



**TOGETHER**  
*for a sustainable future*

## OCCASION

This publication has been made available to the public on the occasion of the 50<sup>th</sup> anniversary of the United Nations Industrial Development Organisation.



**TOGETHER**  
*for a sustainable future*

## DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

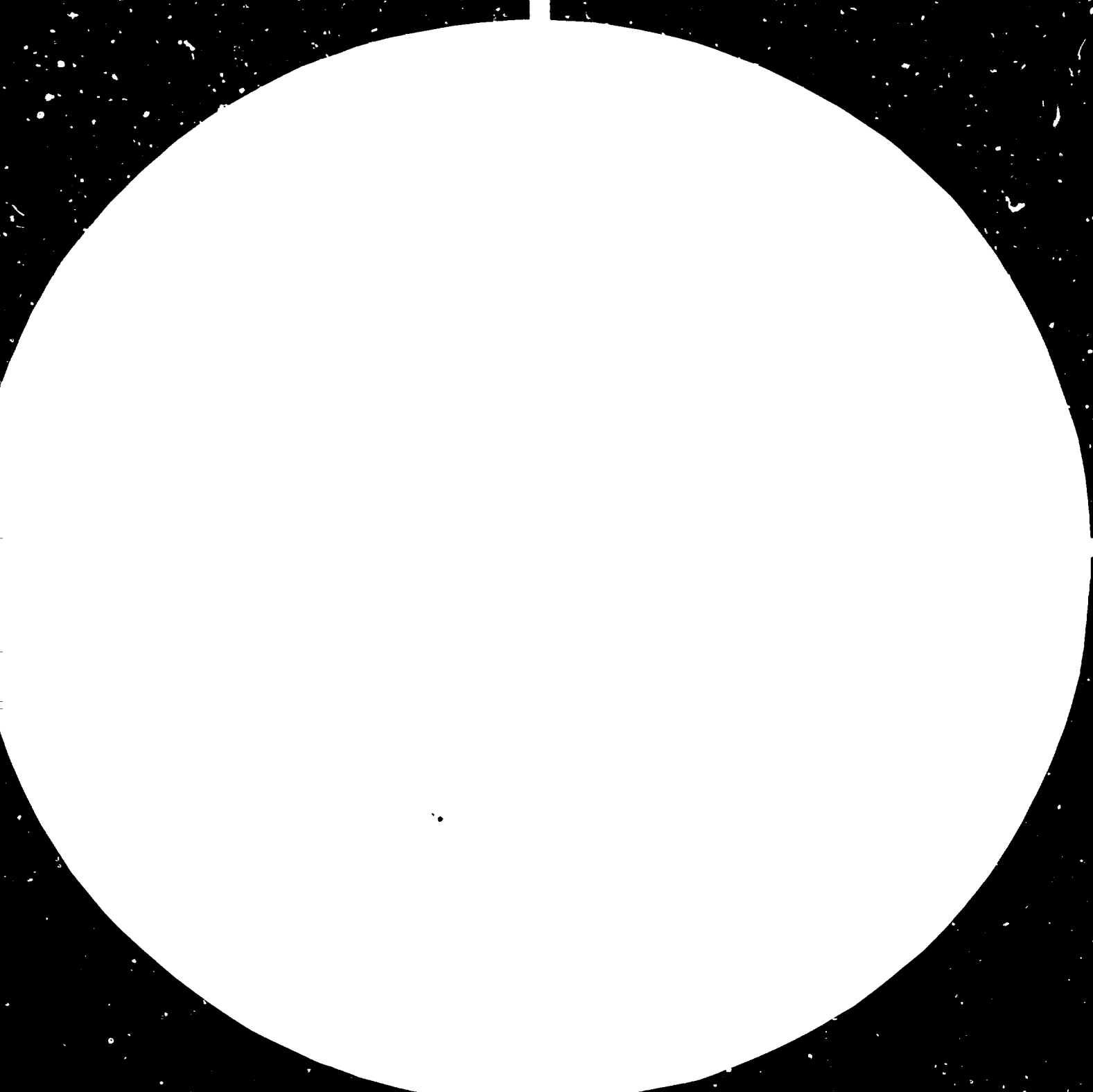
## FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

## CONTACT

Please contact [publications@unido.org](mailto:publications@unido.org) for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at [www.unido.org](http://www.unido.org)





28



32



36



Microcopy Resolution Test Chart

U.S. GOVERNMENT PRINTING OFFICE: 1963 O 564-727

09896

UNITED NATIONS INDUSTRIAL  
DEVELOPMENT ORGANIZATION

Distr.  
LIMITED

UNIDO/ICIS.179  
1 September 1980  
ENGLISH

SURVEY OF MARINE POLLUTANTS FROM INDUSTRIAL SOURCES  
IN THE WEST AFRICAN REGION—NIGERIA \*  
(EP/INT/79/009)

Prepared by Michel R. Mounier, Engineer

000132

~~000132~~

---

\* This report has not been cleared with the United Nations Environment Programme and the United Nations Industrial Development Organization which do not therefore necessarily share the views presented. This document has been reproduced without formal editing.

