



REGIONAL SEAS

UNITED NATIONS ENVIRONMENT PROGRAMME

River inputs to the West and Central African marine environment

UNEP Regional Seas Reports and Studies No. 3

Prepared in co-operation with



Note

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PREFACE

The Regional Seas Programme was initiated by UNEP in 1974. Since then the Governing Council of UNEP has repeatedly endorsed a regional approach to the control of marine pollution and the management of marine and coastal resources and has requested the development of regional action plans.

The Regional Seas Programme at present includes ten regions and has over 120 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to combating environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the Governments concerned. It is designed to link assessment of the quality of the marine environment and the causes of its deterioration with activities for the management and development of the marine and coastal environment. The action plans promote the parallel development of regional legal agreements and of action-oriented programme activities.

By Decision 88 (V). C of 25 May 1977, the Governing Council of UNEP requested the Executive Director to initiate the development of an action plan for the West and Central African Region.

After a preparatory process, which included a number of experts meetings, fact finding missions and in-depth studies on resources and environmental problems of the region, the Conference of Plenipotentiaries on Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan 16-23 March 1981) adopted:

- the Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the West and Central African Region;
- the Convention for the Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region; and
- the Protocol Concerning Co-operation in Combating Pollution in Cases of Emergency.

The Governments of the region also established a trust fund to support the activities called for in the Action Plan. UNEP was designated as the secretariat of the Action Plan and the Convention.

This report was prepared as a contribution to the development of the Action Plan for the West and Central African Region. It provides an evaluation of the present status of monitoring river discharges, sediment discharges and contaminant discharges into the West and Central African Marine Environment, a description of the organizational set-up regarding water quality monitoring in countries of the region, existing problems and recommendations for action to improve the situation, together with a very preliminary estimate of total water, sediment and pollution inputs into the marine environment of the region.

The report is a synthesis of information and data obtained from Governmental sources, National Committees for the International Hydrological Programme and a fact-finding mission undertaken by two UNESCO consultants who visited ten countries in the West and Central African Region in November and December 1980. Furthermore, in order to review and complete the information and data collected and to formulate recommendations for follow-up activities, a Meeting of Experts on River Inputs to the West African Region was organized in Dakar, Senegal, 16-18 December 1980.

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REPORT ON RIVER INPUTS TO THE WEST AND CENTRAL AFRICAN
MARINE ENVIRONMENT

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I. INTRODUCTION AND OBJECTIVES

Within the framework of the Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the West and Central African Region (WAF) Unesco has been charged by UNEP (Project FP/0503-79-08) with an evaluation of the present status of regional monitoring of contaminants in river waters and sediments discharging into the West and Central African marine environment from the coastal countries.

The main objectives are:

- (i) to assess the present knowledge on the water and sediment discharged by major West African rivers to the West and Central African marine environment;
- (ii) to assess the nature and quantity of chemical compounds entering the West and Central African marine environment through rivers that are of concern to human health and/or to the environment
- (iii) to recommend harmonized methods of analysis of river dissolved and particulate pollutants in the region and to assist in developing the basis for water quality control measures in the coastal zone including beaches and productive areas
- (iv) to identify institutions, laboratories and individual scientists actively involved in river studies relevant to the project (hydrology, chemistry, sedimentology.....)

II. LINKS OF THE UNEP SPONSORED WAF WITH OTHER RELEVANT UNITED NATIONS PROGRAMMES

The international context of the WAF, in so far as this concerns river inputs to the seas and existing Unesco programmes and Unesco collaboration in joint programmes, is briefly outlined. It is noted that linkages existed between the various international scientific programmes fostered by Unesco, and that these are an important ingredient of any successful multi-disciplinary programme.

a. International Hydrological Programme (IHP)

The IHP is one of Unesco's international scientific programmes, with the objectives of contributing to a better knowledge of the hydrological system, and to the application of this knowledge to the rational use and management of the earth's water resources. Educational training is an important component of the IHP, covering the whole gamit of specializations in the water sciences, as well as promotion of education and training at technician, undergraduate and post-graduate levels. Assistance to Member States in the development of infrastructures in the sphere of water resources, with a view to developing their capacity to evaluate their water resources and to manage them scientifically is also an objective of Unesco's activities in the water sciences field.

The study of the influence of man's activities on the hydrological cycle has formed an important part of the IHP. Other IHP projects have

A second phase (1981-1983) of the IHP is in progress. One of the projects deals with the processes of water erosion and sedimentation in river basins, and the calculation of solid matter parameters, including the use of regional physical-geographical parameters, and the compilation of global sediment yield data. Another project concerns the methods for determining the balances of chemical substances in rivers and other water bodies, as well as coastal zones of the seas.

An important continuing IHP activity is the publication of "Discharge of Selected Rivers of the World", which is a compilation of monthly runoff data for more than 200 stream-gauging sites throughout the world.

National Committees for the IHP exist in practically each of the African Member States as well as in many countries. The Unesco Regional Office for Science and Technology for Africa is developing regional programmes in the field of scientific hydrology, in particular training activities, and a Regional Hydrologist has been appointed to promote this co-operation and participation in the IHP.

b. Man and the Biosphere (MAB) Programme

The MAB programme comprises 14 major themes or projects. Several of the MAB projects have relevance to the study of river inputs to the seas, but the principal features of MAB are its integrative focus and its stress on multi-disciplinary studies.

Active MAB National Committees exist in most of the African Member States, and these Committees coordinate national research and training programmes as well as organize regional activities.

c. IOC

The International Oceanographic Commission (IOC) and the Division of Marine Sciences of Unesco are the vehicles for regional activities, which encompass physical oceanography, marine and coastal biology and pollution, and marine geology and geophysics activities.

d. WORRI, GEMS-Water and RIOS

River input of substances (both dissolved and particulate) to the oceans has been recognized as one of the major interactions between industrialized society and the oceans. The assessment of the input of rivers to the oceans has been undertaken by Unesco at two different levels. At the global level, a catalogue of major rivers discharging to the oceans has been compiled, with the financial support of UNEP; this so called WORRI project provides a first list of 200 rivers ranked according to their mean annual discharge. Provisional data for the water quality of rivers discharging to the oceans have also been compiled, especially for the industrialized countries of Europe, North America and Japan. On the other hand, the Global Environmental Monitoring System water component (GEMS-Water) - a collaborative project linking UNEP and WHO, Unesco and WMO - will provide baseline data of water quality for major rivers near their mouths, as well as for rivers passing through large cities and for lakes and groundwater. Unesco is collaborating with UNEP and WHO in the training of specialists who will participate in the GEMS-Water project, as well as its wider role in the

of a Unesco/SCOR workshop held at Melreux, Belgium, in 1976 have been published by Unesco under the title "Biogeochemistry of Estuarine Sediments", 1978. The proceedings of a workshop held in Rome in April 1979 in the framework of RIOS are presently being edited by the Secretariat of the Intergovernmental Oceanographic Commission (IOC) for publication; they will give information on river composition, processes affecting this composition during estuarine mixing, the resulting flux to the oceans and the influence of man's activities on these characteristics.

On the regional scale, Unesco has conducted projects within the general framework of the UNEP Regional Seas Programme. Following on from the pilot Mediterranean projects, two projects - MED IX and MED X - allow an accurate assessment of the mass balance of water discharged to the Mediterranean and a first assessment of the dissolved pollutant discharge (MED X). MED IX stresses the importance of particulate matter as the carrier of most heavy metal and organic pollutants, and provides the first data on particulate matter composition in that region. After that was completed the preliminary project "River Inputs to the South-East Asian Seas".

The experience acquired during these projects has provided a sound basis for the planning and execution of a preliminary project "River Inputs to the West and Central African Seas". During this project, have been identified, together with the status of monitoring of water quality parameters included in the "Black list", "Grey list" and a miscellaneous list of determinants. A preliminary catalogue of major rivers discharging to the West and Central African seas and compilation of water quality data for major rivers have been prepared.

III. IMPLEMENTATION OF THE PROJECT

1. Introduction

In order to fulfil the objectives defined in paragraph 1, the following action has been taken by the Secretariat:

- (i) establishing contacts with institutions, laboratories and individual scientists actively involved in river studies;
- (ii) collection of all available data and reports on river water quality and river discharges including hydrological yearbooks, reports, scientific publication, maps...;
- (iii) identification of the major problems encountered in the field of water quality monitoring and of river pollution abatement;
- (iv) identification of countries' experts who could attend a Consultation of Experts on the River Inputs to the West and Central African Seas to be held prior to the Intergovernmental Meeting of Experts to review the Draft Action Plan for the WAF;
- (v) Synthesis of available data and first assessment of river discharge to West and Central African Seas;
- (vi) Organizing of an Expert Consultation on River Input to the West and Central African Seas in Dakar, Senegal, in December 1980.

2. Present Status of National Monitoring of Waters

2.1 SENEGAL

2.1.1. Status of Monitoring

2.1.1.1 Environmental Protection

A plan for environmental protection is under study. A national agency for the protection of waters with the aim of controlling industrial discharges to rivers and ground water will be established. A study of environmental protection criteria to be adopted by industrial plants is being conducted by the National Company for Development Studies (Société Nationale pour l'Etude du Développement, SONED).

Moreover, Senegal has implemented a coordination system between the Navy and the Airforce in order to control the marine coastal waters. Ships discharging into coastal waters are located by aircraft which warn the navy for an in-situ intervention.

2.1.1.2 Water Discharges

The Directorate of Water Resources (DH-Direction de l'Hydraulique) is in charge of the river gauging stations of Senegal. It is assisted by a WMO mission and produces hydrological yearbooks. All the Senegal rivers are monitored for river discharge.

The French Overseas Office for Science and Technology (ORSTOM)* Hydrological Department, also measures river discharge in a limited number of stations, especially on the Senegal river.

2.1.1.3 Solid Matter Transport

As far as is known, solid matter transport is only measured by ORSTOM on the Senegal river. However, these studies are only preliminary. It has not been possible to check with the Office for the Development of the Senegal river basin (Office de Mise en Valeur du Sénégal (OMVS)) whether other organizations are also concerned with the problem.

2.1.1.4 Water Quality

So far there is no systematic survey of river water quality but a limited number of studies are performed by various organizations:

- SONEES (Société nationale d'exploitation des eaux du Sénégal/Senegal National Company for the exploitation of water) controls the quality of drinking water, especially in Dakar (Central Laboratory) and St. Louis. Dakar drinking water is partly provided by the lake of Guiers, which is fed by Senegal river flood waters, and the Cap Vert groundwaters.
- ORSTOM (Hann Center) has entered upon an intensive study of the Senegal river water chemistry. The aim of this study is basically the geo-chemical mass-balance of this river but it will be very helpful to

- The Geological Laboratory of Dakar University is carrying out ground water quality studies and a special study on fluorides is being performed by Mr. Travai.
- The Environmental Sciences Institute (Dakar University) is said to have entered upon limnological studies of the Lake of Guiers.

