Environmental Pollution Project, University of Alexandria

Project Findings and Recommendations

Serial No.: FMR/SC/OPS/87/252 (UNDP)

United Nations Educational, Scientific and Cultural Organization

United Nations Development Programme

Paris, 1987

E G Y P T

AQUATIC ENVIRONMENTAL POLLUTION PROJECT, UNIVERSITY OF ALEXANDRIA

Project Findings and Recommendations

Report prepared for the Government of the Arab Republic of Egypt by the United Nations Educational, Scientific and Cultural Organization (Unesco) acting as Executing Agency for the United Nations Development Programme (UNDP)

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Terminal Report

I. INTRODUCTION

Socio-economic background

1. Alexandria in its earlier stages was mainly built around two natural harbours, one on each side of the Anfushi (Kayet Bey) Peninsula. Development in modern times has occurred both east and west and, since the 1950s, with accelerated urbanization and industrialization, the city has expanded east to Abu-Kir and west to Agamy. It now occupies a narrow stretch of land 40 kms long and 1 to 4 kms wide, surrounded on three sides by aquatic environments: the sea to the north, Abu-Kir Bay to the east and Maryut Lagoon to the south.

2. Since 1900 the population has increased from 350,000 to more than three million inhabitants. The socio-economic importance of Alexandria derives from its being Egypt's major harbour, its main summer resort - with some 16 beaches - and its second University city, while some 30% of the country's industry is concentrated around it. There are numerous textile companies, oil refineries, paper mills, fertilizer producers and various other chemical industries.

3. The summer season sees a periodical increase of the population of about 500,000 to one million, with a corresponding increase in the city's income. Together with Abu-Kir, Alexandria's fishing industry provides about 20% of Egypt's Mediterranean fish catch, most of the fish, bivalves and shrimps, being consumed locally.

Project request

4. Alexandria is, however, faced with a critical waste-water problem which stems from two causes, the high rate of population increase and the rapid industrial growth within and around the city. In 1973 the Government requested UNDP assistance in developing aquatic pollution research in Alexandria University. Accordingly, a Unesco consultant (Mr. V. Zitko) in 1974 prepared a report on the University's relevant institutions, facilities and current activities, and proposed a project with a budget of US $ 100,000.

5. This project aimed at developing a "Centre for Aquatic Pollution Research" to strengthen and coordinate the activities of the various University institutions involved in this area. Budget provision was made for the analysis of a large number of samples in commercial laboratories abroad.

6. The project was later re-drafted, with an increased budget. The project document was signed on 27 October 1979 and the project began in January 1980. The initial duration was for three years, with a UNDP budget of US $ 395,500 and a Government counterpart contribution of L.E. 173,800 in kind and L.E. 52,500 in cash. A delay of two and a half years in completing the laboratory building necessitated an extension of the project for three more years while the tenth

and final revision extended it to December 1986 with a total UNDP input of US $ 497,131.

II. PROJECT OBJECTIVES

Development objectives

7. The project's long-term objectives stated in the project document were to:

a) assist the Government in developing and applying, on a national scale, a coordinated programme of research and control in the field of Aquatic Environmental Pollution;

b) assist in developing a pollution-monitoring network, give advice for waste control and treatment of domestic water, and participate in the elaboration of appropriate legislation;

c) survey all types of pollution of the aquatic environment, suggesting methods for abatement and control.

Immediate objectives

8. The project's immediate objectives were to:

a) assist the University of Alexandria in developing and coordinating a research programme to identify the major causes of pollution in the aquatic environment of the Alexandria area;

b) give scientific guidance to the government agencies concerned with the sources of water pollution;

c) establish a fully fledged "Aquatic Environmental Pollution Unit" at the University of Alexandria Research Centre(UNARC) and assist in making this unit operational;

d) organize graduate studies and training for specialists in the monitoring and research of aquatic environment pollution;

e) cooperate with UNARC's on-going research programmes in physical and biological sciences and carry out high-level research on environmental problems, with special emphasis on pollution studies.

III. PROJECT ACTIVITIES

Work Plan

9. The work plan established at the start of the project comprised three programmes:

a) Establishment of a marine pollution analytical research unit: development of a team of adequately trained senior and junior scientists to operate the unit, and provision of the laboratories and equipment required;

b) Monitoring and research: Production of a coordinated multi-disciplinary monitoring and research plan to achieve the project's research objectives, and allocation of the various tasks assigned to sub-groups, each headed by a senior scientist. This programme was based on two objectives, to:

   i) reach an understanding of the ecological systems in the coastal zone and assess the health of the marine environment around the city of Alexandria; and

   ii) identify the pathways of toxicants, leading back to human beings.

c) Scientific guidelines: Elaboration of the scientific bases of guidelines for an action plan and protective measures for the marine environment.

Equipment

10. The equipment list incorporated in the project document was critically reviewed and was updated. New specifications were established for laboratory analytical instruments, field sampling and measurement equipment, ancillary light equipment and chemicals.