80-43191

Preliminary Remarks

The currency in use in Nigeria is the Naira (N) divided into 100 Kobos. As of July 15, 1980 the value of the U.S. Dollar (\$) against the Naira was approximately

$$\text{\$ 1} = \text{N } 0.58$$

The following acronyms have been used in the present report:

BOD<sub>5</sub> = Biochemical Oxygen Demand - 5 days  
COD = Chemical Oxygen Demand  
SS = Suspended Solids  
NNOC = Nigerian National Oil Company  
TPY = Tons Per Year.

The mention in the text of company or product names does not imply their endorsement by the United Nations Industrial Development Organization (UNIDO).

The appellations used in this publication and the presentation of the data do not imply that the United Nations Secretariat is taking any position regarding the legal status of any country, territory, city or zone nor their rights, no more than the location of their borders or boundaries.

### Summary

The present report was prepared in partial fulfilment of the requirements of project EP/INT/79/009 "Survey of Marine Pollutants from Industrial Sources in the West African Region", i.e. a survey of the types and quantities of industrial pollutants discharged from land-based sources into the marine environment and of the present methods of management and disposal of those wastes. The consultant was to visit the main industries located on the Atlantic coast of Nigeria and to fill a standard water pollution questionnaire describing the situation at each plant. Unfortunately, the visit to Nigeria had to be very short and the information reported here concerning the orders of magnitude of the main pollutants rejected into the Atlantic Ocean by Nigerian industries was largely based on published data and professional judgment.

It seems that the most severe problems are the oil contamination of the surface water and of the beaches due to oil exploration, exploitation and transportation activities as well as the dumping of domestic wastes near urban centers where no system for sewage, drainage or refuse disposal is available.

Industrial pollution is probably severe in Lagos State where more than half the Nigerian manufacturing industry is concentrated and around the the oil industry centers of Warri, Port Harcourt and Calabar.

It is recommended that a comprehensive plan of action be immediately formulated and implemented to regulate and monitor industrial wastewater discharges and that adequate vocational training and expert assistance programmes be initiated.

TABLE OF CONTENTS

<u>Chapter</u>	<u>Page</u>
INTRODUCTION .....	5
I. INDUSTRIAL SETTING	
A. Background .....	8
B. Legal and Institutional Aspects of Pollution Control	9
C. National Capabilities to Control Pollution .	11
D. Description of the Main Industrial Plants located on the Coast	11
II. COASTAL POLLUTION	
A. Estimation of Industrial Pollution .....	13
B. Other Observations .....	16
III. CONCLUSIONS AND RECOMMENDATIONS	
A. Conclusions .....	20
B. Recommendations .....	21
References .....	22

Appendices

I. Associates in Nigeria .....	24
II. Sample of the Pollution questionnaire communicated to the Federal Ministry of Housing and Environment	25

## INTRODUCTION

The West African Region has been recognized by the Governing Council of the United Nations Environment Programme (UNEP) <sup>1/</sup> as a "concentration area" in which UNEP, in close collaboration with the relevant components of the United Nations System, will attempt to fulfill a catalytic role in assisting the developing states of the West African Region to formulate and implement, in a consistent manner, a commonly agreed upon Action Plan.

Recognizing the complexity of the problem and being aware of numerous ongoing activities, the following preparatory work was undertaken or is underway to provide a basis for the Action Plan:

UNEP Exploratory Mission on Marine Pollution Problems of the West African Coastal States of the Gulf of Guinea, 25 April - 2 July 1976;

IMCO/UNEP Workshop on Prevention, Abatement and Combating of Pollution from Ships in the Gulf of Guinea and Adjacent Coastal Areas, Douala, 12-17 December 1977 (FP/0503-77-05);

IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas, Abidjan, 2-9 May 1978 (FP/0503-77-04);

UNEP Resident Representatives/Interagency Meeting, Abidjan, 10-11 May 1978 (covered by internal project FP/0503-77-03);

FAO/UNEP Studies on: (i) Legal Aspects of Marine Environment Protection in the Gulf of Guinea and Adjacent Coastal Areas, and (ii) on the Marine Pollution of the Region, and Need and Possible Mechanisms for Control thereof (FP/0503-77-02);

UNEP Mission to the West African coastal States to discuss the first draft Action Plan, December 1978 - April 1979 (covered by internal project FP/0503-77-03);

United Nations/Governments of Benin and Togo Workshop on Causes of and Possible Solutions to Coastal Erosion in Benin and Togo, Lomé, 29 January - 9 February 1979;

Informal consultation with representatives of the West African States attending GC.7, Nairobi, 26 April 1979.

---

<sup>1/</sup> Decision 88.C (V) of 25 May 1977.



The IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas (Abidjan, 2-9 May 1978), identified industrial waste as a major source of marine pollution in the region. The report of the meeting noted <sup>2/</sup> that;

"Rapidly increasing industrial development of the region, particularly in the coastal zone and along the major rivers, is likely to lead to an increase in the volume and diversity of industrial wastes discharged without adequate treatment into the marine environment. Detrimental effects of these discharges have been observed in many places, and yet practically no records exist on the amounts discharged, on the concentration of these pollutants in the marine environment or on their effects on marine life and human health.... Considering that the living marine resources, which are easily damaged by these types of pollutants, constitute an important source of revenue and food for the population of the region, a pilot project to assess the magnitude of the problem caused by discharges of industrial and agricultural waste into the marine environment is recommended."

