

Figure S.10.4-4 Results of Taabo reservoir Operation (Water Level at the End of Month)

## **4.2 Reservoir Operation Study**

As the existing large and medium scale reservoirs except the hydropower have been operated without the operation rule and the reservoir water has not been used always to meet the water use for agriculture and urban water supply. Some reservoirs presents the empty or scarce water conditions at the dry season and their beneficial area suffers from water shortage problem. It is necessary to set up the reservoir operation rule for the existing and proposed medium and large dams. The reservoir operation study to set up the rule is to be carried out taking into account the following items;

### **4.2.1 Reservoir Inflow**

The discharge observation data of about 20 years in the recent years shall be used for the reservoir inflow. Old discharge data more than 20 years ago shall not be used for the reservoir operation study because such data are fairly changed as compared with the recent data due to the water use for the projects in the upstream basin in the past. Since small sub-basins will not have the observation discharge record, the inflow data will be reconstructed based on rainfall data, catchment area conditions, discharge data at adjoining basin, etc.

### **4.2.2 Water Demand**

Monthly irrigation water demand is to be estimated based on proposed cropping pattern and cropping area as well as unit irrigation requirement for different crops. In case of wet season crops such as paddy, the supplemental irrigation water will be estimated taking into account effective rainfall, while the full irrigation water will be required for the dry season crops.

Monthly domestic water demand also is to be estimated based on unit consumption water (lcd) and population.

### **4.2.3 Notice Notes for Reservoir Operation Study**

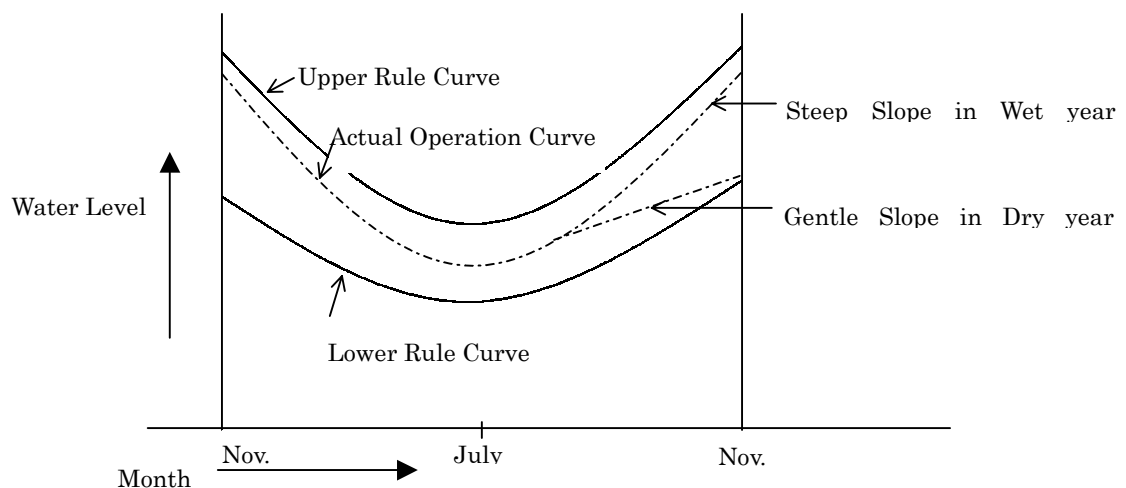
Items which have to take into account for the reservoir operation study are as follows;

- The reservoir will reach the full water level at the end of wet season from October to November and approach to the lowest water level at the beginning of wet season from June to July because the reservoir is to store a rich inflow during July to October and release it mainly in the dry season as well as in June to July at the beginning of the wet season crops.
- If the reservoir water level does not reach the full water level at the end of November, the proposed irrigation area can't be fully irrigated and will be reduced depending on the available reservoir water at the end of November

- The carrying over capacity in the reservoir to supplement the small reservoir inflow in next dry year will be estimated also by the operation study.
- The flood control to store the peak flood discharge occurred during August and September shall be studied. The upper rule curve will be set up based on the reservoir operation for flood control, while the lower rule curve prepared based on the scarce runoff in the dry year.
- As for the small scale reservoir, it will be not necessary to carry out the detailed reservoir operation study but prepare the reservoir operation guideline.