Laboratories

11. Laboratories made available to the project in the new UNARC building were adapted and modified to house the analytical instruments. One of the rooms was turned into a trace metal laboratory, to meet the standards of a dust-free laboratory.

Staff training

12. Senior scientists from the project were sent on short-term study tours to specialized institutes in their respective fields to upgrade their experience. Junior scientists were trained in the project laboratories by national scientists and visiting consultants.

Pollution sources

13. The various land-based sources of pollution of the marine environment were listed and their physico-chemical characteristics and their rates of outflow investigated (see Appendix F).

Pollutant flow data

14. Coastal oceanographic cruises were carried out periodically to collect basic data to provide an understanding of the ecological system and an assessment of the rates of inflow and the pathways of the pollutants introduced (Appendix F).

15. The beaches were monitored for faecal pollution indicators and beaches exceeding internationally-agreed standards were identified.

Fish and sea-food examination

16. Fish from areas subjected to domestic waste-water effluents were clinically examined for parasites and disease vectors, such as salmonella spp. Sea-foods, including most of the commercial fish-species, shrimps, crabs and mussels, were also analyzed for chlorinated pesticide residues, PCBs, mercury, cadmium and six other trace metals. Particular attention was given to organic mercury, the more toxic form of this element.

Metals flow studies

17. The cycles of mercury, cadmium and six other heavy metals were investigated downstream from the industrial and agricultural effluents. Attention was given to particle transport and to the physico-chemical forms of the metals in different compartments of the ecosystem.

Chlorinated hydro-carbon residues

18. The level of chlorinated hydro-carbon residues was monitored in the agricultural effluents in the coastal zone and the adjacent lagoons. Drinking water was also monitored.

Oil and tar pollution

19. Oil and tar on 40 kms of beaches and in coastal waters was monitored for two years. The surveys focussed on the rate of input from refinery effluents and oil terminals, and on floating tar balls, dissolved and emulsified petroleum hydrocarbons, tar depositions on beaches and oil in bottom sediments.

Effluent assays

20. Effluent waters were bio-assayed using Tilapia fish, brine shrimps and zoo-plankton as test organisms. Lethal and sub-lethal effects were assessed, the experiments extending over three to four months.

Nutrient salts pollution

21. The impact and dynamics of the huge amounts of nutrient salts released with agricultural run-off and with domestic waste-water were investigated in a mass balance perspective. The studies covered processes such as denitrification, nitrogen fixation, the role of sediment-water interface and nutrient uptake by algae, and the rate of self-purification.

Legislation

22. A legislation committee was set up by the project in cooperation with a Tokten consultant (Dr. O. Elwan) and his counterpart from the Faculty of Law, Alexandria University. A comprehensive review of all international and regional agreements, conventions and protocols concerning marine pollution control was prepared for submission to the national authorities.

IV. PROJECT OUTPUTS

Progress Assessment

23. The progress of the project during its implementation was assessed by biennal Tripartite Review Meetings, by the UNDP information and monitoring reports and by the consultants' reports.

Analytical unit

24. A fully operational aquatic pollution analytical unit has been established at UNARC by the project. The unit was structured as a multi-disciplinary facility which is to remain as a central laboratory for aquatic pollution research within the University. An inventory of the major equipment acquired and housed in this unit is given in Appendix C.

Data Base

25. A substantial data base has been generated by the project on the coastal zone and the impact of pollution. The parameters measured in effluent water, in sea water, in sediments and in sea-food are listed in Appendix F. Some of the scientific results of the project were summarized in the technical reports submitted by the project to UNDP and Unesco in February 1983, November 1984, and February 1986 (Appendix D).

Seminars and workshops

26. Substantial contributions were made by the project to local seminars and to international workshops on Mediterranean pollution. The scientific achievements of the project are published in part in the Proceedings of six workshops on the various aspects of marine pollution in the Mediterranean, convened by the UN-Environmental Programme, and in other international workshops. The published papers are listed in Appendix E.

Scientific output

27. The scientific output of the project is the object of a separate comprehensive technical report in course of preparation. The tentative table of contents is given in Appendix D. The report is in three monographic parts, dealing with the three sub-areas investigated: El-Mex Bay west of Alexandria, Abu-Kir Bay to the east, and the intermediate sub-area, the main coastline of the city. An ecosystem approach has been followed. A concluding part is to

deal with the general aspects, proposed guidelines for an action plan and conclusions and recommendations.

Pollution Report (in Arabic)

28. A comprehensive report in Arabic on the state of pollution and the pollution sources in the coastal zone has been submitted by the project to the Inter-Ministerial Commission for Pollution. The report recommends the creation of a structured inter-ministerial body for surveillance of the environment, for implementation of legal measures and for environmental impact analysis.

V. PROJECT ACHIEVEMENTS

Training

29. Training and the upgrading of national capabilities was a major project objective, and to develop a team of qualified research workers in aquatic pollution research the project made the best possible use of its training and consultant components.