The meeting recommended that a detailed survey of land-based sources of industrial and agricultural pollutants be carried out as a first step towards the objective of establishing regionally applicable standards for the management and control of industrial and agricultural pollutants.

Based on the recommendations of the Abidjan workshop, the draft action plan for the West African region calls for "a detailed survey of industrial and agricultural pollutants discharged directly or indirectly into the sea." <sup>3/</sup>

Within the framework of Project EP/INT/79/009 called "Survey of Marine Pollutants from Industrial Sources in the West African Region" carried out by the United Nations Industrial Development Organization (UNIDO) as a service to the United Nations Environmental Programme (UNEP), UNIDO has conducted a survey of the types and quantities of industrial pollutants discharged from land-based sources into the marine environment and of the present methods of disposal and management of those wastes.

Given the complexity of the present or potential environmental problems created by the rapid industrialization of the area, UNIDO has assigned a pollution control expert to each country with the following objectives:

---

<sup>2/</sup> Report of the Workshop, pages 8 and 9.

<sup>3/</sup> UNEP/WG.27/3, page 5, para 13.5.

- (i) prepare an inventory of industrial sources of pollution discharging into the marine environment;
- (ii) assess the nature and quantity of pollutants entering the sea area from industrial sources, including pollutants from indirect discharge; <sup>4/</sup>
- (iii) review the present industrial waste treatment and disposal practices.

This information was to be gathered primarily by travelling to the country and by visiting the most important industrial facilities located within 20 km of the shore. In the case of Nigeria however, it was not possible to organize field trips within the time-frame of the study. One had to rely on literature sources and on very sketchy information gathered during a short stop-over in Lagos from 10 July to 15 July 1980.

---

<sup>4/</sup> An indirect discharge is understood to mean a discharge into a river or stream located not more than 20 km from the coast.

## I. INDUSTRIAL SETTING

### A. Background

With an area of 923,769 square kilometer, Nigeria is the largest of the 18 countries visited in West Africa within the framework of this project. It is also the most populated, with reported estimates averaging 80 million inhabitants. The country is divided into three by the River Niger and its tributary, the Benue.

The coastal belt of 15 to 100 km in width consists of mangrove swamp forest intersected by an intricate network of creeks and rivers and by the great Niger Delta. There are two well-marked seasons, the rains lasting from April to October and the dry season from November to March. Temperatures at the coast seldom exceed 32°C but humidity is high. Rainfalls exceed 4 000 mm per year.

Even though the Nigerian industry is developing rapidly, it is still at an early stage. The manufacturing industry only contributed 10% to the GDP in 1977 and was dominated by low technology, light industrial sectors such as food processing and beverages. The enormous potential of the oil resources was confronted with a great weakness in the intermediate goods sectors such as industrial chemicals and fertilizers. The thrust of the Third National Development Plan has been towards consumer durables (automobile assembly), capital goods and heavy industries such as steel and petrochemicals. This new phase of industrialization takes time, and there are indications that the objectives of the Plan were postponed in many areas.

Lagos State, on the western section of the coast, contains the capital city of Lagos, a tentacular conurbation of 4.2 million people [Ref. 3] and the large port of Apapa. It also shelters almost half of all the Nigerian industry. Other industrial centers located along the coast are Warri, Port Harcourt and Calabar. One may estimate that 75% of the Nigerian industry is located along the coast.

B. Legal and Institutional Aspects of Pollution Control

Nigeria has taken several steps to curb marine pollution. The following account is reproduced from Ref. 6:

"Nigeria has ratified the 1954 IMCO convention on marine pollution; following a recent decision, it will soon process the ratification of the 1969 one; and as regards the 1973 one, Nigeria has financed the mission of an expert Mr. Wennink, whose report gives data qualifying the action to be taken and their cost etc. as implications to becoming a party of that convention. Nigeria will ratify the convention in due course and in the meantime applies many standards laid therein.

Within its 30 miles territorial waters, Nigeria has defined 3 zones for navigation: inshore, restricted and offshore waters. The restricted zone, where oil exploitation exists, may be entered only through buoyed channels. Ships cruising in inshore and offshore waters should report to 4 stations along the Nigerian sea coast. A "police" ship may check any time the positions of the ships.

All ships with the Nigerian flag are annually controlled in Lagos. The new giant tankers will be fitted and equipped to meet the requirements of the 1973 international convention although this one has not yet come into force.

Pollution inspectors are and will be trained in USA and the U.K. to be able to cope with any oil pollution cases (...).

It is expected that Nigeria will follow the recommendations of the Wennink report, thus allowing the port of Lagos to be as much pollution free as possible (oil wastes incineration, oil stockage, refuse disposals, etc....).

On a more general coverage, Nigeria has created at the end of 1975 a Federal Ministry dealing with environment problems and the Federal Department of Fisheries has established in 1976 a Nigerian Institute of Oceanography and Marine Research. One of its main objectives is marine pollution studies with a programme including: monitoring of pollutants, creation of research stations at Calabar and Lagos, definition of preventive and curative means to control marine pollution."