2.1.2 Major Conclusions

So far there is no regular monitoring network of surface waters but the analytical and technical skill exists, especially at the Directorate for Water Resources, SONEES and ORSTOM. SONEES and ORSTOM-Hann laboratories are fairly well equipped with various lamps for atomic absorption spectrometry to measure the black and grey list of parameters previously defined within UNEP programmes.

Analysis are performed on request. A mobile laboratory for field analyses as well as sampling stations (Senegal river excluded) is now available.

On the whole, there is no global study of the aquatic and terrestrial environment.

The major rivers in Senegal and Gambia which should be taken into account in the Regional Seas Programme are obviously the Senegal and Gambia rivers. The measuring stations are to be situated sufficiently far inland to avoid the quality of the parameters being influenced by sea water intrusion.

2.2 GAMBIA

2.2.1 Status of Monitoring

Hydrometeorological activities are carried out by the Water Resources Department. Salinity and discharge were monitored during a UNDP project studying salt intrusion (1975). Actually a laboratory exists which is not operational due to lack of personnel, chemicals and equipment. The major causes of pollution are: fertilizers, pesticides, domestic sewage and wastes from a brewery in Banjul.

2.2.2 Future Plans

Gambia is planning to establish an environmental agency. It plans to analyse and monitor the GEMS-Water basic determinants in the Gambia River. Microbiological analysis of potable water of Banjul is also foreseen to start in January 1981. There is an urgent need for trained personnel and adequate equipment.

2.3 LIBERIA

2.3.1 State of River Monitoring

In Liberia, the Liberian Hydrological Service is part of the Ministry of Lands and Mines and has a mandate to carry out studies relating to water resources development. There are several agencies doing various work within

2.3.1.1 Liquid Discharges

The Hydrological Service has 35 gauging stations of which 18 are equipped with automatic water level recorders. Personnel (hydrologists) visit these stations periodically to make discharge measurements.

2.3.1.2 Solid Discharges and Water Quality

During the visit of hydrologists to the gauging stations samples are collected and analysed in Monrovia for Zn, Fe, Nitrate, Cu, Pb, Turbidity, Hardness (Ca and Mg) acidity, alkalinity, electric conductivity, pH, Cr, F, SO_4 and colour.

2.3.2 Major Conclusions and Problems

Pollution in Liberia is mainly caused by Iron and Mining Companies. Various companies in the process of extraction, dump overburdens and other waste materials on the mountain slopes and other convenient areas from where they find ready access to the nearby streams and rivers through runoff during heavy tropical rains.

Also some other companies such as the rubber companies discharge their effluents directly into the natural river system or ocean body.

Apart from the monitoring of the rivers which have been polluted by the mining companies (St. John, Yah), the Liberian Hydrological Service tries to monitor many other rivers and creeks for agriculture, drinking and city water supply and other development purposes depending on the availability of resources and equipment. As the service does not have the resources to monitor all the rivers, it makes the mining and other companies monitor the mines and creeks around them and forward a monthly report to the service.

The seven main rivers to be included in the WAF programme are: Mano, Zeffa, St. Paul, St. John, Castos, Senghuen, Cavalla. The Mano river has been the object of a study carried out by the Mano River Basin organization (Hydro-power project).

2.4 IVORY COAST

2.4.1 State of River Monitoring

2.4.1.1 Liquid Discharges

The monitoring of the hydrological network is ensured by the Central Directorate for Water Resources (Direction Centrale de l'Hydraulique (DCH)) of the Ministry of Public Works, Transport, Building and Town Planning - and in particular by the Division of Surface Water Resources directed by Mr. Bourges. These data are managed by Mr. Ramana, chief hydrologist of the DCH directed by Mr. Camerlo.

The whole of the network including 103 limnometric stations is divided into three regions comprising two hydrological monitoring brigades each. Information is obtained continuously from twenty stations equipped with limnigraphs.

This network, perfectly operational in 1980, should be brought to 170 stations (that is 15 supplementary stations for each brigade), half of which could be equipped with limnigraphs within the next two years.

For several decades, this administration has been regularly publishing the data obtained in hydrological yearbooks.

2.4.1.2 Solid Discharges

At present, there is no programme of regular acquisition of data concerning solid discharges in Ivory Coast. However, certain local studies present interesting results, such as the monography carried out on the white Bandama and its affluents by Mr. Camus in 1972, or the publication of a general study in 1971: "the natural environment of the Ivory Coast" (memoire ORSTOM No. 50).

Furthermore, the staff training project of the DCH should bring about the daily sampling of solid discharges for every station of the monitoring network from 1981 onwards.

2.4.1.3 Water Quality

Several organizations have plans for water quality studies and carry out certain activities in this field. They are:

- the Directorate of Drainage and Sanitation
- the Centre of Oceanographic Research
- the Directorate of Industrial Environment
- the ORSTOM Centre of Adiopo-Doumé

These organisms have their own analytical equipment adapted to their specific problems, and the whole list of parameters selected for the WAF Programme can be analysed in the country.

An institute for the analysis of drinking water supply and another one for waste water analysis are also located in Abidjan.

A certain number of data on the Bandama river and rain water have been published.

2.4.2 Major Conclusions and Problems

The services in charge of the hydrological network are developing a project for automatic hydrological monitoring with computerization of data located in the country. This project is under the supervision of the Central Directorate for Water Resources. Part of the project deals with the training of technicians, the other part concerns the harmonization of the existing computer centre with the storage and treatment of hydrological data.

Presently, the training of hydrologists is performed within the framework of various conventions between the administration and ORSTOM. As an example, the hydrological monitoring is conducted by hydrologists trained by ORSTOM and affected to the Central Directorate for Water Resources. Similarly, this personnel is also responsible for the training of staff members and technicians for the Surface Water Resources Division. For the last

The co-ordination of the various bodies involved in water quality is not yet achieved.

Basic research, previously conducted by ORSTOM, was stopped a few years ago, owing to the priority given to intensive agriculture and the food industry. The situation is now changing and the government has decided to develop once again this kind of research by ORSTOM and its relevant bodies.

2.5 GHANA

2.5.1 State of River Monitoring

2.5.1.1 Water and Sediment Discharge

The regular river discharge monitoring (including sediment) is realized by the Architectural and Engineering Services Corp. (AESC), a state agency which has replaced the Public Works Department. Water Yearbooks of Ghana are regularly published by this agency.

The Water Resources Research Unit (WRRU) of the Council for Scientific and Industrial Research (CSIR) has carried out specific river surveys, including discharge measurements, which are found in CSIR reports.

2.5.1.2 Water Quality

A regular water quality monitoring exists for the Volta river on stations located on two major reservoirs: upstream of Akosombo dam (Volta Lake) and Kpong dam. These stations are surveyed by the Volta Lake Research Institute of the University of Ghana.

The WRRU carried out intensive analytical work on some rivers, such as the Densu (study completed) and the Pra river (ongoing study). The parameters analysed are the major elements, the nutrients and some metals. The WRRU laboratory is well equipped with an atomic absorption spectrometer and a spectrophotometer.

The Institute of Aquatic Biology of the CSIR is in charge of the pollution surveys on the rivers of Ghana, but detailed information is lacking on this activity.

The Environmental Protection Council of Ghana is in charge of coordinating the various activities in environmental studies.

2.5.2 Major Conclusions - State of Monitoring

GHANA has been studying river hydrology and river quality for many years and numerous administrations are actively involved in this field. The analytical potential is high and there are at least three laboratories well-equipped for water quality analysis.

The major sources of pollution to Ghanaian rivers come from mining (gold, manganese and diamonds), timber, rubber and agro-base industries.

African region, December 1980, agreed that the following rivers should be monitored at the stations indicated below:

<u>River</u>	<u>Stations</u>
Tano	no station yet
Pra	Daboase and Konongo
Volta	Kpong and Ada
Ankobra	Dominase and Ankwaso
Densu	Weiija and Asuboi
Ayensu	Ochereku

It must be noted that the river Ofin is not reported in the above list. This river is a tributary of the Pra river and receives much effluent from mining industries.

The river Tano forms part of the boundary between Ghana and the Ivory Coast. This river has not been studied in the past because of the lack of industries and poor accessibility in the area. Two stations will, however, be selected for the WAF Regional Seas Programme.

Effluents from the Konongo gold mines in the Ashanti region enter the river Pra by way of the river Ofin.

At present, the Water Resources Research Unit is in the process of mounting a major water quality study of this river in connection with salt-water intrusion problems encountered on the river at Daboasi. Discharge measurements are available for this river. Some sediment discharge data are available for this river at Beposo.

The Volta river has been extensively studied. Most of the data required are available.

Discharge measurements are available for the river Ankobra as well as some sediment load discharge data. This river drains the important gold mining areas of Takwa and Prestea. A manganese mining industry at Msuta also discharges to a tributary of the Ankobra. Pollution indices monitored are cyanide, BOD at 27°C and DC.

Most of the pollution in the river Densu basin is due to high population density. River discharge measurements, as well as water quality measurements have been made, and also some sediment discharge measurements.

No water quality studies have yet been made on the Ayensu river; however, discharge measurements have been made over the years.

The rivers to be monitored in the Regional Seas Programme (West and Central Africa) are: river Volta downstream of the Kpong dam, river Tano, Pra,

Waters.

2.6 TOGO

2.6.1 Present Status of River Monitoring

2.6.1.1 River Discharge

The national network for hydrological monitoring is partly taken care of by the Hydrological Division of the Hydraulic Directorate (Ministry of Mines, Hydraulic Resources and Public Works), and the other half by ORSTOM. Both these organizations have published yearbooks (two volumes of data before 1971 published in December 1973 and June 1974, a second issue of data for 1971-1979 may be published in 1981). Data exchange between the Hydrological Division and ORSTOM is permanent. There is a joint documentation Centre. Finally, local studies on the Mono river basin which borders Benin and Togo have been performed by the two countries in collaboration with the support of various international consultants and ORSTOM.

Mr. Katakou, technical secretary of the International Hydrological Programme for Togo, also centralises data for the International Drinking Water Supply and Sanitation Decade. The different technological committees concerned are:

- the Meteorological Service of the Ministry of Transport
- the National Bureau of Mining Research (Bureau Nationale de Recherches Minières, (ENRM)) and the Hydrological Section of Mr. D'Almeida
- the Directorate of Rural Engineering to which Mr. Katakou belongs
- the Directorate for Sanitation directed by Mr. Nenonéné from the Ministry of Health

2.6.1.2 Solid Discharges

Solid discharges have only been measured in the framework of local studies made by foreign consultants and by ORSTOM, notably Mr. Colombani's publications.