30. The project from the beginning established fruitful cooperation with the Institut für Meereskunde, Kiel, and the Institut für Meeresforschung, Bremerhaven, in the Federal Republic of Germany. Through this cooperation the project was enabled to refine its working techniques and inter-calibrate the results of analyses. Two particularly delicate research procedures benefited greatly from this interaction: the determination of mercury and other trace metals and the monitoring of residual organo-chlorines and chloro-phenols in the marine ecosystem.

31. Several junior scientists had the opportunity to carry out their post-graduate research programmes within the framework of the project's work plan. The subjects of their M.Sc. or Ph.D. theses (listed in Appendix G) reflect the multi-disciplinary approach followed by the project. They deal, among other subjects, with problems such as the dynamics of nutrient salts and the role of the sediment-water interface, trace-metals, organo-chlorines and organo-phenols in fish and in the ecosystem, the sub-lethal effects of long-term exposure to waste-waters, and perturbations of the intertidal communities.

Data collection

32. The project has carried out a thorough investigation of the pollution processes in the marine environment around Alexandria, identified the key problems, and provided a mass of basic data for environmental modelling and management and for sound problem-solving.

VI. FINDINGS

Overall condition of Alexandria's aquatic environment

33. Alexandria's aquatic pollution problem is complicated by the multiplicity and dispersal of the effluents. About six million cubic metres a day of agricultural drainage water, carrying agro-chemicals and trace metals, are disposed of west of Alexandria, together with industrial wastes containing mercury. Untreated domestic waste-water is released through more than 20 outfalls distributed along the city's coastline. More than two million cubic metres of "black liquor" are released into Abu-Kir Bay to the east. This "black liquor" is the almost opaque waste-water released from paper mills, heavily loaded with particulate cellulose and lignin. The city is thus surrounded by a belt of degraded aquatic environments subjected to multiple pollution.

Beaches

34. The project monitored the bathing beaches for about a year until the pattern was established. Of the 12 main beaches, seven were found greatly to exceed all internationally-agreed standards of microbiological contamination. Five of them remain heavily contaminated at all times. A steady aggravation appears to have been taking place in the last few years due, undoubtedly, to the increased population density. Evidence has been presented in earlier works of a significant risk for bathers - especially the younger age-groups - of contracting typhoid on the contaminated Alexandrian beaches.

Bivalves and fish infection

35. Frequent gastro-enteritis cases in summer have been traced back to the consumption of raw bivalves - Donax trunculus and Mactra corallina.

36. Small fishing grounds have developed around the sewage outfalls and from these comes much of the fish marketed in Alexandria. Clinical examination has shown that from 3% to 100% of such fish are severely infected. Some are salmonella carriers, such as Trygon sp. and Raja sp.

Alternative outfall system

37. A proposed alternative outfall system, under consideration by the municipality, has been critically examined by the project in the light of all hydrodynamic data available. The system design assumes that the waste-water will remain trapped in the sub-surface or disposed of 10 kms out and at a depth of 50 metres. Hydrodynamic data, however, show that the vertical density gradient in the proposed area of discharge is not well pronounced and that onshore currents prevail from 5% to 29% of the time. The outfall system proposed cannot, therefore, be considered as a safe solution for sewage disposal.

Mercury contamination

38. Mex Bay, west from Alexandria, is subjected to heavy mercury contamination from two sources, the wastes of the chloro-alkali plant and the agro-chemicals drained into the Bay. The water and sediment levels exceed the background levels

about 30 and 35 times respectively. The total input to the Bay is of about 6 kgs per day. About 90% of the mercury is in particulate form and much of it settles down and remains trapped in the Bay. It is re-mobilized during heavy weather and when dredging is carried out.

39. The mercury level in Mex Bay fish frequently exceeds the standards recommended by WHO. It is highest in demersal fish such as the flatfishes and the mullidae, but also in the scombrids. Most of the mercury in their edible tissues is in the organic form - (70% - 90%). The organic form is the most toxic.

40. The much greater rate of increase in mercury level with age for Mex Bay fish, as compared to other localities around Alexandria, provides an unmistakeable index of heavy contamination.

41. In this situation, fishermen and their families, being heavy consumers of fish, are likely to be a population group at risk. It is desirable, therefore, that the hair and blood mercury levels of this group be investigated according to the recommendations of WHO and the results should be made use of for developing an environmental management policy - the most efficient tool for which is modelling.

Pesticide Pollution

42. Egypt imports annually 30,000 tons of pesticides at a cost of some L.E. 150 million, and rodenticides at some L.E. 25 million, besides using locally-produced pesticides at about L.E. 20 million. About 70% of the pesticides in use are insecticides, the remaining 30% being fungicides and herbicides. Aerial spraying has become a general practice in the last few years, so the sprayed pesticides ultimately reach the aquatic environment, either through aerial transport or through land drainage.