The problem of industrial pollution from land-based sources is one of the concerns of the Federal Ministry of Housing and Environment, as well as that of the State and local governments. The Guidelines for the Fourth National Development Plan (1981-85) state as follows (p. 57, Ref. 17):

"Creating the Clean Environment:

9. The Third Plan made a start in trying to solve the primary environmental problems of our human settlements. The Fourth Plan will go further to tackle other aspects of the problem. In particular, it will focus on providing the infrastructure for environmental assessment and management. The following problems will receive closer attention.—

- (i) Secondary Environmental Pollution - especially with respect to industrial activities as they affect water, land and air.
- (ii) Noise Pollution.
- (iii) Natural Disaster.—Floods, soil erosion, and desert encroachment.

In order to achieve a meaningful environmental management programme, the environmental characteristics of the country will be documented, including soil conditions, hydrology, vegetation, etc. Based on this information, environmental quality standards will be established and made mandatory for various categories of producers who contribute significantly to environmental pollution.

10. With information gathered from the environmental (mapping) exercise, the Department of Environment will adopt the following guidelines to enhance environmental conservation and prevent pollution.

- (i) Steps will be taken to ensure that environmental planning is conducted as an integral part of project planning by all agencies. In this regard the feasibility studies for all projects both private and government, should be accompanied by statements on their environmental impact. The onus, therefore, devolves on the sponsors of the projects to take account of the likely impact of their project on the environment and show how they plan to mitigate it. The sponsors of new industrial projects, for example, will be required to show satisfactory plans of how they propose to dispose of the wastes to be generated from their establishment before such projects can be approved.
- (ii) Because environmental tolerance varies from place to place, Federal, State and Local Governments will set appropriate standards according to the unique ecological and physiographic characteristics of their areas.
- (iii) An effective inspectorate unit will be established in the Environmental Planning Division of the Federal Ministry of Industries."

C. National Capabilities to Control Marine Pollution

A definite effort has been initiated in Nigeria to control marine pollution. In particular, the Federal Government is organizing itself to cope with the legislation and enforcement requirements of an effective programme. A number of engineers residing in Nigeria also have received a basic training that could easily enable them to become proficient in the methods and techniques of pollution control.

However the human, institutional and financial resources of the country are already strained to cope with the numerous problems stemming from the present pace of industrial development. Outside assistance, particularly for the training of specialists and the drafting of rules and regulations, would be very beneficial.

D. Description of the Main Industrial Plants located on the Coast

The following paragraphs describe briefly the large industrial installations which discharge liquid pollutants within 20 km of the Atlantic waters to the best of the writer's knowledge. No site visit could be made, unfortunately, and one had to rely on published data and on a few notes taken during the very short stay of the writer in Lagos.

1. Oil Production

Nigeria's maximum oil production capacity was about 2.41 million barrels per day during the first half of 1979, which represents roughly 10% of the OPEC capacity. Cutbacks decided by the National Nigerian Petroleum Corporation (NNPC) brought actual production down to about 2.15 million barrels per day during the second half of 1979 [Ref.3]. (The 3rd national plan called for 3 million bpd in 1980). The major oil fields are located near Port Harcourt and Calabar.

Although little pollution results from normal oil well operation, accidents easily take catastrophic proportions: the latest oil leak spread 280,000 bbl on the surface of the ocean. Clearly, the rich coastal fishing grounds could be endangered by such occurrences.

2. Oil Refining

Port Harcourt is equipped with a 75,000 barrel per day refinery and a 150,000 ton per year lube oil and asphalt plant.

Warri is equipped for catalytic cracking and refines 100,000 barrel of crude per day.

The writer understands that the wastewaters go through biological treatment plants before they are discharged in water streams and from there into the ocean.

### 3. Oil Transportation

Oil is exported by tankers from the ports of Lagos, Port Harcourt and Calabar. In addition, a comprehensive network of pipelines is being built for inland transportation.

### 4. Petrochemicals

Ref. 4 mentions plans to build a petrochemical complex near Port Harcourt to produce caustic soda (40,000 TPY), vinyl chloride monomer (40,000 TPY), PVC (40,000 TPY), polyethylene (40,000 TPY) and ethylene (100,000 - 250,000 TPY). These plans have not yet been realized.

### 5. Iron and Steel

A "Midrex" direct reduction plant of 500,000 TPY is expected to come on stream at Warri. The plant, consisting of a pelletizing unit, a DR reactor, electric arc furnaces, a continuous casting machine and rolling mills will produce less severe water pollution than would a conventional integrated plant. The rolling mills require copious quantities of water, which gets contaminated with oil, grease and suspended solids from hot and cold reduction. Chemical wastes from pickling, tin plating and galvanizing as the case might be contribute special wastewater problems which will have to be dealt with.

### 6. Pulp and Paper

A mill producing 60,000 TPY with possible expansion to 100,000 TPY of fine and cultural paper is due to start up in 1980 at Iwopin. Another project calls for 100,000 TPY of newsprint capacity in Calabar but has been delayed.