#### 4.2.4 Reservoir Operation Practice

The reservoir operation practice shall be done monitoring the reservoir inflow, flood, variation of reservoir water level, outflow, etc. Reservoir shall be operated so as to place the fluctuated water level between the upper and lower rule curve.



When the actual operation curve shows the steep slope than the upper and lower curve, it is judged that the reservoir is operated with the wet year pattern and will reach the full water level at the end of wet season. Contrary the gentle slope shows the operation with the dry year pattern and the reservoir will not reach the full water level at the end of wet season.

#### 4.2.5 Guideline for Study on Reservoir Plan

Many reservoir dams will be planned and constructed for the water use in agriculture and domestic and industrial water supply and hydropower. It is useful in the reservoir plan and reservoir water use to set up the following guideline.

##### (1) Standard Yield for Reservoir Inflow

The standard yield for the reservoir inflow on average year is evaluated as follows, based on the hydrological analysis in the control points and sub-basin. The average inflow in the wet and dry season is estimated easily by multiplication of the catchment area and runoff yield. For example, average inflow for the catchment area of 100sqkm and runoff yield of 200 mm is estimated at 20 MCM.

**Table S.10.4-1 Runoff Yield in Major Sub-Basin**

River Basin		Runoff Yield			River Basin		Runoff Yield		
		Wet	Dry	Total			Wet	Dry	Total
1. Sassandra				3. Comoe					
Upper Basin		200	20	220	Upper Basin		87	1	88
Middle Basin		165	15	180	Lower Basin		44	1	45
N'zo		330	30	360	4. Bani-Niger				
Bafingo		265	40	305	Baoule		158	5	163
2. Bandama				Kankelaba		118	3	121	
Upper Basin		72	3	75	Bagoé		156	6	162
Marahoué		87	3	90	5. San Pedro				
Upper							216	95	311
Marahoué		100	5	105	6. Agneby		28	3	31
Middle					7. Bia				
N'zi Upper		50	2	52			95	15	110
N'zi Lower		51	3	54	8. Me		208	22	230

As is clear in the above table, the dry season yield in the Bandama, Comoe, Bani-Niger is extremely small as only 1 to 5 mm. The water use in the dry season in those river basin, therefore requires the reservoir with a large capacity. As the Sassandra has some runoff yield of 15 to 40 mm even in the dry season. The reservoir capacity for the dry season water use could be small as compared with that of the Bandama and Comoe. Agneby river basin shows the low runoff yield in the wet and dry season, because many water uses for agriculture and water supply have been made in the river basin. There is no more water resources development in the Agneby basin.

**(2) Proper Active Reservoir Capacity for Agriculture**

The proper active reservoir capacity in the small and medium scale dam for agricultural purpose is estimated at 80 to 100% of average inflow in the wet season taking into account the following conditions;

- Wet season inflow in the dry year with a return period of once to 5 years is assumed at 70 to 80% of the average year's inflow. Reservoir capacity shall be planned so as to have the carrying over capacity equivalent to 20~30% of average wet season inflow in order to recover the less inflow in the dry year.
- A part of wet season inflow will be used for supplemental irrigation for the wet season crops and released to the beneficial area without storage. This supplemental water use

quantity is reduced from the average wet season inflow in the estimation of reservoir capacity. This supplemental water quantity is assumed at about 30 to 40% of the average runoff in the wet season.

**(3) Rainfall and Evaporation on Reservoir Area**

Rainfall on the reservoir surface area is considered as the reservoir water, while 80 to 90% of the pan evaporation value against the reservoir area as the reservoir losses.