43. Knowledge about the level and distribution pattern of chlorinated pesticide and chloro-phenol derivatives in the marine and brackish waters of Egypt was practically non-existant when the project started.

44. The project identified DDT derivatives and PCBs in all water, sediment and biota samples examined. Levels and distribution patterns, however, differ significantly in the three ecosystem compartments, and also differ with distance from the sources and with their type.

45. The flux of chlorinated hydrocarbons to the coastal zone is highest with agricultural drainage through Edku lagoon outlet and the mixed industrial El-Tabya effluent to Abu-Kir. DDT was undetectable in water, hexachlorocyclohexane (HCH), DDE and DDD being the major compounds in sea water.

46. It is in the Abu-Kir sediments to the east of Alexandria, which are richer in organic matter, that the highest level of chlorinated hydrocarbons is encountered. Sediments along the whole coastal zone appear to be a sink also for PCBs and for herbicide derivatives, trichlorophenols and PCPs. DDT, absent from water samples, was present in all sediments.

47. The gradient is reversed for fish. It is in the Mex fish, off the industrial zone, that DDT and its major degradation products reach their highest level, while decreasing eastward. The same pattern is recorded for PCBs, Mex fish also showing the highest levels, up to 1.3 mg/kg in the liver tissue on a wet basis. The PCB pattern detected in fish liver corresponds well to the PCB type "Colphen A 60". The level of organochlorine compounds is positively correlated to tissue fat content.

48. Drinking water has also been investigated for chlorinated hydrocarbons. Chlorination results in the formation of a number of additional, still unidentified, chlorinated hydrocarbons. Dichlorophenol, a degradation product of the herbicide 2,4,D, persists throughout the treatment process.

49. There are still many unidentified chlorinated hydrocarbons in the coastal zone in both organisms and sediments. There still is a knowledge gap about the effect of such organic micropollutants on the ecosystem, if account is taken of the synergistic effect of detergents, trace metals and other stressors. Further investigations will be needed to elucidate these matters.

Oil pollution

50. Oil contamination of the sea surface and heavy deposition of tar balls and tar lumps on bathing beaches are now a permanent feature in Alexandria. To quantify the extent of oil pollution, the beaches and coastal zone were monitored during two years. Dissolved and dispersed oil, floating tar and tar on beaches were measured bi-monthly according to standard methods.

51. All petroleum activities - refining, dry docking, loading of crude oil and refined products, and deballastation - are concentrated on the western side of the city. It is estimated by the project that about 500 tons of dissolved and dispersed hydrocarbons are released annually into the coastal waters with cooling water from the oil refineries.

52. Domestic waste-water also drains oil residues from small factories and from car-service stations. The eastern beaches, downstream from the sewage effluents, are also contaminated with oil.

53. The average amount of tar deposited weekly per metre width of beach ranges from 140g in winter to 15 g in summer. Summer temperature and sunlight play an effective role in bringing about the rapid degradation of oil residues. This rate of tar deposition appears to be one of the highest in the Mediterranean basin, with the exception of the Libyan beaches.

Effects on fishing resources

54. Besides being Egypt's main summer resort, Alexandria is also one of the main fishing areas on the country's Mediterranean coast. The fishery resources appear to be both increased - by the organic input through domestic waste-water effluents - and endangered, by the industrial waste water effluents. A clear-cut example is given by the Bay of Abu-Kir.

55. The impact of industrial effluents on the fishery resources in the Bay of Abu-Kir has been investigated by the project. The Bay is known to provide from 6% to 10% of the Egyptian Mediterranean fish catch. Furthermore, it was also one of the major spawning and nursery grounds for migratory mullet fish and shrimps, their young re-stocking the coastal lagoons. This cycle is at present seriously endangered by the smothering effect of the "black liquor" continuously released into the Bay through El-Tabyah effluent.

56. The fishery statistics show a sustained drop in the landings of mullet and of shrimps, both from the Bay and from the connected Edku lagoon. Flatfish such as Solea Solea from the Bay have decreased in average size as a result of the paucity of their food-fauna.

Project Location

57. The choice of the University of Alexandria Research Centre (UNARC) as the host institution for the project was justified since the project was an inter-Faculty and inter-disciplinary activity. However, the total absence of oceanographic logistics and of appropriate experience in UNARC was an unforeseen hindrance to the project.

58. The project also met with some difficulties in the development of the analytical unit. A long delay was caused by the absence of laboratory space in the first stages, and laboratories were made available only in mid-1982, two and a half years after the project started, and limited laboratory space continued to be a partial constraint on the latter's activities.

VII. CONCLUSIONS AND RECOMMENDATIONS

General conclusions and recommendations

59. The Aquatic Environmental Pollution Research Unit has been established in the University of Alexandria Research Centre as a major output and immediate objective of the project. The Unit is now fully functioning, with well-equipped laboratories, a well-trained staff, and a well-designed monitoring and research programme.