### 7. Fertilizers

There are plans to produce nitrogen fertilizers in Warri (450,000 TPY ammonia and 250,000 TPY urea) with the possibility of producing also NP and NPK fertilizers. The contract was apparently awarded in 1979, then the whole project was postponed.

## II. COASTAL POLLUTION

### A. Estimation of Industrial Pollution

The first step was to estimate the industrial activity on the coast of Nigeria in all sectors and for all facilities large and small. Sectoral data available in References 3 and 18 were used to project 1980 values which were then amended whenever a more reliable value was available. The proportion of the industrial activity situated on the coast of Nigeria was estimated to be 75 per cent of the total. The writer estimated that approximately 50 per cent of the industrial activity in Nigeria was concentrated in the Lagos area, and approximately one-half of the remaining industry was located along the coast.

Production indices were based upon an index of 100 in 1972 and a value for 1979 was available (Table 1). Production data for industry in Nigeria were available for 1972 (Table 2) and the index was used to update the production data to 1979. Since the degree of concentration of industry on the coast was unknown and it was necessary to use judgement to estimate the activity on the coast, an attempt was not made to correct the 1979 projection to 1980. It was assumed that these projections were adequate to estimate 1980 conditions.

Certain sectors of industry listed in Table 2 were not included in the table of indices (Table 1) and it was necessary to assume an index. In these cases the overall industrial index of 163.8 was used to correct the 1972 production rates. When the projected production for 1979 was less than the production that actually occurred in 1977, the projected value was discarded and judgement was used to estimate a 1979 production rate.

Data for fish production from the Atlantic Ocean were inconsistent between two editions of the book entitled Africa - South of the Sahara. In the 1978 edition fishing in the Atlantic was reported to have declined from a high annual production of 338,400 tons live weight in 1974 to 169,700 tons live weight in 1975. The 1979-80 edition had modified all of the data such that a gradual increase in catch from 155,800 tons live weight in 1973 to 169,800 tons live weight in 1977 was shown.



Table 1. Industrial production indices for Nigeria [Ref. 3]  
(Basis 1972 = 100)

Type of industry	1977	1978	1979*
Edible oils	14.8	15.4	14.8
Sugar	123.2	111.8	131.4
Sweets	207.3	201.6	211.1
Non-alcoholic beverages	303.5	332.3	307.6
Beer	185.6	285.2	288.6
Cigarettes	122.0	129.0	126.5
Cotton, textiles	172.9	167.1	198.7
Other textiles	964.7	1,129.3	1,108.0
Shoes	123.5	119.3	123.3
Paints and similar products	241.8	280.3	269.7
Soaps and detergents	328.4	362.5	312.2
Refinery products	123.6	124.5	120.1
Other petroleum products	86.6	74.6	71.3
Pharmaceutical products	186.5	352.9	300.3
Rubber	109.3	122.6	122.4
Cement	117.1	139.6	165.9
Tin	47.4	42.6	38.3
Corrugated iron	214.7	191.7	193.3
Motor vehicle assembly	1,097.3	992.7	1,151.9
Radio, record player and television assembly	128.6	95.7	101.6
Total manufacturing industry	193.5	221.4	222.3
Electric energy	212.3	260.6	280.2
Mining	114.5	103.6	131.0
Total industry	142.1	145.0	163.8

\* Estimated average of the first half of 1979

Source: Central Bank of Nigeria

Table 2  
Industrial production in Nigeria  
[Ref. 18]

		1972	1973	1974	1975
Fishing	metric tons live weight	318			
Tinned meat	metric tons	803	534	530	430
Margarine	metric tons	5,050	5,050	5,050	5,066
Groundnut oil	'000 metric tons	66	112	21	16
Wheat flour	'000 metric tons	274	280	280	280
Biscuits	metric tons	10,790	12,490	17,090	21,800
Raw sugar	metric tons	28,000	30,000	38,000	39,000
Sugar confectionery	metric tons	13,094	16,133	8,634	16,691
Prepared animal feed	metric tons	45,661	47,000	10,758	11,000
Beer (including stout)	'000 hectolitres	1,649.4	2,140	5,887	2,968
Soft drinks and mineral waters	'000 hectolitres	786	945	861	1,401
Cigarettes	metric tons	10,635	8,527	8,011	10,170
Cotton yarn, pure	metric tons	3,247	5,646	965	4,952
Woven cotton fabrics	'000 sq. metres	191,256	307,000	275,677	276,000
Knitted fabrics	metric tons	1,399	2,100	2,344	3,221
Leather footwear	'000 pairs	5,317	5,769	6,288	6,294
Plastic footwear	'000 pairs	12,171	11,621	14,643	19,096
Plywood	cubic metres	50,000	54,000	60,000	64,000
Paints	'000 litres	13,124	n.a.	15,021	18,794
Soap and detergents	metric tons	44,319	64,682	47,146	75,240
Motor spirit (petrol)	metric tons	517,000	717,000	623,000	535,000
Kerosene	metric tons	307,000	419,000	372,000	294,000
Distillate fuel oils	metric tons	566,000	660,000	665,000	509,000
Residual fuel oils	metric tons	752,000	926,000	976,000	855,000
Lubricating oils	metric tons	25,000	53,000	53,000	41,000
Bicycle and motor cycle tyres	'000	2,085	1,780	2,799	893
Other road vehicle tyres	'000	223	307	307	1,655
Rubber footwear	'000 pairs	1,734	2,316	3,217	1,719
Cement [incomplete coverage]	'000 metric tons	1,143	1,222	1,206	1,383
Tin metal (unwrought)	metric tons	6,744	5,983	7,374	4,829
Nails, screws, nuts, bolts, etc.	metric tons	7,962	n.a.	n.a.	8,547
Radio receivers and radiograms	number	122,943	93,000	102,000	103,000
Television receivers	number	3,496	2,428	6,822	7,000
Lorries assembled	number	6,119	7,458	5,463	12,244
Electric energy	million kWh	2,158	2,625	2,828	3,175