**(4) Reach Time of High Water and Low Water Level**

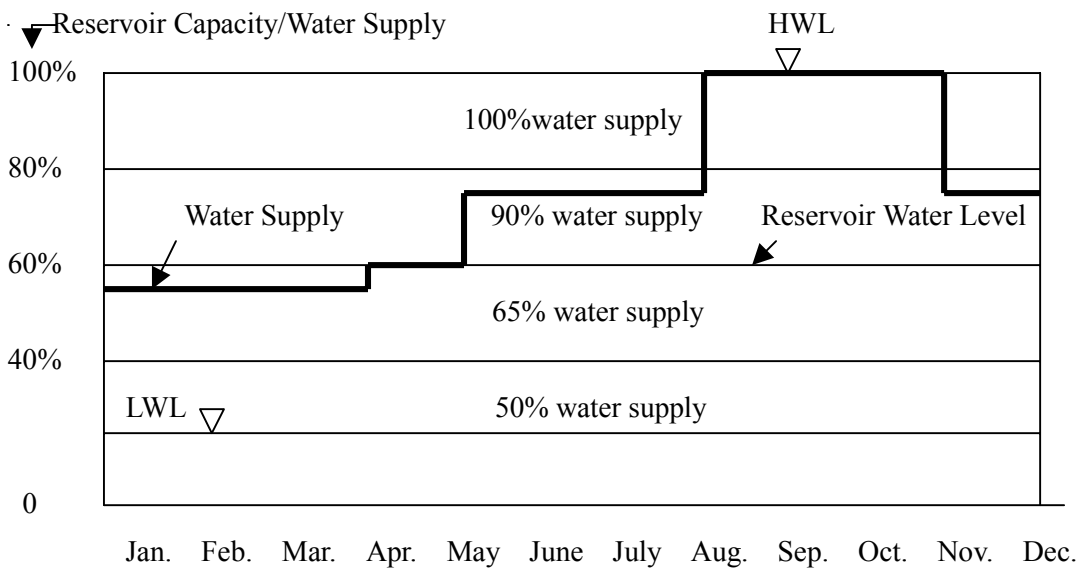
Reservoir will be operated generally so as to reach the high water level at the end of wet season (November) by rich wet season inflow and the low water level at the end of dry season (May). In case the reservoir does not reach near the full water level at the end of wet season, the irrigation area to be proposed in the next dry season shall be reduced in accordance with the available reservoir capacity at the end of wet season.

**(5) Probability D.P. Method for Preparation of the Proper Reservoir Rule**

According to our experience, it is a practical method to prepare the operation rule by “Probability DP(Dynamic Program) Method”

Basic consideration of the Probability DP Method is preparing the reservoir operation rules which would be reached to the lowest drought damage through the reservoir operating term. The solution of this method could be obtained by probability analysis and trial / error method based on actual observation hydrological data.

Moreover, the solution would be probably indicated as following figure.



## **CHAPTER5 Criteria and Manual**

### 5.1 Criteria and manual for River Works

The contents of the criteria and manual for river works are as shown in Table S.10.5-1,2,3.

### 5.2 Manual for Water Right

The contents of the manual for water right are as shown in Table S.10.5-4.

Table S.10.5-1 Preparation of “Criteria and Manual for River Works - Survey -”

Item	Contents
① Investigation of precipitation	Network • Location of gauging stations/ Equipment/ Observation/ Summary of data
② Investigation of water level / discharge	Network • Location of gauging station/ Staff-gauge/ Equipment/ Observation/ Summary of data/ Measurements of discharge/ Data arrangement
③ Hydrological statistic	Collection and arrangement of data/ Supplementation for missing data/ Probability analysis(return period)/ Correlation analysis/ Correlogram analysis (time series correlation)
④ Run-off analysis	<u>Flood run-off calculation</u> : Rational formula/Unit-hydrograph Storage function/ Tank model/ Equivalent roughness/ Run-off function methods <u>Law water run-off calculation</u> : Tank model method <u>Flood routing</u>
⑤ Roughness coefficient/ Water level analysis	<u>Roughness coefficient</u> : <u>Water level analysis</u> : Uniform flow/ Non-uniform flow/ Unsteady flow Circulation • balance of groundwater .
⑥ Groundwater survey	Wave/ River mouth water level • discharge/ Tidal level/
⑦ River-mouth survey	Littoral drift sand/ Bottom material/ Water quality/ Wind/ etc.
⑧ Sediment yield and transport surveys	River bed fluctuation/ Sediment transportation/ River bed material surveys
⑨ Coastal survey	Wave/ Current/ Sounding/ Littoral drift sand/ Tidal surveys
⑩ Water quality and bed material survey	Water quality/ Bottom deposit/ Groundwater quality/ Pollution source etc. surveys
⑪ Soil exploration and geological survey	Soil exploration for levees/ Investigation for river structures/ Geological survey for dams/ Site reconnaissance/ Seismic prospecting/ Electric prospecting/ Boring/ Soil • Rock tests etc.
⑫ Ecological environment survey	Vegetation (flora) • / Fish( ichthyo-fauna • plankton)/ Bird & Beats(fauna) investigations etc.
⑬ Investigation of river economy	Flood control economy