60. However, if this gain is to be lasting and the project's development objectives are to be attained, there is a basic and pressing need for continuity of funding and structure for the work begun. To this end there is need for:

a) Preparation of a management plan for the future continuity of funding and structure of the Unit, and

b) Implementation of the plan and subsequent independent evaluation of the process.

61. Should the evaluation show the implementation of the plan to be satisfactory, the laboratory equipment purchased through the project could then be transferred to the University.

62. Much better communications need establishing between the Unit and the various Egyptian authorities which deal with aquatic pollution and environmental quality. Such authorities could benefit from giving the Unit's findings greater weight in their considerations. Such improved communications could allow the national authorities to make more extensive future use of the Unit's capabilities.

63. All specialist staff working on the project have been seconded from University Faculties and Institutes - the Institute of Oceanography and Fisheries (Academy of Scientific Research and Technology) and the Etay-el-Barud Pesticide Research Station of the Ministry of Agriculture. To ensure continuity of the research work already started it would be advantageous if such secondments continued.

64. There are needs to:

a) develop and provide numerical predictive models for the management of the major pollution problems identified in the Alexandria area during the project;

b) provide for the field verifications necessary to improve the models;

c) provide for on-the-job training and study tours in environmental modelling procedures and impact analyses;

d) carry out a pilot study of mercury accumulation in the Alexandrian population groups most vulnerable through the consumption of contaminated fish, and

e) provide the national authorities with environmental management options based on the modelling studies.

65. Now that the quality of the Aquatic Environmental Pollution Research Unit is such that it may be considered as a national centre of excellence, the scope of its activities might be expanded so that it can also serve as a Regional Centre, without interfering with its national responsibilities. The University of Alexandria could with advantage explore ways and means of supporting such increased responsibilities, and consideration might also be given to including the Unit as a "government designated institution" within the framework of the UNEP Regional Seas Programme and the Barcelona Convention.

Scientific conclusions and recommendations

66. In view of the high quality of most of the scientific reports produced by the project, results might well be published both as contributions to specialized conferences and also as scientific papers. Exposure in this way to criticism within a peer review system could aid in maintaining a high scientific standard and facilitate the removal of any shortcomings. Such publication could also help to establish the Aquatic Environmental Pollution Research Unit at UNARC as a regional centre of excellence. Appropriate scientific periodicals would be:

Estuarine and Coastal Marine Science;
Air, Soil and Water Pollution;
Marine Pollution Bulletin.

67. For similar reasons it would be highly desirable for the Unit to participate in international intercalibration exercises.

68. The bacteriological monitoring of sewage pollution should be continued after termination of the project, in view of the high level of contamination of the Alexandrian coastal waters by coliforms. This monitoring would also assess the situation before and after construction of outfalls during and after the diversion of effluents into Lake Maryut, and until completion of the master plan for the Alexandria sewerage system.

69. A periodic monitoring programme should be continued on the effects and indicators of pollution, including the occurrence of heavy metals in food fish and other organisms and the biological effects, together with bio-assays of waste-water to ascertain long-term trends.

70. A continuous programme should also be established to evaluate the quality of the waste-water output of newly established industries, in order to monitor the release of noxious wastes.

71. For public health considerations, the analytical capacity for surveying chlorinated hydrocarbon pesticides, other biocides and chlorinated compounds such as chlorophenols and chlorinated anilines in different matrices should be maintained.

72. Although near-shore distribution patterns of a variety of pollutants have been established, little appears to be known concerning their distribution along the coast of Egypt and into the sea. Therefore, the oceanographic component of future pollution research projects should be strengthened. Equipment and local expertise are available, but ship-time is needed.

73. Results, particularly concerning trace metals, should be combined with oceanographic data in numerical models yet to be developed. This should lead to a predictive capability regarding the assimilative capacity of specific in-shore areas as a basis for future decision-making.

74. In view of the high quality of trace metal analyses in biological samples, possibilities should be investigated for holding regional and national training courses in this field.

APPENDIX A

List of Unesco Consultants

Name of Consultant	Country of Origin	Field of Specialization	Duration of Contract From	To
EHRHARDT, M.	Fed.Rep. of Germany	Marine Chemistry	19.03.80 06.04.86	01.04.80 19.04.86
GRASSHOFF, K.G.	ditto	Marine Pollution	29.03.80	01.04.80
LEMKE, A.	U.S.A.	Toxicity Bio-assays	18.10.80	26.11.80
ERNST, W.	Fed.Rep. of Germany	Chlorinated Hydrocarbons	25.10.81 01.04.82 11.83	24.11.81 02.05.82 12.83
HARMELIN, J.G.	France	Marine Biology	10.81	11.81
BERNHARD, M.	Italy	Bio-assays	11.81	12.81
KREMLING, K.	Fed.Rep.of Germany	Trace Metal Chemistry	15.11.81 10.83	14.12.81 11.83
HARMS, U.	ditto	Trace Metals in Biological matrices	10.83	11.83
JORGENSEN, S.E.	Denmark	Modelling	19.10.84 26.11.86	02.11.84 08.12.86
MEJER,	Denmark	Ecology	26.11.86	08.12.86