Sources: Federal Office of Statistics, Economic Indicators; United Kingdom, Yearbook of Industrial Statistics.

The original sources of information [Ref. 19 and 20] were consulted, and the significant changes mentioned above had been made in the reported catches from the Atlantic Ocean. An explanation was not given for the change. Only a comment in the introductory material discussed changes stating that more reliable data are substituted when they become available.

The next step was to estimate the pollution loading due to those sources. Standard values adopted for all 18 countries based on production volumes were used. The procedure is the same as that employed by UNIDO in the Mediterranean Sea study (Carmichael and Nemerow, 1977). Carmichael and Nemerow (1977) used the US Environmental Protection Agency Guidelines [Ref. 12] where information was available, to convert production data to contaminant loads. In all cases where EPA guidelines were used, 30-day average values were selected. The EPA guidelines described pollutional parameters for effluents after treatment only. Where effluent guidelines were not available for a particular industry, the characteristics of raw wastewaters for a given industry were taken from a book by Middlebrooks and EPA reports [Ref. 13 and 14].

It was necessary to infer raw wastewater information from treated effluent loading data by considering what constitutes the best practical treatment assumed in the Effluent Guidelines. The raw waste load factors based on production rates used to estimate pollutants from all West African countries are reproduced in Table 3. Table 4 shows the results of both production estimates and corresponding pollution loadings derived by applying the method described above to the Nigerian coast.

### B. Other Observations

Although it is increasing, pollution from land-based industrial sources may not be the most severe cause of damage to the marine environment along the Nigerian shore. The main pollution problems may still be "related to oil exploitation, oil transportation along the seashore and at Lagos, and the dumping of wastes at sea and lagoons principally at Lagos where there exists no system for sewage, drainage and refuse disposal. Another problem, but of minimal importance compared to the ones above, concerns the pesticides after they are drained from agricultural areas (Calabar and Lagos areas) by rivers flowing in the coastal lagoons" [Ref. 6].

Table 3

Raw waste loads based on production rates used to estimate pollution discharges from West African countries

Type of Industry	Raw Waste Loads, kg/ton									
	BOD <sub>5</sub>	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus
Canned and preserved fruits and vegetables	5.13	6.33		12.8						
Southern (nonbreaded) shrimp		253.3	80.0							
Alaskan bottom fish processing		11.3	0.60							
Corn wet milling	9.02	8.93		22.6						
Corn dry milling	0.71	0.63		1.78						
Bulgur wheat flour mills	0.10	0.10		0.25						
Parboiled rice	0.93	0.53		2.33						
Ready-to-eat cereal	2.67	2.67		6.68						
Wheat starch gluten	13.3	13.3		33.3						
Simple slaughterhouse (kg/ton LKW)	0.80	1.33	0.4	2.0						
Dairy products	0.90	1.35		2.3						
Crystalline cane sugar	5.73	1.20		14.3						
Edible oils	22.3	19.5	14.0	55.8						
Brewery	10.2	4.73		11.2						
Soft drinks	3.15	4.33		7.9						
Flavouring extracts (chocolate, etc.)	Insignificant discharges									
Coffee	625	50		1,562						
Bottling wine	3.15	4.33		7.9						
Alcohol production (kg/m <sup>3</sup> )	4.85			12.12						
Petroleum refining (topping)	0.094	0.080	0.029	0.47	0.010	0.0006	0.0016			
Petroleum refining (cracking)	0.126	0.080	0.048	0.35	0.026	0.0006	0.0016			
Petroleum storage and washing			0.5							
Petrochemicals	0.144	0.116	0.047	0.85	0.084	0.0009	0.0023			
Manufacturing soap flakes and powders	0.067	0.067	0.067	0.33						
Manufacturing bar soap	2.27	3.87	0.27	5.67						

Table 3 (cont'd.)  
Raw waste loads based on production rates used to estimate pollution discharges from West African countries