Table S.10.5-2 Preparation of “Criteria and Manual for River Works – Planing -”

Item	Contents
① Integrated river plan	Basic policy for the integrated river plan/ Basin plan/ Inland water plan/ Sediment plan/ Environment plan .
② Fundamentals of water use (low flow) plan	Discharge necessary for maintaining normal function/ Future water demand/ Development water .
③ Fundamentals of flood protection plan	Design rainfall • Hydro-graph • Flood discharge/ River channel plan & Reservoir plan in flood protection plan
④ Fundamentals of environmental conservation plan	River environment conservation and improvement plan/ Water quality preservation(improvement) plan
⑤ Waterway and river structure plan	Formulating river channel plan/ Excavation of new river/ Design of flood level/ Longitudinal and cross section of river channel/ Levee/ Revetment/ Leak prevention/ Groynes/ Ground sill/ Weir/ Sluice-way and conduit/ Gate/ Tunnel river/ Inner water treatment/ River mouth treatment
⑥ Multipurpose facility plan	Multi-purpose dam / Weir / Multi-purpose regulating reservoir / Flow regime regulating channel plans
⑦ Dam installation plan	Selection of dam types/ Determination of dam size/ Spillway and other discharge installations/ Administrative installation/ Plan for maintaining the functions of surrounding of the reservoirs
⑧ Erosion control (sabo) facility plan	Dams/ Groundsel/ Revetment/ Spur dyke/ Channel works/ Hillside work/ etc.
⑨ Shore facility plan	Sea dykes/ Revetments/ Groins/ Offshore dykes/ Ancillary facilities
⑩ Other	



Table S.10.5-3 Preparation of “Criteria and Manual for River Works – Design -”

Item	Contents
① Design of river structures	<ul style="list-style-type: none"> <li>-Levee</li> <li>-Revetment</li> <li>-Ground Sill</li> <li>-Weir</li> <li>-Sluice-way and Conduit</li> <li>-Gate</li> <li>-Tunnel river</li> <li>-Drainage pumping station</li> <li>-Siphon culvert</li> </ul>
② Design of dam	<ul style="list-style-type: none"> <li>- Decision of Basic form/ Type/ Location</li> <li>- Basic condition of dam design</li> <li>- Preparatory work studies</li> <li>- Geological analysis</li> <li>- Design of foundation ground for dam</li> <li>- Design of concrete dam</li> <li>- Design of fill-type dam</li> <li>- Design of spillway and outlet</li> <li>- Design of gate</li> </ul>
③ Design of erosion control (sabo) facility	<ul style="list-style-type: none"> <li>- Sabo dam</li> <li>- Ground sill</li> <li>- Revetment</li> <li>- Groynes</li> <li>- Water channel facilities</li> <li>- Hillside works/ Reforestation</li> </ul>

Table S.10.5-4 Preparation of “Manual for Establishment of Water Right”

Item	Contents
• Scope of public water	Studies based on water law
• Planning standard year	Studies based on hydrological statistic analysis
• Hydrological data accuracy	Studies based on manual for river works
• Discharge necessary for maintaining normal function of river flow	It is same as river maintenance discharge
• Restricted Discharge	Storage restrict/ Intake restrict and Keeping discharge at the control points
• Design control point	Calculation of water balance/ Water use safety factor etc.
• Temporary water right	Temporary water right to intake high water/ Period limited temporary water right
• Water use safety factor	1/10 for domestic water supply, 1/5 for agricultural water supply etc. shall be studied.
• Evaluation of existing water use	Especially agricultural water
• High water right	The high water right is producing the hard water resources management
• Water storage at out of watershed	The water storage at out of watershed is producing hard water resources management
• Criteria of standard drought discharge	Related to Normal flow/ River maintain discharge/ Limited water use/ Water use safety factor/ Existing water use
• Criteria of river structure examination	Dam/ Intake facilities/ Administrative facilities/ Operation and administrative criteria etc.
• Criteria of water use examination	For agriculture, domestic water, hydropower, industry etc.
• Criteria of wide area water supply	

## **CHAPTER 6 Evaluation**

### **6.1 Technical Evaluation**

The Study principally aims at the improvement of water resources management, but not at the water resources development, in the whole country of Cote d'Ivoire. Accordingly the plans/items recommended by the Study are essentially matters of management such as organization, institution, laws/regulations, and training, although some plans/items include the matters with measures by structures and facilities.