2.6.1.3 Water Quality

As for the solid discharges, the only available data corresponds to local studies such as those carried out by Mr. Colombani from 1965 to 1967.

Measurements of physical parameters, temperature and conductivity are sometimes carried out. Chemical data are rarely available. However, in the framework of the study "Knowledge of the natural environment of Lake Togo" being carried out by Mr. Millet (ORSTOM) under the direction of Mr. Katakou, a programme of chemical analysis is foreseen. Hydro-biological analyses are to be made by Mr. Nenonéné's services.

2.6.2 Major Conclusions and Problems

The state of the existing hydrological monitoring network is very satisfactory. On the other hand, the development of an analytical follow-

It should be mentioned here that an important factory of phosphate extraction is situated near the coast. Its impact on marine environment should be particularly studied.

Proposed major rivers to be monitored within the WAF programme are the Haho and the Mono, this last one being the borderline with Benin.

2.7 BENIN

2.7.1 General Presentation

Over an area of nearly 112,600 km², the Popular Republic of Benin presents an appreciable hydrological network, including:

- the river Mono (which is shared by the Republic of Togo)
- the river Oueme
- the river Couffo
- the river Zou
- the river Niger (with its affluents Mekrou, Aliboru and Sota)

2.7.2 State of River Monitoring

2.7.2.1 Liquid Discharges

The monitoring of river gauging network was carried out by CRSTOM (until recently) and especially by the Directorate for Hydraulic Resources. The measurements are reported regularly and constantly up-dated.

2.7.2.2 Solid Discharges

Some local studies are of real interest, especially those relating to erosion problems in river basins or in areas mechanically cleared. But, it seems that no comprehensive national survey has been undertaken in this field. Very serious plans are un-erway for the said studies.

2.7.2.3 Water Quality

Here, as in the case of the studies of solid discharges, nothing very important has been done. Analyses are made regularly, especially in the fields of:

- water quality for irrigation
- water quality for pisciculture
- water quality for human consumption
- water quality of Lake Nokoue, Laguna of Porto-Novo and waters of the low ground of Cotonou.

The various projects and studies (carried out or to be carried out) on water quality are the responsibility of:

- the Directorate for Water Resources
- the Water and Electricity Company of Benin (Société Béninoise

- the UNDP/FAO Agropedology Project
- the National University of Benin (UNB)
- ORSTOM
- the Directorate of Rural Engineering (Direction du C erie rural (DGR))

The laboratories of the Directorate for Water Resources of the SBEE, of UNB and more especially the one for the Agropedology Project, are equipped to deal with such analyses, but it will be necessary to assist them technically and to reinforce staff and equipment.

2.7.3 Major Conclusions and Problems

The existing network of discharge monitoring is more or less functioning. This network is insufficient and it would be desirable to extend it so as to allow a better appreciation of the problems.

The laboratories for water quality analysis are appropriate, especially the one for the UNDP/FAO Agropedology Project which has just been equipped with an atomic absorption spectro-photometer, but determination of some specific constituents such as pesticides will be difficult. Presently these products do not cause any problem, but in years to come their utilization will be more generalized and it will be necessary to master their analysis.

The problem of the pollution of the coastal waters of Benin by phosphates from Togo and oil from ships is getting more threatening and causes great damage to the marine biotic resources.

2.8 NIGERIA

2.8.1 State of River Monitoring

2.8.1.1 River Discharge Monitoring

The Federal Department of Water Resources is the coordinating organism in charge of collecting hydrological data. Due to the federal status of Nigeria, the river gauging work is sometimes realized by other administrations: such as Ogun State, Oyo State or the Inland Water Ways Department in charge of river navigation, particularly for the Niger itself.

The Federal Department of Water Resources is presently publishing its first Hydrological Yearbook for the year 1978/79. However, a certain amount of information found in this Yearbook concerns only the water levels and not the water discharges needed for the West African and the GEMS-Water Programme.

The Niger river, which has the greatest discharge apart from the Zaire river in the West African region, is regularly gauged, and water discharges are available.

2.8.1.2 Water Quality Monitoring

There is no nation-wide water quality monitoring at the present

As for other countries bordering the Gulf of Guinea, Nigeria has a major lagoon system fed by rivers during the rainy season and by underground waters during the dry season. The water retention time in this system which extends over more than 200 km is high. Moreover, a major industrial and urban source of pollution, namely Lagos city and its surroundings, is located on this system where heavy metal pollution is already very high (some fish present at times the mercury level accepted

Due to the rapidly growing Nigerian industries and, particularly, the oil industry, some minor rivers can be heavily polluted and therefore constitute a major pollutant input to the Gulf of Guinea.

As for other countries bordering the Gulf of Guinea, Nigeria has a major lagoon system fed by rivers during the rainy season and by underground waters during the dry season. The water retention time in this system which extends over more than 200 km is high. Moreover, a major industrial and urban source of pollution, namely Lagos city and its surroundings, is located on this system where heavy metal pollution is already very high (some fish present at times the mercury level accepted

2.8.2 Major Conclusions

The Ministry of Health has a special section devoted to environmental problems: the Environmental and Occupational Health Unit located in Ibadan. The Unit carries out water analyses on some rivers.

The Kainji Lake Research Institute in Kainji is devoted to the limnological study of this major African reservoir. This work is mainly in connection with the fisheries development of the lake and the water analysis carried out by this Institute (according to its annual report) mostly concerns the nutrients. These stations, however, are located far upstream from the river delta and do not take into account the Benue, a major tributary which reaches the Niger downstream of the Kainji Lake.

The Chemical Oceanography Section of the National Institute of Oceanography and Marine Research works on various aspects of coastal water quality including the very important lagoon complex situated between the Niger Delta and the Niger Delta. This section plans to study the pollution of the Lagos Lagoon and is developing laboratory facilities. So far no studies on rivers have been carried out.

The newly founded Environmental Planning and Protection Division is in charge of coordinating all work concerning environmental studies and of making the appropriate recommendations to the Federal Government on any environmental matters. This organization will, in future years, launch several studies concerning water and sediment pollution in areas exposed to severe pollution such as the Lagos Lagoon (Industrial and urban wastes) and the Niger delta where chronic oil pollution occurs and which is exposed to major oil spill. 40% of all the industries in Nigeria are located in Lagos State. One of the scientists (Mr. Tokoke) of this Division has completed a study of the heavy metal contamination of the Lagos Lagoon.

2.9 CAMEROON

2.9.1 Present Status of River Monitoring

2.9.1.1 Water Discharge

The hydrological section from the I.R.G.M. (Institut de Recherche Géologique et Minière/Geology and Mining Research Institute) of the DGRST (Direction générale de la Recherche Scientifique et Technique/General Directorate for Scientific and Technological Research) is responsible for the river gauging operations. This gauging network has been established by ORSTOM. This network is operational (71 limnimetric stations including 8 limnigraphic stations). Almost 65% of the Cameroon area is presently monitored. Numerous detailed monographs have been performed on river basins by ORSTOM scientists. Among others, one can quote the Nyong and coastal rivers, Senaga and Bamiléké country studies.

2.9.1 Solid Discharges

Solid Discharges were measured some years ago in the framework of regional monographing (e.g. Bamiléké platform) by ORSTOM. These studies are now completed, they have shown high solid discharges as compared to the West and Central African average.

2.9.1.3 Water Quality

A water quality yearbook from South Cameroon has been edited by ONAREST (now DGRST) and ORSTOM under the direction of Mr. Naah and Mr. Olivry. Now, due to the re-organization of DGRST, the laboratories are not operating for a 1-2 year period.

Other organizations such as the Sub-Directorate for Sanitation of the Health Ministry do have the analytical facilities but are not presently dealing with river water quality. The Sub-Directorate for Water and Sanitation of the Ministry of Mines and Energy controls drinking and waste waters in cities. It makes some inspections (which are considered insufficient) of polluting industrial activities. The National University is conducting various research projects on water quality. There is a project on the establishment of an institute for water quality and coastal resources. Moreover, a laboratory for the control of drinking and waste waters is foreseen. This laboratory would also control the quality of petroleum products but this latter activity is not primarily concerned with environmental protection. The MAB (Man and the Biosphere) permanent secretariat coordinates the environmental activities among the various administrations.

2.9.2 Major Conclusions and Problems

The river water discharge network has been operating on a regular basis for several years. On the other hand, the river water quality network which was working some years ago (general hydrochemical parameters, major elements, Fe, Mn, Al) is presently under re-organization.

Similarly, to other West African coastal states, the damming of

quality, especially by trapping sediments, which can absorb pollutants. Intensive agricultural development (e.g. sugar cane) may alter the water quality in such a manner that fish mortality is sometimes observed (Mbanjok area). Point sources of organic pollution such as the Edea paper factory must also be mentioned.

Major rivers proposed to be monitored within the WAF programme are: Nkam, Senaga, Nyong, Ntem and Mounjo.

2.10 GABON

2.10.1 Present Status of River Monitoring

2.10.1.1 Water Discharge

Until 1977 the river gauging station network was taken care of by ORSTOM which routinely published hydrological yearbooks until 1979. Since 1978, this monitoring network has been integrated within the CENAREST (Centre National de la Recherche Scientifique et Technique/National Centre for Scientific and Technological Research) within the framework of the section for hydrological studies and research. This section has also performed monographic studies such as that on the Ogooné river (in press).

2.10.1.2 Solid Discharges

Presently, there is no regular survey of river solid discharges. However, some point measurements have been carried out in certain specific studies.

2.10.1.3 Water Quality

The CNAR (Centre National Anti-Pollution/National Anti-Pollution Centre) which is under the DGRSEPN (Direction générale de la Recherche Scientifique de l'Environnement et de la Protection de la Nature/General Directorate for Scientific Research of the Environment and the Protection of Nature) is in charge of water quality monitoring in Gabon.

However, the CNAR does not have its own laboratory but requests the analytical office of the Ministry of Mines to carry out the analysis. The CNAR has recently been created - one of its projects is an inventory of polluted areas in Gabon and their degree of contamination, this project must be achieved in 1981. For the moment, river water quality data are scanty and there is no regular survey.

2.10.1.4 Major Conclusions and Problems

Following a re-organization, the river discharges monitoring network is operating with limited means and the reading of limnometric stations is no longer performed. The network re-organization will be completed within two years. Mainly for financial reasons, there is presently no river water quality network. The major sources of agricultural pollution are restricted owing to agricultural practices. The numerous oil bore-holes and the refinery projects near Port Gentil represent a potential pollution source for coastal waters. In the whole south area of Ogooné and in the western part of the

The proposed major rivers to be monitored within the WAF Regional Seas Programme are the following: Lomo, Oggoné, Nyango.