Type of Industry	Raw Waste Loads, kg/ton		Oil Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus
	SO <sub>2</sub>	SS								
Tires and inner tubes	0.43	0.11								
Emulsion crumb rubber	2.67	4.33	1.07	53.3						
Solution crumb rubber	2.67	4.33	0.93	24.3						
Latex rubber	2.27	3.67		45.7						
Leather tanning + finishing (hair pulp with chrome tanning)	26.67	33.3	5.0	66.7			0.67			
Pulp, paper and paperboard (unbleached kraft)	18.67	40.0		46.7						
Cement manufacturing (leaching)	2.67			6.7						
Explosives	1.46	29.3		3.87						
Textiles printing and dyeing (assume cloth weighs 0.15 kg/m <sup>2</sup> )	22.7	58.0		282.0		0.40	0.40			
Paint and laquer	0.13	0.20		0.33						
Plywood (kg/m <sup>3</sup> of plywood)	0.62			1.56		0.70				
Veneer (hardwood, kg/m <sup>2</sup> )	3.64			9.1					0.15	
Iron and steel		0.24	0.073		0.61	0.01				
Primary aluminium smelting by Hall-Heroult process	10.0							6.67		
Phosphate manufacturing	3.33							0.33		1.00
Sulfuric acid	0.30	0.045								
Ammonium sulfate					2.5					0.063
Plating and galvanizing	1.26							0.018		
Fertilizers	3.33							0.33		1.00
Pharmaceuticals	21.3	47.3		53.3						
Batteries 1/	6.24	1,560		15.6						

1/ 62.4 kg/ton of lead and cadmium are also discharged.

Table 4

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Nigeria

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr															
				BOD <sub>5</sub>	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous						
Eastern Part of Atlantic Coast	NNOC	Crude petroleum	107 mill. tons/year				53,500,000												
		Fishing	170,000 tons live weight		1,921,000	102,000													
		Tinned meat	986 tons/year	790	1,310	394	1,972												
		Margarine	6,000 tons/year	133,800	117,000	84,000	334,800												
		Groundnut oil	7,300 tons/year	162,790	142,350	102,200	407,340												
		Wheat flour	600,000 tons/year	60,000	60,000		150,000												
		Raw sugar	27,600 tons/year	158,148	33,120		394,680												
		Beer	357 mill. liters	3,641,400	1,688,610		3,998,400												
		Soft drinks	181 mill. liters	570,150	783,730		1,429,900												
		Textiles	276,608 tons/year	6,279,000	16,043,264		78,003,456		110,643	110,643									
		Plywood	80,000 m <sup>3</sup> /year	49,600			124,800		56,000										
		Paints	26,500 tons/year	3,445	5,300		8,745												
		Soap and detergents	103,800 tons/year	235,626	401,706	28,026	588,546												
		Petroleum refining	8.9 mill. tons/year	1,121,400	712,000	427,200	3,115,000	231,400	5,340	14,240									
		Bicycle + motor cycle tires	1,914 tons/year		823	210													
		Other tires	2,050 tons/year		881	226													
		Cement	1.42 mill. tons/year	3,791,400			9,514,000												
Pulp + paper	60,000 tons/year	1,120,200	2,400,000		2,802,000														
<b>Total</b>				17,327,749	24,311,094	54,244,256	100,873,639	231,400	171,983	124,883									

### III. CONCLUSIONS AND RECOMMENDATIONS

#### A. Conclusions

1. Since Nigeria is one of the most important countries of the Gulf of Guinea in terms of area, population, shore length and industrialization, one wishes that more accurate data were available. One can only surmise that environment consciousness is still lacking in many areas, and that present practices will pose a great threat to the population's health and welfare as well as to the aquatic life in such areas as Lagos, Warri, Port Harcourt and Calabar if no change occurs parallel to the rapid growth of industry and urban population.
2. The ambitious industrialization plans, much of which to take place along the shore, suggest the urgency of establishing wastewater effluent standards: one should incorporate the proper pollution control equipment at the design stage rather than postpone it to an unspecified time and face costly retrofit and environmental repair needs in the future.
3. One gathers from various sources that the most severe problems are related to oil contamination of the surface water and beaches as well as to the dumping of domestic wastes at sea and lagoons in urban centers where no system for sewage, drainage or refuse disposal is available.
4. The Federal Government has initiated an effort to curb all three types of pollution (general industrial, oil related and domestic) but the task ahead is still gigantic. There is a staggering need for training of qualified people, effective planning, legislative and enforcement capabilities as well as for proper information and communication.
5. The state of the marine environment in Lagos and along most of the shore has already acquired such a bad reputation that the development of tourism would require not only a significant clean-up effort but also a concerted public relation campaign.

3. Recommendations

It is recommended that a long range plan of action be developed and implemented to control air, water and solid waste pollution. This includes the following immediate actions:

1. Development of rules and regulations defining permissible levels of contaminants in industrial wastewaters so that all existing and future industrial plants are treated equally fairly and can plan ahead accordingly.
2. Establishment of water quality monitoring programmes to determine the present and anticipated degree of pollution in Nigerian coastal waters.
3. Establishment of vocational training and expert assistance programmes in order to increase the quantity and quality of relevant knowledge locally available.
4. Development of a comprehensive information programme in collaboration with industrial and civic group leaders.