The technical evaluation is to be carried out from general viewpoints for the engineering matters/items of the following sectors:

- (1) Water use quantity control plans
- (2) Water resources development plans
- (3) Water quality control plans
- (4) Watershed management plans
- (5) O & M of water control facilities
- (6) Meteo-hydrological data management
- (7) Establishment of data base for rivers
- (8) Effective use of GIS

As a conclusion, the proposed/recommended measures at respective field of water resources management are technically viable in general. However, there are some conditions to make certain the successful results. The specific evaluation from the technical aspects is briefly described as follows:

#### **(1) Water use quantity control plans**

The water use quantity control is done basically at control points established by the JICA study. Then the following are carried out at respective point:

- (a) Evaluation of water use/demand and water supply potential
- (b) Water balance study
- (c) Water allocation and control to the users/areas
  - Establishment of water use right
  - Establishment of operation rule of water control facilities such as dams and diversion works

It is expected that the actual practices for evaluation, allocation and control of water are comparatively complicated, due to various factors involved. However, it would be possible to establish the practical control system based on the comprehensive study and analyses, but with the following conditions.

- (a) Collection of detailed/reliable hydrological data
- (b) Specific survey on actual conditions of rivers, river facilities and groundwater

In addition, the special attention should be paid on the following points:

- (a) It is necessary to carry out the water balance study in consideration of the following factors:
  - Seasonal variation
  - Regional differences
  - Yearly variation
- (b) Establishment of computerized system for the above items will be required in the future. The actual control has to be made basically by reservoir operation and gate control of intakes.
- (c) Flexible rule/system is essential for taking into account the practical countermeasures at the time of unexpected situations
- (d) Quantity of irrigation water use shares a large part of the total use. Accordingly, the effective use for irrigation should be considered with high priority.
- (e) Operation rule should be as simple as possible, taking into account the long-term O & M cost as well as the availability of well-educated operator.
- (f) Long-term monitoring and analyses are essential for reliable evaluation of the surface water as well as the groundwater.
- (g) Additional control points will be necessary in the future.
- (h) Reasonable limit of water use rate in each river should be taken into account for the future development.

## **(2) Water resources development plans**

The water resources development plans proposed by the Study are classified into the following:

- (a) Dam project for multi-purposes or single purposes (irrigation/agriculture, water supply, hydro-power, fishery and flood control)
- (b) Expansion project of irrigation area

(c) Rehabilitation project of irrigation facilities

Critical issues on technical matters are unlikely as far as the detailed plan & design is carried out on the basis of the detailed survey. However, the special attention should be paid, for dam construction, on the following points:

- (a) Selection of dam site based on soundness of topography as well as foundation geology.
- (b) River diversion plan & method during the construction, in consideration of sufficient capacity against unexpected floods.
- (c) Construction/embankment following the technical specifications.
- (d) Design of structures/facilities in consideration of simple & easy operation and maintenance.
- (e) Confirmation of water availability in the future at respective dam site.

The points listed above are the most probable causes of unexpected failure/problems of dam project.

**(3) Water quality control plans**

The water quality control in rivers, reservoirs, lagoons and groundwater will be carried out in the following manners:

- (a) Monitoring of water quality
- (b) Monitoring of sediment loads
- (c) Monitoring of pollution sources (primary and secondary)
- (d) Monitoring of water-borne diseases
- (e) Control of effluent from pollution sources
- (f) Improvement of water quality in respective water body (mainly by sewerage system)

Among them, there would be no remarkable difficulty on technical aspects for the items of (a) to (e). However, it would not be easy to find practical methods to improve the water quality of the existing polluted water body, especially for large volume of water. It would be reasonable to make best effort on the control of effluent from pollution sources with priority. For the improvement of already contaminated water quality, it would be reasonable way to expect the natural function of water purification. Special priority should be given to the conservation and improvement of water quality in lagoons.