APPENDIX B

National Staff

Name	Specialization	Affiliation
HALIM, Y.	Principal Investigator	Faculty of Science and UNARC
EL-SEBAR, A.	Pesticides	Faculty of Agriculture and UNARC
EL-SOKKARY, I.	Heavy Metals	Faculty of Agriculture and UNARC
EL-SHARKAWY, F.	Sanitary	Institute of Public Health
SALEM, A.	Waste-Water Chemistry	Faculty of Engineering
MACKLAD, F.	Chlorinated Hydrocarbons	UNARC
SALEH, H.H.	Fish Bio-assay	Institute of Oceanography and Fisheries
TOMA, S.	Heavy Metals	National Research Centre
KHALIL, A.	Algae	Faculty of Science
OSMAN, M.	Physical Oceanography	Faculty of Science
EL-RAYIS, O.	Chemical Oceanography	Faculty of Science
EL-SAYED, M.Kh.	Sedimentology	Faculty of Science
EL-BANNA AWAD, H.	Oil	Faculty of Science
DORGHAM, M.	Plankton	Faculty of Science
EL-GUINDI, A.	Physical Oceanography	Faculty of Science
ATA, M.	Bottom Fauna	Faculty of Science
GUERGUES, Sh.	Plankton and Fisheries	Institute of Oceanography and Fisheries
FAYSAL, M.	Fish diseases	Faculty of Veterinary Medicine
ABOUL DAHAB, O.	Oil and Heavy Metals	Faculty of Science

APPENDIX C

Main Equipment Items Provided by UNDP

Slee Horizontal Laminar Flow Bench

Vertical Laminar Flow Bench

Basic 3700 Gas Chromatograph, flame ionization detector, electron capture detector, hall electrolyte conductivity detector, automatic limenar temperature programme, hydrogen generator, oxygen filter

VARIAN DOUBLE BEAM Spectrophotometer

Polarographic Analyser, EG&G

BRAYSTOCKE Directional Reading Current-Meter

TURNER Spectrofluorometer

Sterility Test Unit

SAVONIUS Rotor Current Meter and spare parts

Low temperature incubator

PERKIN ELMER Atomic Absorption Spectrophotometer, with spare parts

BECKMAN Field Salinometer

Distillation apparatus, quartz glass, for acid purification for trace metals

Digestion Units with teflon vessels and hot plates with thermostat

APPENDIX D

Contents of the Technical Reports prepared by the Project (+)

First Technical Report (February 1983)

(+) For further details contact Prof. Halim, Director, Aquatic Pollution Unit, University of Alexandria

APPENDIX D (Cont'd)

IV.1 Waste-Water, El-Tabia Station

IV.2 Egyptian Crude Oil, Dissolved and Dispersed

Second Technical Report (November 1984)

I. Environmental Conditions in Abu-Kir Bay

I.1 Physico-Chemical Conditions and Plankton

I.2 Impact on Fisheries

II. Environmental Conditions in Mex Bay

II.1 Copper, Lead, Cadmium and Zinc in Coastal Waters

II.2 Mercury

Total Mercury in Ecosystem
Mercury Species in Water
Mercury Species in Different Trophic Levels
Mercury Species in Different Fish Organs

II.3 Sediment Water Interface

II.4 Plankton Distribution

III. Pesticides in the Marine Environment of Alexandria

III.1 Overview of the Status of Pesticides in Egypt (1950-1984)

III.2 Organo-chlorine Compounds in Marine Organisms, Sediments and Water Samples Collected from Alexandria Area

IV. Clinical Study of Fish from Polluted Areas

V. Bio-assay Experiments on Fish and Microcrustacea

Third Technical Report (February 1986)

Trace Metals in Fish from West of Alexandria

Methodology

Data Sheets

APPENDIX E

Scientific Publications of the Project

El-Sokkary, I.
Mercury accumulation in fish from Mediterranean Coastal Area of Alexandria, Egypt
Proc. ICSEM/IOC/UNEP Vth Workshop on "Marine Pollution of the Mediterranean", Cagliari, Italy, Oct. 1980.

Aboul Dahab, O. and Halim, Y.
Relationship between dissolved and dispersed petroleum hydrocarbons and floating tar in Alexandria coastal waters.
Proc. ICSEM/IOC/UNEP Vth Workshop on "Marine Pollution of the Mediterranean", Cagliari, Italy, Oct.1980.

Aboul Dahab, O. and Halim, Y.
Oil pollution of the marine environment in the area of Alexandria.
Proc. ICSEM/IOC/UNEP Vth Workshop on "Marine Pollution of the Mediterranean", Cagliari, Italy, Oct. 1980.

El-Sebae, A.
Ecotoxicological impact of pesticides used in Egypt as aquatic pollutants.
Proc. Sc. Meeting on Environmental Pollution in the Mediterranean Region MESAEP, Athens, 30 August - 1 September 1981.