REFERENCES

- [1] "Economic Report, Nigeria". March 1979. Lloyds Bank Ltd., London.
- [2] "Third National Development Plan 1975-1980", 2 volumes, Central Planning Office, Federal Ministry of Economic Development, Lagos.
- [3] "Weltwirtschaft am Jahreswechsel", Nigeria, Mitteilungen der Bundesstelle für Aussenhandelsinformation, March 1980.
- [4] Patel, A.N. and Onwuka, M. D., "The chemical and allied process Industries in Nigeria", Chemistry and Industry, 4 March 1978.
- [5] Portman, J. F. "Le Golfe de Guinée: Pollution, Necessité d'un Contrôle et dispositifs possibles à cet effet", FAO/UNEP IAMPGG/6, April 26, 1978.
- [6] Angot, M. P. and Kamaru, D. "Exploratory Mission on Marine Pollution Problems of the West African Countries of the Gulf of Guinea (25 April - 2 July 1976)", UNEP Na. 76-2247.
- [7] "Nigeria: Economic Memorandum", June 30, 1976. World Bank Document.
- [8] "Europa Yearbook" 1979-1980.
- [9] "Quarterly Economic Review of Nigeria". 4th Quarter 1979. The Economist Intelligence unit Ltd.
- [10] Carmichael, J. B., and N. L. Nemerow. 1977. "Pollutants From Land-Based Sources in the Mediterranean, Industrial Waste Discharges From the Countries of Morocco, Algeria, Tunisia, Libya, Egypt, Israel, and Syria." International Centre for Industrial Studies, United Nations Industrial Development Organization, Vienna, Austria.
- [11] EPA. 1976. "Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Explosives Manufacturing." EPA 440/1-76/060j, Effluent Guidelines Division, Office of Water and Hazardous Materials, U.S. Environmental Protection Agency, Washington, D.C.

- [12] EPA. 1977 . "EPA Code of Regulations." U.S. Environmental Protection Agency, Washington, D.C.
- [13] EPA. 1977 . "Interim Final Supplement for Pretreatment to the Development Document for the Petroleum Refining Industry, Existing Point Source Category." EPA 440/1-76/083A, Effluent Guidelines Division, Office of Water and Hazardous Materials, U.S. Environmental Protection Agency, Washington, D.C.
- [14] Middlebrooks, E. J. 1979. Industrial Pollution Control—Vol. I. Agro-Industries. Wiley-Interscience Publication, John Wiley and Sons, New York, N.Y.
- [15] Wenninck, C. J. "Report on the Evaluation and Quantification of Oil Pollution related to the International Conference as it applies to the Federation of Nigeria". pp. 120.
- [16] Bayer, K. G. "Nigeria, die Wirtschaftsmacht Westafrikas". Osterreichische Diplomatische Korrespondenz Nr. 1/2 1980.
- [17] Anonymous, "Guidelines for the Fourth National Development Plan (1981-1985)", Federal Ministry of National Planning, Nigeria.
- [18] "Africa: South of the Sahara". Europa Publications Limited, 18 Bedford Square, London WC1B 8JN.
- [19] "Yearbook of Fishery Statistics, Catches and Landings", Vol. 45, FAO. Rome 1978.

APPENDIX 1

Associates in Nigeria

1. Mr. Erich E. Lethmayer  
Senior Industrial Development Field Adviser  
UNDP/UNIDO, Lagos, Nigeria
2. Mr. Mikkelsen  
JPO  
UNDP/UNIDO, Lagos, Nigeria
3. Mr. G. Bekele  
Senior Industrial Development Field Adviser  
UNDP/UNIDO, Nairobi, Kenya
4. Dr. Raimi O. Okijutu  
Assistant Director  
Environmental Planning and Protection  
Federal Ministry of Housing and Environment  
Lagos, Nigeria.

APPENDIX II

Sample of the Pollution Questionnaire  
communicated to the Federal Ministry of  
Housing and Environment



**UNIDO**

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Vienna International Centre  
P.O. Box 300  
A-1400 Vienna, Austria

Industrial Wastes Questionnaire

1. Industry identification

1.1 Name and address

1.2 Geographical location where industrial wastes are disposed

2. Identify type of industry

3. Production of goods (List various types) Amounts and Units of  
Production Year

4. Number of employees (average)

5. Source of water:

6. Industrial uses of water (average values, m<sup>3</sup>/d)

Process \_\_\_\_\_  
Cooling \_\_\_\_\_  
Boiler \_\_\_\_\_  
Sanitary Sewage \_\_\_\_\_  
Total \_\_\_\_\_

7. Industrial wastewater collection

Combined ( )

Separate for process water, sewage, rain run off ( )

Number of wastewater outfalls \_\_\_\_\_

8. Total industrial wastewater, m<sup>3</sup>/year \_\_\_\_\_

Amount receiving treatment \_\_\_\_\_

9. Describe treatment processes before effluent discharge

10. Are data available on characteristics of the wastewater?

Summarize available data below

Pollutant	Ave. Conc.	Vol, m <sup>3</sup> /day	Total Pollution Load, tons/year
-----------	------------	--------------------------	------------------------------------

BOD<sub>5</sub>

COO

Temperature

pH

Suspended solids

Metals (specify!)

Specific organic pollutants

11. To what body of water or sewer system are wastes discharged?

12. Uses of body of water receiving wastes

13. Distance in metres to sewer system

14. Amounts of solid waste, tons/ year

15. Disposal practice for solid wastes

	% total
Municipal system	_____
body of water	_____
land fill	_____
incineration	_____