2.11 CONGO

2.11.1 Present Status of Monitoring

2.11.1.1 River Discharge

River gauging monitoring is performed by ORSTOM. Hydrological yearbooks are published.

2.11.1.2 Solid Discharges and Water Quality

So far the northern part of the Congo does not have any significant industries and it is sufficient to control the river solid discharges. Water quality would be worth monitoring in the Kurilou-Niani river which flows through an industrialized area.

There is a river gauging station upstream of Brazzaville.

Although three laboratories (Mining Service, Water Department, ORSTOM, Public Health) are able to analyse most of the GEMS-Water determinants, no institution is presently involved in a regular survey of water quality.

2.11.2 Major Problems

There is a need for qualified personnel and additional equipment. The Congo (Zaire) river, which is the bordering river with the Republic of Zaire, might be studied for water and sediment through an intergovernmental project with Zaire and the Central African Republic, but some difficulties have to be solved before achieving this co-operation.

2.12 ZAIRE

2.12.1 Present Status of Monitoring

2.12.1.1 River Discharge

Hydrological yearbooks on the Zaire river are published.

2.12.1.2 Solid Discharges and Water Quality

There is no specialized institution in charge of water quality monitoring, but there is a water quality laboratory in Kinshasa. Several sedimentological studies have been conducted, especially by the Hydraulical Laboratory of Gergehout (Belgium) and the Central Laboratory for Hydraulics (Laboratoire Central d'Hydraulique de France (LCHF)).

2.12.2 Major Problems - Projects

A problem of sample conservation exists owing to the distance between the Kinshasa laboratory and the Zaire river mouth (350 kms). An inventory of polluting industries has been established by a UNDP/UNIDO consultant survey. The implementation of a sampling station at the Zaire

3. MAJOR OVERALL CONCLUSIONS AND FOLLOW-UP RECOMMENDATIONS

3.1 Overall Findings and Conclusions

The following countries participated in the study: Senegal, Gambia, Liberia, Ivory Coast, Ghana, Togo, Benin, Nigeria, Cameroon, Gabon, Congo, Zaire.

3.1.1 Present Status of River Monitoring of Water Sediment Discharge and Water Quality

Annex I provides a classification of major rivers of West Africa according to drainage area and discharge and Annex II a list of selected rivers in West Africa indicating for each of the rivers the availability of data for water discharge, sediment discharge and water chemistry.

The following conclusions can be drawn from Annex II: of the 41 identified rivers for which the status of monitoring is known, 28 have long sequences of river discharge data; for 34 of the 41 rivers no sediment data are available. No water chemistry data are available for 30 of the 41 rivers.

3.1.2 Global Water Input from the African Continent to the Gulf of Guinea and Adjacent Regions

The average long-term water input from rivers to the West African seas is around 80,500 cubic meters per second.

The details of the yearly budget are given in Annex VI, while Annex III provides a catalogue of river water discharges by country

3.1.3 Estimation of Sediment and Pollutant Inputs to the West African Seas

In view of the scarcity of data (see para 3.1.1), no reasonable accurate estimate can be made of either total suspended sediment input or total pollutant input by rivers into the West and Central African environment. The data that are available are given in Annex V for river sediment discharges and Annex IV for river quality, both by country.

3.1.4 National Institutions and Laboratories undertaking River Monitoring and Water Quality Analysis

A list of national institutions is given in Annex VIII.

The majority of countries have the minimum equipment for determining fundamental parameters of black and grey lists but are facing serious problems with regard to the maintenance of the equipment, shortage of qualified manpower and adequate funds.

3.2 Recommendations

The recommendations enumerated hereunder were developed by the meeting of experts on "River Inputs to the West and Central African Marine

3.2.1 Selection of Parameters

- (Rec. 1) It is recommended that every country select the parameters from those selected for the GEMS-Water Programme and the Regional Seas Programme according to national needs and possibilities.

The parameters most frequently referred to are essentially organic pollution indices, different metals and pesticides.

3.2.2 Selection of Rivers

- (Rec. 2) It is recommended to measure in priority the water quality of those rivers for which the discharges are known in order to set up mass-balances of pollutants discharged into the seas.

- (Rec. 3) It is recommended that small rivers which are known to be highly polluted are also included in the WAF programme.

3.2.3 Location of Sampling Sites

- (Rec. 4) It is recommended that water quality and sediment measuring stations be set up immediately upstream of the zone of sea water intrusion, taking into account the possibility of access to the station.

- (Rec. 5) It is recommended, when rivers discharge to the seas through coastal lagoons and these lagoons are seriously polluted, special pilot projects should be set up to study these areas.

3.2.4 Sampling Frequencies

- (Rec. 6) It is recommended that the sampling frequency for the purpose of the WAF programme be at least once a month, with higher frequency during the flood season in particular for the determination of particulate pollutants.

- (Rec. 7) It is recommended that for the near future the sampling frequency be dependent on accessibility of the measuring station, the prevailing difficulties in analysing given parameters and national priorities.

3.2.5 Water Quality Analysis

- (Rec. 8) It is recommended that each institution continue, in principle, to use the method they are familiar with as regards pre-treatment, treatment and analysis.

- (Rec. 9) It is recommended to standardize the method for the pre-treatment of samples: for example, filtering raw water through 0.4 μ pore size filters.

- (Rec. 10) It is recommended to undertake an intercomparison exercise and to provide standards to laboratories in the region.

- (Rec. 11) It is recommended that water quality analysis be accompanied by the determination of pollutants in living organisms used for food or other organisms that can be used as pollution indicators.

- (Rec. 12) It is recommended that the measurement of BOD be carried out in the region at 20°C for three days, and not according to criteria used in the

3.2.6 Financial Aid

- (Rec. 13) It is recommended that financial aid be given to individual countries to allow them to purchase supplementary analysis material or additional material for analysing specific parameters, rather than using funds for the establishment of regional centres.

3.2.7 Intergovernmental Co-operation

- (Rec. 14) It is recommended that, taking into account the importance of the Zaire river, which represents about 50% of the total river discharge into the West African Seas, an intergovernmental project be launched by the three main countries of the basin, (Central African Republic, Zaire and Congo) with the aid of international organizations.

3.2.8 Training

- (Rec. 15) It is recommended that training be made a major objective both in the framework of the Regional Seas Programme and in GEMS/Water in particular at the middle technician level in the field of water chemistry.

- (Rec. 16) It is recommended that training be also specifically directed towards the problems connected with the maintenance of analytical equipment. The Scientific Instrument Centre in Accra (Ghana) could be utilized as a base for this type of training.

3.2.9 Data Publication

- (Rec. 17) It is recommended that Unesco publish a regular newsletter regarding water quality in West and Central African countries.

3.2.10 Estuaries and Coastal Lagoons

- (Rec. 18) It is recommended to launch pilot projects to study the chemical, biological, environmental and economic aspects of lagoons, in particular, in the areas which are seriously affected by pollution such as lagoons near Lagos and Abidjan and the estuary of the St. John river in Liberia.

ANNEXE 1.

CLASSEMENT DES PRINCIPAUX FLEUVES DE L'AFRIQUE DE L'OUEST (1)
CLASSIFICATION OF PRINCIPAL RIVERS OF WEST AFRICA (1)

Par ordre décroissant de bassins versants According to decreasing drainage area		Par ordre décroissant de débits (3) According to decreasing water discharge	
Zaire	3 822 020 (km ²)	Zaire	40 680 (m ³ /s)
Niger	1 125 000	Niger	8 500
Sénégal	441 000	Ogooué	4 758
Volta	398 371	Sanaga	2 060
Saloum Casamance	268 000	Cross	1 557
Ogooué	205 000	Volta	= 700 (4)
Sanaga	135 000	Sénégal	774
Bandama	> 100 000 (2)	Saloum Casamance	695
Sassandra	> 80 000 (2)	Konkouré	683 (2)
Ouémé	50 000	Nyanga	511
Cross	48 000	Sassandra	= 360
Ntem	31 000	Pra	289 (2)
Mono	22 000	Ntem	288
Nyanga	20 000	Bandama	285
Non classés (données à l'embouchure inconnues) Not classified (unknown total drainage area)		Nyong	194 (2)
		Ouémé	182
		Tano	146 (2)
		Mono	110
		Nkam	62 (2)
Pra	> 23 000 (2)	Non classés - not classified	
Nyong	> 19 000 (2)		
Konkouré	> 16 000 (2)		
Tano	> 16 000 (2)		
Nkam	> 2 500 (2)		
Como	> 2 500 (2)	Como	

(1) Ce classement est provisoire puisque de nombreux fleuves n'ont pu être pris en compte par manque de données
This classification is not definitive as a great number of rivers are missing due to lack of data

(2) Débit et bassin versant partiels (dernière station de jaugeage)
Partial discharge or drainage area at the last gauging station

(3) Valeurs sur une longue période - long-term average

(4) 1 260 m³/s de 1936 à 1963

ANNEXE II

LISTE DES FLEUVES SELECTIONNES DANS L'AFRIQUE DE L'OUEST (1)
 LIST OF SELECTED RIVERS IN WEST AFRICA AND STATE OF MONITORING (1)