Awad, H.E.A.
Passive tagging of oil pollution sources in Alexandria beaches.
Proc. Sc. Meeting on Environmental Pollution in the Mediterranean Region MESAEP, Athens, 30 August - 1 September 1981.

Awad, H.E.A.
Quantifications of petroleum inputs in Alexandria waters from three significant sources.
Proc. Intermunicipal Conf. Against Pollution in the Mediterranean Sea, Barcelona, 27-29 November 1981.

Awad, H.E.
Oil pollution impact on the ecosystems of Alexandria, Egypt: Aromatic hydrocarbons.
Proc. Intermunicipal Conf. Against Pollution in the Mediterranean Sea, Barcelona, 27-29 November 1981.

Dorgham, M. and Awad, H.E.
Effect of two Egyptian crude oils on four phytoplankton species.
Proc. VIIth International Conference on "Chemistry of the Mediterranean", Primosten, Yugoslavia, 6-12 May 1982.

Halim Y., Aboul Dahab, O., and El-Rayis, O.
Chemical forms of mercury in flesh, gills and liver from fish species of different habitats from two localities west of Alexandria.

APPENDIX E (Cont'd)

Proc. FAO/UNEP Workshop on "The Bio-geo-chemical Cycle of Mercury in the Mediterranean", Sienna, 27-31 August 1981.

Aboul Dahab, O., El-Rayis, O., and Halim, Y.
Mercury species in coastal marine organisms from different trophic levels west of Alexandria.
Proc. FAO/UNEP Workshop on "The Bio-geo-chemical Cycle of Mercury in the Mediterranean", Sienna, 27-31 August 1981.

El-Rayis, O., Aboul Dahab, O., and Halim, Y.
Total Mercury in the coastal marine ecosystem west of Alexandria.
Proc. FAO/UNEP Workshop on "Bio-geo-chemical Cycle of Mercury in the Mediterranean", Sienna, 27-31 August 1981.

Saleh, H.H.
Regulation and uptake of labelled iron (Fe^{55}) and labelled mercury (Hg^{203}) in the organs and flesh of Tilapia zilli living in fresh and saline water.
Proc. FAO/UNEP Workshop on "Bio-geo-chemical Cycle of Mercury in the Mediterranean", Sienna, 27-31 August 1981.

Aboul Dahab, O., El-Rayis, O., and Halim, Y.
Environmental Conditions in Mex Bay, west of Alexandria.
1. Physical speciation of four trace metals in the Bay waters.
Proc. ICSEM/IOC/UNEP VIIth Workshop on "Marine Pollution of the Mediterranean", Lucerne, 11-13 October 1984.

El-Rayis, O., Aboul Dahab, O. and Halim, Y.
Environmental conditions in Mex Bay, west of Alexandria.
2. Mercury species in the Bay waters.
Proc. ICSEM/IOC/UNEP VIIth Workshop on "Marine Pollution of the Mediterranean", Lucerne, 11-13 October 1984.

El-Samra, M., Halim, Y. and Moustafa TH.
Environmental conditions in Mex Bay, west of Alexandria.
IV. Role of the sediment-water interface in the nitrogen and phosphorous dynamics.
Proc. ICSEM/IOC/UNEP VIIth Workshop on "Marine Pollution of the Mediterranean", Lucerne, 11-13 October 1984.

Laenge, R. and Halim, Y.
Monitoring lethal and sub-lethal effects of waste-water from El-Tabia (Alexandria) on the crustacean Artemia Salina.
Proc. ICSEM/IOC/UNEP VIIth Workshop on "Marine Pollution of the Mediterranean", Lucerne, 11-13 October 1984.

El-Rayis, O.
Bio-accumulation of cadmium in coastal marine organisms of different trophic levels.
Proc. UNEP/FAO Workshop on "Toxicity of Bioaccumulation of selected substances in marine organisms", Rovinj, 5-9 November 1984.

APPENDIX E (Cont'd)

Ernst, W., Macklad, F., El-Sebae, A., and Halim, Y.
Monitoring of organo-chlorine compounds in some marine organisms from Alexandria region.
Proc. International Conference Env. Haz. Agrochem., Alexandria, 8-12 November 1983.

Osman, M.M., and Dorgham, M.
Environmental conditions in Abu-Kir Bay east of Alexandria.
1. Physico-chemical conditions and plankton downstream from land-based effluents.

Halim, Y., Faisal, M., and Ahmed, I.I.
Fish diseases, an index of water pollution? A review.
Proc. FAO/UNEP Workshop on "The Effects of Pollution on Marine Ecosystems", Blanes, Spain, 7-11 October 1985.

Halim, Y., Saleh, H.H. and Salem, A.
Environmental conditions in Abu-Kir Bay east of Alexandria downstream from "El-Tabia" effluent.
2. Impact on coastal fisheries.
Proc. FAO/UNEP Workshop on "The Effects of Pollution on Marine Ecosystems", Blanes, Spain, 7-11 October 1985.

Dorgham, M.
Occurrence of Tintinnids in two polluted areas of Alexandria coast.
Proc. FAO/UNEP Workshop on "The Effects of Pollution on Marine Ecosystems", Blanes, Spain, 7-11 October 1985.

El-Gindy, A.
Estimation of water exchange and residence time of the waters in the Western Harbour of Alexandria (Egypt).
Rapp. Comm. int. Mer, Medit. 30,2 (1986)

El-Gindy, A., Halim, Y. and Aboul-Dahab, O.
Preliminary estimates of water and trace metals balances in Mex Bay, west of Alexandria (Egypt).
Rapp. Comm. int. Mer Medit. 30,2 (1986).

Macklad, F.M., and Halim, Y.
An overview of the level of organo-chlorine compounds in the coastal zone of Alexandria.
Rapp. comm.int. Mer Medit. 30,2 (1986)

Aboul-Dahab, O. and Halim, Y.
Impact of land-based sources on chromium species and concentrations in coastal waters west of Alexandria.
Rapp. Comm. int. Mer Medit. 30,2 (1986)

Aboul-Dahab, O. and Halim, Y.
Petroleum hydro-carbons in Alexandria coastal sediments as assessed by emission and synchronous fluorescence spectra.
Rapp. Comm. int. Mer Medit. 30,2 (1986)

APPENDIX F

Parameters Measured

I. Effluents

Temperature
pH
Dissolved oxygen

Total solids
Suspended solids
Volatile solids
Fixed solids
Settleable solids
Volatile suspended solids
DDT, DDE, DDD
PCB
Chlorophenols

COD
BOD
Sulphides
Ammonia
Nitrite
Nitrite
Phosphate
Chlorides
Sulphates
Total hardness
Heavy metals

II. All Stations in the Coastal Zone

A. Water, at standard depths

Salinity
Temperature
pH
Dissolved oxygen
Suspended matter
Dissolved organic matter
Transparency
Phosphate
Nitrate
Nitrate
Ammonia
Silicate
Hydrogen sulphide

Dissolved lead
Particulate copper
Dissolved copper
Particulate iron
Dissolved iron
Particulate cadmium
Dissolved cadmium
Particulate manganese
Dissolved manganese
Phytoplankton standing crop
Zooplankton standing crop
Plankton diatoms
Dinoflagellates

APPENDIX F (Cont'd)

Particulate mercury
Dissolved organic mercury
Dissolved inorganic mercury
Particulate zinc
Dissolved zinc
Particulate lead

Blue-green algae
Euglenophytes
Green algae
Tintinnoinea
Copepoda
Ratifera

B. Sediment

Sediment texture
Organic matter
Water content
Mercury
Zinc
Lead

Copper
Iron
Cadmium
Manganese
Phosphate
Nitrate

III. Additional Parameters for El-Mex Bay

A. Water

Total Nitrogen
Organic nitrogen
Total phosphorous
Organic phosphorous
Oxidizable organic material
Rate of Nitrogen fixation in the water column

Rate of nitrate uptake
Rate of ammonia uptake
Rate of phosphate uptake

B. Sediments

Rate of Phosphate release
Rate of nitrate release
Rate of ammonia release
Rate of nitrogen fixation

Phosphate in surface sediments
Nitrate in surface sediments
Ammonia in surface sediments

APPENDIX F (Cont'd)

IV. Macro-algae

Ecology
Composition
Total mercury
Cadmium
Lead
Zinc
Iron
Manganese

V. Fish, Bivalves

Chlorinated hydrocarbons
PCBs
Total mercury
Organic mercury
Total cadmium
Iron
Manganese
Lead
Zinc

VI. Human hair samples

Mercury

APPENDIX G

M.Sc. and Ph.D. Theses

Ossama Aboul Dahab

Oil Pollution of Beaches and Coastal Waters of Alexandria - M.Sc. thesis.

Yousry Abdel Sadek

Physico-chemical Characteristics of Effluents and of Abu-Kir Bay Waters - M.Sc. thesis.

Ibrahim Mohamad

Physico-chemical Characteristics of Effluents and of the Near-Shore Waters between Silsila and Abu-Kir Headlands - M.Sc. thesis.

Hoda El-Sayed

Amino Acid Pattern, Total Protein and Lipids in Fish Subjected to Pollution Stress - M.Sc. thesis.

Samia Nabih

Macro-algal Associations Along the Coastline of Alexandria. Pollution Effects and Chemical Composition - M.Sc. thesis.

Ossama Aboul Dahab

Cycle of Inorganic Pollutants in Mex Bay - Ph.D. thesis.

Manal Atta

Microcrustacean Associations Along the Coastline of Alexandria - Ph.D. thesis.

Thana H.M. Mostafa

Dynamics of nutrient Salts in Mex Bay - Ph.D. thesis.