PAYS COUNTRY (of river mouth)	FLEUVES RIVERS	DONNEES DISPONIBLES AVAILABLE DATA		
		Débit Water Discharge	Charge Solide Sediment Discharge	Analyse de l'Eau Water Chemistry
SENEGAL (1)	Sénégal	xxx	0	x
	Saloum-Sine	xxx	0	0
	Caasamance	xxx	0	0
GAMBIA (1)	Gambia	0	0	0
GUINEE	Corubal	0	0	0
GUINEE-BISSAU	Konkouré	xxx	0	0
SIERRA LEONE	Kolente	0	0	0
	Moa	0	0	0
LIBERIA (1)	Mano	xxx	xx	xx
	Loffa	xxx	0	0
	St. Paul	xxx	0	0
	St. John	xxx	0	0
	Cestos	xxx	0	0
	Senghuen	xxx	0	0
	Cavalla	xxx	0	0
IVORY COAST (1)	Sassandra	xxx	0	x
	Davo	*	0	0
	Bandama	xxx	0	xx
	Comoé	xxx	0	0
GHANA (1)	Tano	xxx	xx	0
	Fra (+Offin)	xxx	xx	xxx
	Volta	xxx	xx (2)	xxx
	Densu (4)			
	Ancobra (4)			
	Argensu (4)			
TOGO (1)	Maho (4)			
	Mono	xxx	0	x
BENIN (1)	Mono	xxx	0	0
	Ouemé	xxx	0	0
	Couffo (4)			
	Zou (4)			

xxx moyenne à long terme - long-term average

PAYS COUNTRY (of river mouth)	FLEUVES RIVERS	DONNEES DISPONIBLES AVAILABLE DATA		
		Débit Water Discharge	Charge Solide Sediment Discharge	Analyse de l' Water Chemis
NIGERIA (1)	Ogun	0	0	0
	Oshun	0	0	0
	Niger	xxx (3)	xxx (2) (3)	0
	Cross	x	0	0
CAMEROON (1)	Nkam	x	0	x
	Sanaga	xxx	xx	xx
	Moungo	xxx	0	0
	Nyong	xxx	0	xx
	Ntem	xxx	0	0
GABON (1)	Como	0	0	0
	Ogooué	xxx	0	0
	Nyanga	xxx	0	0
CONGO P.R.	Zaire	xxx	xxx	xx
ZAIRE (1)	Zaire	xxx	xxx	xx
ANGOLA	Mbridge	0	0	0
	Cuanza	0	0	0
	Cunene	0	0	0
TOTAL NUMBER OF RIVERS	xxx	28	2	1
	xx	-	5	6
	x	3	0	4
	0	10	34	30
		41	41	41

- (1) Pays représentés au réunion d'experts
Countries represented at expert meeting
- (2) Valeur actuelle inconnue - present day value unknown
- (3) Période d'étude inconnue - period of study unknown
- (4) Pas d'informations sur des données en janvier 1981
No information on data in January 1981

ANNEK III

CATALOGUE DES DEBITS LIQUIDES DES FLEUVES
CATALOGUE OF RIVER WATER DISCHARGE

If for a certain river no data are indicated it means that in January 1981 no data were readily available. Data may exist and will become available.

COUNTRY-PAYS	SENEGAL	
RIVER-FLEUVE (REF)	Sénégal	
STATION	Dagana	Bakel
CODE		bB 24
MAP NUMBER-NUMERO DE REFERENCE		
LATITUDE N	16° 31' N	14° 54' N
LONGITUDE E	15° 30' W	12° 27' W
TOTAL DRAINAGE AREA-SUPERFICIE TOTALE DU BASSIN (km ²)	441 000	441 000
DRAINAGE AREA AT STATION- SUPERFICIE A LA STATION (km ²)	268 000	218 000
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)		
STATION ALTITUDE-ALTITUDE DE LA STATION (m)	- 0,44	+ 11,16
WATER DISCHARGE-DEBIT m ³ .s ⁻¹ (l.s ⁻¹ .km ⁻²)		
I	206 (0.8)	143 (0.7)
II	114 (0.4)	83.9(0.4)
III	62.5(0.2)	46.3(0.2)
IV	31.2(0.1)	19.8(0.1)
V	17.4(0.1)	9.7(0.0)
VI	35.7(0.1)	111 (0.5)
VII	417 (1.6)	585 (2.7)
VIII	1210 (4.5)	2310 (10.6)
IX	1990 (7.4)	3420 (15.7)
X	2310 (8.6)	1090 (7.8)
XI	1460 (5.4)	576 (2.6)
XII	455 (1.7)	257 (1.2)
ANNUAL MEAN-MOYENNE ANNUELLE	695 (2.6)	774 (3.5)
OBSERVATION PERIOD-	1903-1969	1903-1969

COUNTRY-PAYS

GUINEE

GUINEE-BISSAU

RIVER-FLEUVE (REF)

STATION

CODE

MAP NUMBER-NUMERO DE REFERENCE

LATITUDE N

LONGITUDE E

TOTAL DRAINAGE AREA-SUPERFICIE

TOTALE DU BASSIN (km^2)

DRAINAGE AREA AT STATION-

SUPERFICIE A LA STATION (km^2)

DISTANCE TO MOUTH-DISTANCE

A L'EMBOUCHURE (km)

STATION ALTITUDE-ALTITUDE

DE LA STATION (m)

WATER DISCHARGE-DEBIT

$\text{m}^3 \cdot \text{s}^{-1}$ ($10^{-1} \cdot \text{km}^{-2}$)

I

II

III

IV

V

VI

VII

VIII

IX

X

XI

XII

ANNUAL MEAN-MOYENNE ANNUELLE

OBSERVATION PERIOD-

PERIODE D'OBSERVATION

COUNTRY-PAYS

SIERRA-LEONE

SIERRA-LEONE

RIVER-FLEUVE (REF)

Kolente

Kaba

STATION

CODE

MAP NUMBER-NUMERO DE REFERENCE

LATITUDE N

LONGITUDE E

TOTAL DRAINAGE AREA-SUPERFICIE

TOTALE DU BASSIN (km²)

DRAINAGE AREA AT STATION-

SUPERFICIE A LA STATION (km²)

DISTANCE TO MOUTH-DISTANCE

A L'EMBOUCHURE (km)

STATION ALTITUDE-ALTITUDE

DE LA STATION (m)

WATER DISCHARGE-DEBIT

m³.s⁻¹ (l.s⁻¹.km⁻²)

I

II

III

IV

V

VI

VII

VIII

IX

X

XI

XII

ANNUAL MEAN-MOYENNE ANNUELLE

OBSERVATION PERIOD-

COUNTRY-PAYS

SIERRA LEONE

SIERRA LEONE

RIVER-FLEUVE (REF)

Sewa

Moa

STATION
CODE

HAP NUMBER-NUMERO DE REFERENCE

LATITUDE N

LONGITUDE E

TOTAL DRAINAGE AREA-SUPERFICIE

TOTALE DU BASSIN (km²)

DRAINAGE AREA AT STATION-

SUPERFICIE A LA STATION (km²)

DISTANCE TO MOUTH-DISTANCE

A L'EMBOUCHURE (km)

STATION ALTITUDE-ALTITUDE

DE LA STATION (m)

WATER DISCHARGE-DEBIT

m³.s⁻¹ (l.s⁻¹.km⁻²)

I

II

III

IV

V

VI

VII

VIII

IX

X

XI

XII

ANNUAL MEAN-MOYENNE ANNUELLE

OBSERVATION PERIOD-

PERIODE D'OBSERVATION

COUNTRY-PAYS

LIBERIA

LIBERIA

RIVER-FLEUVE (REF)

Cess

Cavally

STATION

CODE

MAP NUMBER-NUMERO DE REFERENCE

LATITUDE N

LONGITUDE E

TOTAL DRAINAGE AREA-SUPERFICIE

TOTALE DU BASSIN (km²)

DRAINAGE AREA AT STATION-

SUPERFICIE A LA STATION (km²)

DISTANCE TO MOUTH-DISTANCE

A L'EMBOUCHURE (km)

STATION ALTITUDE-ALTITUDE

DE LA STATION (m)

WATER DISCHARGE-DEBIT

m³.s⁻¹ (l.s⁻¹.km⁻²)

I

II

III

IV

V

VI

VII

VIII

IX

X

XI

XII

ANNUAL MEAN-MOYENNE ANNUELLE

OBSERVATION PERIOD-

COUNTRY-PAYS	COTE D'IVOIRE		COTE D'IVOIRE	
RIVER-FLEUVE (REF)	Davo		Bandama	
STATION CODE	Dakpadou		Tiassalé AA 45	Br1 AA
MAP NUMBER-NUMERO DE REFERENCE				
LATITUDE N			5° 53' N	6° 00'
LONGITUDE E			4° 49' W	4° 25'
TOTAL DRAINAGE AREA-SUPERFICIE TOTALE DU BASSIN (km ²)			2100	000
DRAINAGE AREA AT STATION- SUPERFICIE A LA STATION (km ²)	6 600		94 250	59
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)			≈ 100	
STATION ALTITUDE-ALTIUDE DE LA STATION (m)	71,82		13	3
WATER DISCHARGE-DEBIT m ³ .s ⁻¹ (l.s ⁻¹ .km ⁻²)				
I	4,45 (0,7)		60,0 (0,6)	47,
II	5,50 (0,8)		(42,8) (0,5)	24,
III	16,50 (2,5)		32,7 (0,3)	18,
IV	28,40 (4,3)		30,0 (0,3)	27,
V	93,60 (14,2)		49,7 (0,5)	42,
VI	88,50 (13,4)		199,0 (2,1)	105,
VII	19,60 (3,0)		83,0 (0,9)	195,
VIII	8,38 (1,3)		25,3 (0,3)	423,
IX	4,28 (0,6)		73,7 (0,8)	1020,
X	19,80 (3,0)		67,3 (0,7)	1010,
XI	33,20 (5,0)		62,0 (0,7)	369,
XII	10,10 (1,5)		15,1 (0,2)	123,
ANNUAL MEAN-MOYENNE ANNUELLE	27,7 4,2		61,7 (0,7)	285
OBSERVATION PERIOD- PERIODE D'OBSERVATION	1978		1978	195

COUNTRY-PAYS	TOGO	
RIVER-FLEUVE (REF)	Haho	
STATION CODE	Tatatou AA 1730	
NAP NUMBER-NUMERO DE REFERENCE		
LATITUDE N	07° 01' N	07° 01'
LONGITUDE E	01° 32' E	01° 01'
TOTAL DRAINAGE AREA-SUPERFICIE TOTALE DU BASSIN (km ²)	22 000	
DRAINAGE AREA AT STATION-SUPERFICIE A LA STATION (km ²)	20 100	9
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)		
STATION ALTITUDE-ALTITUDE DE LA STATION (m)	59	
WATER DISCHARGE-DEBIT m ³ .s ⁻¹ (l.u. ⁻¹ .km ⁻²)		
I	2,51 (0,1)	0,0
II	1,14 (0,1)	0
III	2,03 (0,1)	0,0
IV	4,03 (0,2)	0,0
V	8,52 (0,4)	0,1
VI	54,70 (2,7)	0,7
VII	195 (9,5)	49,8
VIII	304 (14,8)	141
IX	438 (21,4)	211
X	257 (12,5)	104
XI	53,10 (2,6)	7,8
XII	9,46 (0,5)	0,5
ANNUAL MEAN-MOYENNE ANNUELLE	110,8 (5,4)	42,9
OBSERVATION PERIOD-	1951-19	197

COUNTRY-PAYS	GHANA		GHANA	
RIVER-FLEUVE (REF)	Pra		Volta	
STATION CODE	Dabonasi AA 1530		Sanchi (Ha AA 0601	
MAP NUMBER-NUMERO DE REFERENCE				
LATITUDE N	05° 08' N		06° 12' N	
LONGITUDE E	01° 39' W		00° 06' E	
TOTAL DRAINAGE AREA-SUPERFICIE TOTALE DU BASSIN (km ²)			398 371	
DRAINAGE AREA AT STATION- SUPERFICIE A LA STATION (km ²)	22 710		394 100	
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)				
STATION ALTITUDE-ALTITUDE DE LA STATION (m)	0,1		6	
WATER DISCHARGE-DEBIT m ³ .s ⁻¹ (l.s ⁻¹ .km ⁻²)				
I	25,50 (3,3)	32,3 (1,4)	100 (0,3)	21
II	115,98 (5,1)	31,2 (1,4)	55 (0,1)	23
III	198,68 (8,2)	35,8 (1,6)	43 (0,1)	22
IV	440,05 (19,4)	81,4 (3,6)	48 (0,1)	24
V	527,52 (23,2)	144,2 (6,4)	110 (0,3)	24
VI	310,45 (13,7)	235,1 (10,4)	380 (1,0)	28
VII	361,89 (15,9)	329,9 (14,5)	920 (2,3)	32
VIII	560,84 (25,0)	189,1 (8,3)	1870 (4,7)	144
IX	415,27 (18,3)	284,2 (12,5)	4930 (12,5)	257
X	260,57 (11,5)	281,0 (12,4)	5120 (13,0)	147
XI	121,23 (5,3)	184,0 (8,1)	1310 (3,3)	37
XII	71,37 (3,1)	81,5 (3,0)	240 (0,6)	31
ANNUAL MEAN-MOYENNE ANNUELLE	288,8 (12,7)	159,6 (7,0)	1260 (3,2)	66
OBSERVATION PERIOD- PERIODE D'OBSERVATION	1954-1968	1973-1975	1936-1963	14

COUNTRY-PAYS	BENIN (Dahomey)		BENIN (Dahomey)	
RIVER-FLEUVE (REF)	Mono		Ouémé	
STATION CODE	Athiémá		Sagon AA 2721	Pont d AA 28
MAP NUMBER-NUMERO DE REFERENCE				
LATITUDE N	6° 35' N		07° 10' N	08° 00'
LONGITUDE E	1° 40' E		02° 26' E	02° 25'
TOTAL DRAINAGE AREA-SUPERFICIE TOTALE DU BASSIN (km ²)	22 000		50 000	
DRAINAGE AREA AT STATION- SUPERFICIE A LA STATION (km ²)	21 200		37 980	24 800
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)				
STATION ALTITUDE-ALTITUDE DE LA STATION (m)	50		7	100
WATER DISCHARGE-DEBIT m ³ .s ⁻¹ (l.s ⁻¹ .km ⁻²)				
I	3,21	(0,2)	10,90 (0,3)	1,50
II	2,79	(0,1)	4,64 (0,1)	0,24
III	6,77	(0,3)	3,42 (0,1)	0,23
IV	4,13	(0,2)	4,33 (0,1)	0,47
V	7,09	(0,3)	9,64 (0,3)	1,14
VI	50,70	(2,4)	47,90 (1,3)	23,60
VII	155	(7,3)	175 (4,6)	129
VIII	294	(13,9)	430 (11,3)	400
IX	351	(16,6)	663 (17,5)	660
X	289	(13,6)	591 (15,6)	405
XI	69	(3,3)	205 (5,4)	76,10
XII	11,30	(0,5)	40,10 (1,1)	8,78
ANNUAL MEAN-MOYENNE ANNUELLE	104 (4,9)		182 (4,8)	144
OBSERVATION PERIOD-	1944-1955		1973	1942-

COUNTRY-PAYS	NIGERIA			
RIVER-FLEUVE (REF)	NIGER			
STATION CODE				ABOH
MAP NUMBER - NUMERO DE REFERENCE				
LATITUDE N				05° 32' N
LONGITUDE E				06° 31' E
TOTAL DRAINAGE AREA - SUPERFICIE TOTALE DU BASSIN (km ²)	1091 000			
DRAINAGE AREA AT STATION SUPERFICIE A LA STATION (km ²)	(2090 000 (#))			1.125400
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)				
STATION ALTITUDE - ALTITUDE DE LA STATION (m)				5,46
WATER DISCHARGE - DEBIT m ³ s ⁻¹ (l.s. -1 km ⁻²)				
I	14575	(13.4)	1460	(1.3)
II	14575	(13.4)	1164	(1.0)
III	11903	(10.9)	1012	(0.9)
IV	7120	(6.5)	1570	(1.4)
V	2815	(2.6)	1514	(1.3)
VI	1061	(1.0)	1965	(1.7)
VII	979	(0.9)	4106	(3.6)
VIII	4100	(3.8)	6739	(6.0)
IX	9160	(8.4)	12645	(11.2)
X	10567	(9.7)	15400	(13.7)
XI	11822	(10.8)	5453	(4.8)
XII	13321	(12.2)	1972	(1.8)
ANNUAL MEAN - MOYENNE ANNUELLE OBSERVATION PERIOD - PERIODE D'OBSERVATION	8500	(7.8)	4584	(4.1)
			1977-1978	

COUNTRY-PAYS	CAMEROUN		CAMEROUN
RIVER-FLEUVE (REF)	Sanaga		Nyong
STATION	Edéa		Olama
CODE	BA 03		BA 1312
MAP NUMBER-NUMERO DE REFERENCE	-		-
LATITUDE N	03°46' N		03°26' N
LONGITUDE E	10°04' E		11°17' E
TOTAL DRAINAGE AREA-SUPERFICIE TOTALE DU BASSIN (km ²)	135 000		18 510
DRAINAGE AREA AT STATION- SUPERFICIE A LA STATION (km ²)	135 000		
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)	-		
STATION ALTITUDE-ALTITUDE DE LA STATION (m)	12		628
WATER DISCHARGE-DEBIT m ³ .s ⁻¹ (l.s ⁻¹ .km ⁻²)			
I	842 (6,2)	122,0 (6,0)	112
II	546 (4,0)	71,7 (3,9)	50
III	481 (3,6)	65,0 (3,5)	59
IV	618 (4,6)	120,0 (6,5)	88
V	925 (6,9)	165,0 (8,9)	129
VI	1330 (9,9)	137,0 (7,4)	155
VII	2040 (15,1)	165,0 (8,9)	144
VIII	2770 (20,5)	118,0 (6,4)	113
IX	4450 (33,0)	136,0 (7,3)	147
X	5630 (41,7)	360,0 (19,8)	271
XI	3490 (25,9)	546,0 (29,5)	360
XII	1430 (10,6)	313,0 (16,9)	238
ANNUAL MEAN-MOYENNE ANNUELLE	2060 11,72	194,4 10,5	150
OBSERVATION PERIOD- PERIODE D'OBSERVATION	1944-1971		1975 19

COUNTRY-PAYS	GABON	GABON
RIVER-FLEUVE (REF)	Como (= Komo)	Ogooué
STATION CODE		Lambaréné Bs 00
MAP NUMBER-NUMERO DE REFERENCE		
LATITUDE N		06°41' S
LONGITUDE E		10°14' E
TOTAL DRAINAGE AREA-SUPERFICIE TOTALE DU BASSIN (km ²)		205 000
DRAINAGE AREA AT STATION- SUPERFICIE A LA STATION (km ²)		203 500
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)		
STATION ALTITUDE-ALTITUDE DE LA STATION (m)		9
WATER DISCHARGE-DEBIT m ³ .s ⁻¹ (l.s ⁻¹ .km ⁻²)		
I		4850 (23,8)
II		4332 (21,3)
III		4887 (24,0)
IV		6030 (29,7)
V		6646 (32,7)
VI		4375 (21,5)
VII		2705 (13,3)
VIII		1990 (9,8)
IX		1943 (9,5)
X		4260 (20,9)
XI		7930 (39,0)
XII		7140 (35,1)
ANNUAL MEAN-MOYENNE ANNUELLE		4758 23,4
OBSERVATION PERIOD		1929-1974
REMARKS-REMARQUES		1929-1971

COUNTRY-PAYS	ZAIRE		ANGOLA
RIVER-FLEUVE (REF)	Zaire		Cuanza
STATION	Banana		Cambambe
CODE			BA 49
MAP NUMBER-NUMERO DE REFERENCE			
LATITUDE N			09° 45' S
LONGITUDE E			14° 29' E
TOTAL DRAINAGE AREA-SUPERFICIE TOTALE DU BASSIN (km ²)	3 822 020		155 000
DRAINAGE AREA AT STATION- SUPERFICIE A LA STATION (km ²)	3 822 020		
DISTANCE TO MOUTH-DISTANCE A L'EMBOUCHURE (km)			
STATION ALTITUDE-ALTITUDE DE LA STATION (m)			187
WATER DISCHARGE-DEBIT m ³ .s ⁻¹ (l.s ⁻¹ .km ⁻²)			
I	48 378 (12,7)	52 794 (13,8)	
II	37 411 (9,8)	42 020 (11,0)	
III	32 245 (8,4)	39 326 (10,3)	
IV	38 534 (10,1)	41 481 (10,9)	
V	40 762 (10,7)	43 097 (11,3)	
VI	36 183 (9,5)	40 404 (10,6)	
VII	31 716 (8,3)	35 017 (9,2)	
VIII	30 660 (8,0)	35 017 (9,2)	
IX	34 631 (9,1)	40 942 (10,9)	
X	42 127 (11,0)	49 023 (12,8)	
XI	54 125 (14,2)	58 181 (15,2)	
XII	59 071 (15,5)	61 414 (16,1)	
ANNUAL MEAN-MOYENNE ANNUELLE	40 684 10,6	44 893 11,7	836
OBSERVATION PERIOD- PERIODE D'OBSERVATION	1950-1959		1958-1968

ANNEX IV

CATLOGUE DE LA QUALITE DES FLEJVES PAR PAYS
CATALOGUE OF RIVER QUALITY BY COUNTRY

Only rivers for which data were
available in January 1981 are
listed.

COUNTRY-PAYS: GHANA
 STATION: Kpong
 DRAINAGE AREA-
 SUPERFICIE DU BASSIN (km²): 394 151

RIVER-FLEUVE: Volta
 CODE: (06° 10' N, 00° 05' E)
 DISTANCE TO MOUTH-
 DISTANCE A L'EMBOUCHEURE (km): 96

SAMPLING PERIOD-PERIODE D'ECHANTILLONNAGE: 1970-1974

	AVERAGE CONTENT CONCENTR. MOYENNE		VARIATION		NO. OF SAMPLE NO. D'ECHANTI.	
	Min.	Max.	Min.	Max.		
BLACK LIST-LISTE NOIRE	Kpong (70-74)	Sogakopé (75)	Kpong (70-74)	Sogakopé (75)	Kpong (70-74)	Sogako (75)
AS MG/M3						
EG MG/M3						
PH MG/M3						
CD MG/M3						
PCB MG/M3						
ORG. CHLOR. C. MG/3						
GREY LIST-LISTE GRISE						
ORTHO P MG/L						
N-NO ₃ MG/L	0,004	0,104	0,0	0,23	0,03	0,18
N-NO ₂ MG/L	0,000		0,0	0,04		
N-NH ₄ ⁺ MG/L	0,147		0,0	0,73		
N _x MG/L						
TOTAL N MG/L						
Cu MG/M3						
Cr MG/M3						
Ni MG/M3						
Zn MG/M3						
Fe						
Mn						
BOD5-DBO ₅ MG/L						
COD-DCO ₅ MG/L						
PERMANG. VALUE MG/L						
C ORG MG/L						
DETERGENT MG/L						
PHENOLS MG/L						
MIN. OILS-						
SUILES MIN. MG/L						
MISCELLANEOUS-DIVERS						
Na ⁺ MG/L					3,0	9,2
Cl ⁻ MG/L					0,0	4,96
SO ₄ ⁻ MG/L		Nil				
F ⁻ MG/L						
SiO ₂ MG/L						
COND. MICRO S.					60	180
RICE OYYS MG/L	60		3	5	8	0

COUNTRY-PAYS: CAMEROUN
 STATION: Nelong
 DRAINAGE AREA-
 SUPERFICIE DU BASSIN (km²): 2250

RIVER-FLEUVE: Nkam
 CODE: BA 0500
 DISTANCE TO MOUTH-
 DISTANCE A L'EMBOUCHEURE (km):

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SAMPLING PERIOD-PERIODE D'ECHANTILLONNAGE: Mar. 1974 & Jan. 1975
 (1 sample each year - 1 prelevement chaque année)

	AVERAGE CONTENT CONCENTR. MOYENNE		VARIATION MIN. MAX.		NO. OF SAMPLES NO. D'ECHANTILLONNAGE
BLACK LIST-LISTE NOIRE					
AS MG/M3					
EG MG/M3					
PB MG/M3					
CD MG/M3					
PCB MG/M3					
ORG.CELOR.C.MG/3					
GREY LIST-LISTE GRISE					
ORTHO P MG/L					
N-NO ₃ MG/L					
N-NO ₂ MG/L					
N-NH ₄ ⁺ MG/L					
N _x MG/L					
TOTAL N MG/L					
Cu MG/M3					
Cr MG/M3					
Ni MG/M3					
Zn MG/M3					
Fe --	0,37		0,14	0,60	2
Mn					
BOD ₅ -DBO ₅ MG/L					
COD-DCO ₅ MG/L					
PERMANG.VALUE MG/L					
C ORG MG/L					
DETERGENT MG/L					
PHENOLS MG/L					
MIN.OILS-					
HUILES MIN. MG/L					
MISCELLANEOUS-DIVERS					
Na ⁺ MG/L	3,2		3,2	3,2	2
Cl ⁻ MG/L	0,5		0	1,1	2
SO ₄ ⁻ MG/L	0,2		0	0,5	2
F ⁻ MG/L					
SiO ₂ MG/L	16,37		16,0	17,75	2
COND. MICRO S.	45		33	57	2
DISS.OXYG.MG/L					
TEMPERATURE (C)					

COUNTRY-PAYS: CAMEROUN
 STATION: YAOUNDÉ
 DRAINAGE AREA-
 SUPERFICIE DU BASSIN (km²): 76 950

RIVER-FLEUVES: SANAGA
 CODE: BA 2432
 DISTANCE TO MOUTH-
 DISTANCE A L'EMBOUCHEURE (km):

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SAMPLING PERIOD-PERIODE D'ECHANTILLONNAGE: Mar. 1973 - Oct. 1974

	AVERAGE CONTENT CONCENTR. MOYENNE		VARIATION		NO. OF SAMPLES NO. D'ECHANTILLON
	MIN.	MAX.	MIN.	MAX.	
BLACK LIST-LISTE NOIRE					
AS MG/M3					
EG MG/M3					
FB MG/M3					
CD MG/M3					
PCB MG/M3					
ORG. CHLOR. C. MG/3					
GREY LIST-LISTE GRISE					
ORTEO P MG/L					
N-NO ₂ MG/L					
N-NO ₃ MG/L					
N-NH ₄ ⁺ MG/L					
N _x MG/L					
TOTAL N MG/L					
Cu MG/M3					
Cr MG/M3					
Ni MG/M3					
Zn MG/M3					
Fe	0,78		0,21	1,78	20
Mn					
BOD ₅ -BOD ₅ MG/L					
COD-DCO MG/L					
PERMANG. VALUE MG/L					
C ORG MG/L					
DETERGENT MG/L					
PEENOLS MG/L					
MIN. OILS-					
BUTILES MIN. MG/L					
MISCELLANEOUS-DIVERS					
Na ⁺ MG/L	2,0		0,46	2,30	20
Cl ⁻ MG/L	0,7		0,35	1,20	20
SO ₄ ⁻ MG/L	0,9		0,48	1,50	20
F ⁻ MG/L					
SiO ₂ MG/L	14,4		11,4	16,6	20
COND. MICRO S.	32,3		21	37	20
DISS. OXYG MG/L					

COUNTRY-PAYS: CAMEROUN
 STATION: M'BALMAYO
 DRAINAGE AREA-
 SUPERFICIE DU BASSIN (km²): 13.555

RIVER-FLEUYE: Nyong
 CODE: BA 1333
 DISTANCE TO MOUTH-
 DISTANCE A L'EMBOUCHEURE (km):

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SAMPLING PERIOD-PERIODE D'ECHANTILLONNAGE: Mar.1973 - Oct.1974

	AVERAGE CONTENT CONCENTR. MOYENNE		VARIATION MIN. MAX.		NO. OF SAMPLES NO. D'ECHANTILLONS
BLACK LIST-LISTE NOIRE					
AS MG/M3					
EG MG/M3					
FE MG/M3					
CD MG/M3					
PCB MG/M3					
ORG.CELOR.C.MG/3					
GREY LIST-LISTE GRISE					
ORTEO P MG/L					
N-NO ₃ MG/L					
N-NO ₂ MG/L					
N-NH ₄ ⁺ MG/L					
N _x MG/L					
TOTAL N MG/L					
Cu MG/M3					
Cr MG/M3					
Hg MG/M3					
Zn MG/M3					
Fe	0,90		0,58	1,34	9
Mn					
BOD5-DBO ₅ MG/L					
COD-DCO ⁵ MG/L					
PERMANG.VALUE MG/L					
C ORG MG/L					
DETERGENT MG/L					
PHENOLS MG/L					
MIN.OILS- HUILES MIN. MG/L					
MISCELLANEOUS-DIVERS					
Na ⁺ MG/L	1,1		0,69	1,40	9
Cl ⁻ MG/L	0,46		0,35	7,10	9
SO ₄ ⁻ MG/L	0,08		0,05	0,19	9
F ⁻ MG/L					
SiO ₂ MG/L	7,0		6,6	8,4	9
COND. MICRO S.	20		15	26	8
DISS.OXIG.MG/L					

COUNTRY-PAYS: ZAIRE
 STATION:
 DRAINAGE AREA-
 SUPERFICIE DU BASSIN (km²):

RIVER-FLEUVE: ZAIRE
 CODE:
 DISTANCE TO MOUTH-
 DISTANCE A L'EMBOUCHEURE (km):

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SAMPLING PERIOD-PERIODE D'ECHANTILLONNAGE:

	AVERAGE CONTENT CONCENTR MOYENNE			VARIATION MIN. MAX.		NO. OF SAMPLES NO. D'ECHANTILLONS
	Nov. 76	Eté 1970	1978-79			
BLACK LIST-LISTE NOIRE						
AS MG/M3						
BC MG/M3						
FB MG/M3						
CD MG/M3						
PCB MG/M3						
ORG.CHLOR.C.MG/3						
GREY LIST-LISTE GRISE						
ORTEO P MG/L						
N-NO ₃ MG/L		0,022				
N-NO ₂ MG/L		0,001				
N-NH ₄ ⁺ MG/L		0,006				
N _T MG/L						
TOTAL N MG/L						
Cu MG/M3		0,3				
Cr MG/M3						
Ni MG/M3						
Zn MG/M3						
Pb MG/L		0,250	0,89			
Mn MG/M3		8,3				
BOD5-DEC ₅ MG/L						
CCD-DCO ₂ MG/L						
PERMANG.VALUE MG/L						
C ORG MG/L						
DETERGENT MG/L						
PHENOLS MG/L						
MIN.OILS- HUILES MIN. MG/L						
MISCELLANEOUS-DIVERS						
Na ⁺ MG/L	0,96	1,70	1,91			
Cl ⁻ MG/L	1,30	2,85	2,36			
SO ₄ ⁻ MG/L		2,95				
F ⁻ MG/L						
SiO ₂ MG/L	9,60	9,80	24,2			
COND. MICRO S.						

ANNEX V

CATALOGUE DES DEBITS SOLIDES DES FLEUVES

CATALOGUE OF RIVER SEDIMENT DISCHARGE

Only those rivers are listed for
which data were available in
January 1981.

COUNTRY-PAYS	SENEGAL	
RIVER-FLEUVE	Gambia	Gambia
STATION	Goulombo	Kedougou
CODE		
DRAINAGE AREA- (km^2) SUPERFICIE DU BASSIN	13°28'N 13°62'W	12°34'N 12°11'W
DISTANCE TO MOUTH- (km^2) DISTANCE A L'EMBOUCHURE		
STATION ALTITUDE- (m) ALTITUDE DE LA STATION		
AVERAGE MONTHLY LOAD- CHARGE MOYENNE MENSUELLE (10^6 kg/month)(10^6 kg.mois ⁻¹)		
I	-	
II	-	
III	-	
IV	-	
V	-	
VI	(9,5)	(0,4)
VII	110	30
VIII	100	101,5
IX	157,2	40,1
X	144,5	(26,8)
XI	(20,7)	
XII	-	-
ANNUAL LOAD-CHARGE ANNUELLE (10^9 kg/year)(10^9 kg.an ⁻¹)	0,65 en 1974	0,2 en 1974
SPECIFIC TRANSPORT (T/ km^2 /year)(t.km ⁻² .an ⁻¹)		
AVERAGE SUSPENDED MATTER- CONCENTR. MOYENNE EN SUSPENSION (mg.l ⁻¹)		
I		
II		
III		
IV		
V		
VI		
VII		

COUNTRY-PAYS	CAMEROUN	
RIVER-FLEUVE	Senaga	
STATION	Nachtigal	
CODE	4°21'N 11°38'	
DRAINAGE AREA- (km ²) SUPERFICIE DU BASSIN	77 000	
DISTANCE TO MOUTH- (km ²) DISTANCE A L'EMBOUCHURE		
STATION ALTITUDE- (m) ALTITUDE DE LA STATION	425 909	
AVERAGE MONTHLY LOAD- CHARGE MOYENNE MENSUELLE (10 ⁶ kg/month)(10 ⁶ kg.mois ⁻¹)		
I	13	
II	3,6	
III	2,3	
IV	4,9	
V	16	
VI	123	
VII	468	
VIII	563	
IX	440	
X	429	
XI	214	
XII	54	
ANNUAL LOAD-CHARGE ANNUELLE (10 ⁹ kg/year)(10 ⁹ kg.an ⁻¹)	2,33	2,79 (1951-57)
SPECIFIC TRANSPORT (t/km ² /year)(t.km ⁻² .an ⁻¹)	30,3	36,2 (1951-57) Ref. (20)
AVERAGE SUSPENDED MATTER- CONCENTR. MOYENNE EN SUSPENSION (mg.l ⁻¹)		
I	6,5) début/	
II	-) beginning	
III	2,4) 1969	
IV	-	
V	15	
VI	89	
VII	145	

COUNTRY-PAYS	ZAIRE	
RIVER-FLEUVE	Zaire	Zaire
STATION	Boma	Brazzaville
CODE		
DRAINAGE AREA- (km^2) SUPERFICIE DU BASSIN	3 822 020	3 750 000
DISTANCE TO MOUTH- (km^2) DISTANCE A L'EMBOUCHEURE		
STATION ALTITUDE- (m) ALTITUDE DE LA STATION	1,90	
AVERAGE MONTHLY LOAD- CHARGE MOYENNE MENSUELLE (10^6 kg/month)(10^6 kg.mois ⁻¹)		1978 1979
I		5293,9 3512,4
II		2552,4 3065,9
III		- -
IV		- -
V		2442,7 -
VI		2638,6 -
VII		- -
VIII		- -
IX		- -
X		- -
XI		- -
XII		3544,9 -
ANNUAL LOAD-CHARGE ANNUELLE (10^9 kg/year)(10^9 kg.an ⁻¹)	54,0	35 à 40
SPECIFIC TRANSPORT (T/ km^2 /year)(t. km^{-2} .an ⁻¹)	14,1	10 à 11,5
AVERAGE SUSPENDED MATTER- CONCENTR. MOYENNE EN SUSPENSION (mg.l ⁻¹)		
I		40,0 25,6
II		27,7 26,3
III		- -
IV		- -
V		22,2 -
VI		24,9 -

ANNEX VI

APPORTS DES RIVIERES A LA COTE D'AFRIQUE DE L'OUEST
RIVER INPUTS TO THE WEST AFRICAN SEA

Essai de bilan des apports en eau des fleuves
aux mers d'Afrique de l'Ouest

Tentative budget of river water discharge to
the West African Sea

Apports en eau des fleuves aux mers d'Afrique de l'Ouest/
Budget of river water discharge to the West African Sea

FLEUVES ET REGION/ RIVERS AND REGION		SUPERFICIE DRAINEE/ DRAINAGE AREA A (10^3 km^2)	DEBIT SPECIFIQUE/ SPECIFIC RUNOFF q ($1. \text{s}^{-1} \cdot \text{km}^{-2}$)	DEBIT/ DISCHARGE Q ($\text{m}^3 \cdot \text{s}^{-1}$)
Sénégal	(1)	440	1.75	774
Sénégal to (au) Corubal	(2)	200	10	2000
Corubal to (au) Cavally	(2)	220	30	6750
Sassandra+Bandama+Como + Mono+Tano+Pra	(1)	295	4.9	1465
Cavally to (à la) Volta (remaining/restant)	(2)	100	5	500
Volta	(1)	394	3.2	1260
Ouemé	(1)	50	5.8	200
Volta to (au) Niger (remaining/restant)	(2)	135	8	1080
Niger	(1)	1125 (3)	7.8	8500
Cross	(1)	48	33.8	1500
Nkam+Sanaga+Nyong+Ntem +Ogoué+Nyanga	(1)	393	19.9	7834
Nkam to (au) Zaire (remaining/restant)	(2)	204	20	4080
Zaire	(1)	3822	10.6	40680
Cunene		83	2.6	215
Zaire to Cunene (remaining/restant)		423	5	2100
TOTAL		7980	10.1	80500
apports connus/known inputs		6650	9.4	62400
apports extrapolés/extra- polated inputs		1330	13.6	18100

(1) données connues/known data

(2) données extrapolées basées sur q/extrapolated data based on q

(3) la partie aréique du bassin n'est pas prise en compte/areic area not taken into account ($\approx 900 \text{ km}^2$)

ANNEX VII

LISTE DES INSTITUTIONS ET LABORATOIRES NATIONAUX EFFECTUANT LA
SURVEILLANCE DES FLEUVES ET DES ETUDES SUR LA QUALITE DES EAUX

LIST OF NATIONAL INSTITUTIONS AND LABORATORIES UNDERTAKING
RIVER MONITORING AND WATER QUALITY SURVEYS

- (State Administrations)
- Nigerian Institute for Oceanography and Marine Research
- Housing and Development
- Environmental Planning and Protection Division of the Ministry of
- Inland Waterways Department
- Federal Department of Water Resources

NIGERIA

- Nigerian Hydrological Service

LIBERIA

- The Environmental Protection Council of Ghana
- Institute of Aquatic Biology of the CSIR
- Industrial Research (CSIR)
- Water Resources Research Unit of the Council for Scientific and

GHANA

- Water Resources Department

GAMBIE/GAMBIA

- Laboratoire du bureau d'analyses du Ministère des mines
- La protection de la nature
- de la recherche scientifique de l'environnement et de
- Centre national anti-pollution (CNAF) de la direction générale
- Centre national de la recherche scientifique et technique

GABON

- ORSTOM, Centre d'Adiopo-Doume
- Direction de l'environnement industriel
- Centre de recherche océanographique
- Direction du drainage et assainissement
- Direction centrale de l'hydraulique

COTE D'IVOIRE/IVORY COAST

- Institut de recherche géologique et minière (IRGM)
- Sous-direction de l'assainissement du Ministère de la santé
- Ministère des mines et de la géologie

CAMEROON

- Direction de l'hydraulique
- Société beninoise d'eau et d'électricité (SBE)
- Société nationale d'irrigation et d'aménagement hydro-agricole
- Université nationale du Bénin (UNB)
- Direction du génie rural

BENIN

ANNEX VII

LISTE DES INSTITUTIONS ET LABORATOIRES NATIONAUX EFFECTUANT LA
SURVEILLANCE DES FLEUVES ET DES ETUDES SUR LA QUALITE DES EAUX

LIST OF NATIONAL INSTITUTIONS AND LABORATORIES UNDERTAKING
RIVER MONITORING AND WATER QUALITY SURVEYS

BENIN

- Direction de l'hydraulique
- Société beninoise d'eau et d'électricité (SBEE)
- Société nationale d'irrigation et d'aménagement hydro-agricole
- Université nationale du Bénin (UNB)
- Direction du génie rural

CAMEROON

- Institut de recherche géologique et minière (IRGM)
- Sous-direction de l'assainissement du Ministère de la santé
- Ministère des mines et de la géologie

COTE D'IVOIRE/IVORY COAST

- Direction centrale de l'hydraulique
- Direction du drainage et assainissement
- Centre de recherche océanographique
- Direction de l'environnement industriel
- ORSTOM, Centre d'Adiopo-Doumé

GABON

- Centre national de la recherche scientifique et technique
- Centre national anti-pollution (CNAP) de la direction générale de la recherche scientifique de l'environnement et de la protection de la nature
- Laboratoire du bureau d'analyses du Ministère des mines

GAMBIE/GAMBIA

- Water Resources Department

GHANA

- Water Resources Research Unit of the Council for Scientific and Industrial Research (CSIR)
- Institute of Aquatic Biology of the CSIR
- The Environmental Protection Council of Ghana

LIBERIA

- Liberian Hydrological Service

NIGERIA

- Federal Department of Water Resources
- Inland Waterways Department
- Environmental Planning and Protection Division of the Ministry of Housing and Development
- Nigerian Institute for Oceanography and Marine Research (State Administrations)

République Populaire

REPUBLIQUE POPULAIRE DU CONGO/PEOPLE'S REPUBLIC OF THE CONGO

- ORSTOM
- Laboratoire du service des mines
- Laboratoire national de la santé publique

SENEGAL

- Direction de l'hydraulique
- SONEES: Société nationale d'exploitation des eaux du Sénégal
- ORSTOM (Centre de Hann)
- Université de Dakar, Laboratoire de géologie, Institut des sciences de l'environnement

TOGO

- Direction de l'hydraulique
- Bureau national de recherche minière
- Direction du génie rural
- Direction de l'assainissement du Ministère de la santé
- ORSTOM

ZAIRE

- Département de l'environnement, conservation de la nature et tourisme, division de la gestion des ressources naturelles
- Laboratoire d'analyse des eaux de l'Université de Kinshasa

ANNEXE VIII

Localization of Major West and Central African Rivers Discharging into the Atlantic Ocean/Emplacement des fleuves de l'Afrique de l'ouest et du centre se jetant dans l'océan atlantique

Map 1 - General map of the study zone/Carte 1 - Totalité de la zone d'étude

Rivers/fleuves

1	Senegal	7	Sanaga
2	Gambia	8	Ogooué
3	Sassandra	9	Zaire
4	Bendama	10	Cuanza
5	Volta	11	Cunene
6	Niger		

Map 2 - From Senegal to Tano rivers/Carte 2 - Du Sénégal au Tano

1	Senegal	11	Bendama
2	Gambia	12	Comoé
3	Casamance	13	Bia
4	Geba	14	Tano
5	Corubal	15	Fra
6	Konkouré	16	Volta
7	Kolente	17	Haho
8	Mpé	18	Mono
9	Cavally	19	Cuémé
10	Sassandra		

Map 3 - From the Volta to the Cuanza rivers/Carte 3 - De la Volta au Cuanza

1	Volta	9	Ntem
2	Haho	10	Comoé
3	Mono	11	Ogooué
4	Cuémé	12	Nyanga
5	Niger	13	Kouilou
6	Cross	14	Zaire
7	Nkasa	15	Cuanza
8	Sanaga		