**(4) Watershed management plans**

The proposed measures and improvement on watershed management are presented from the following three aspects:

- (a) Effective management for increase of forest area
- (b) Increase of agricultural production by irrigation
- (c) Management for effective land use

In general, it seems that the proposed measures are technically sound as far as the detailed survey and studies are carried out with sufficient budget and time.

However, it is sure that the planning for forestation and irrigation needs careful discussion among the experienced engineers/experts. Selections of trees and crops have to be made from comprehensive viewpoints including soil suitability, water availability, climate, etc. Test pilot farm will be effective for confirming the suitability.

#### **(5) O & M of water control facilities**

The proposed measures on operation and maintenance of water control facilities are presented for the following four sectors:

- (a) Agricultural water supply
- (b) Urban water supply
- (c) Rural water supply
- (d) Hydro-electric power

It is not expected to have difficulties on technical points in general. However, careful study and survey will be necessary especially in consideration of the following points:

- (a) Computerized system is necessary and effective, but the actual importation needs to take into account the financial status and availability of experienced engineers/experts.
- (b) Specific alternative studies from overall viewpoints are necessary for multi-purpose use of existing dam and integrated operation of plural number of dams.
- (c) Improvement of water distribution control needs simulation study and practical methods should be decided.
- (d) Inventory survey of existing dam and irrigation systems have to be carried out with special attention on the status of existing operation and maintenance as well as the causes of problems.
- (e) Concerning rural water supply, there would be no serious difficulties on the mechanical matters, however, the hydro-geological matters need the judgement of

experienced engineers/experts.

- (f) Concerning the urban water supply, significant technical issues are unlikely in consideration of the capability of SODECI.
- (g) Concerning the hydroelectric power, significant technical issues are unlikely in consideration of the capability of CIE.

**(6) Meteo-hydrological and hydro-geological network management**

The management of meteo-hydrological and hydro-geological network is categorized into the following:

- (a) Establishment of equipment
- (b) Observation and measurement
- (c) Inspection and maintenance
- (d) Data transmission
- (e) Data processing and management
- (f) Monitoring and evaluation

It would be required to assign highly experienced engineers/experts for the data transmission, data processing & management and monitoring & evaluation. However, as far as the sufficient budget is prepared and the training on O & M is carried out properly, the technical difficulties may not happen.

In addition, for confirming the technical viability, it would be required to review the proposed measures on the following points:

- (a) Necessity of highly technical facilities/equipment (such as radar rain-gauges and real-time weather information system)
- (b) Availability of budget and experienced engineers to keep operational conditions of the established equipment for a long period in the future.
- (c) Establishment of definite and detailed plans based on the proposed management measures, which are described from the general/common viewpoints.

**(7) Establishment of data base for rivers**

It would be unlikely to identify the technical difficulties definitely on the establishment of database for rivers and river-related sectors, such as river facilities, water right, meteorology and hydrology, and river environment.

However, the periodical review and improvement of the data will be significant. In addition, the preparatory studies on the following points will need careful and detailed consideration and discussion among all the relevant agencies concerned.

- (a) Division of the country based on river basins
- (b) Establishment of address of rivers and locations in a river
- (c) Preparation of river system diagram
- (d) Classification of river based on the magnitude of importance for management
- (e) Definition of boundary of river area

#### **(8) Effective use of GIS**

It is expected to utilize the existing GIS more effectively, especially on the following points:

- (a) Use for the database of water resources development and management
- (b) Updating the tabular data periodically
- (c) Extension of the spatial information

The technical difficulties are unlikely if the government can prepare the sufficient hardware and software for the practical uses. Most essential matter for effective use of GIS will be the availability of experienced GIS experts. It seems that the government offices in charge of water management do not have sufficiently experienced GIS experts at present. However, it is possible to get assistance from private companies such CCT of BNEDT and CNTIG, which are the semi-governmental organizations and have good experiences in GIS preparation. In addition, the number of experienced experts will be increased in the government offices in the future according to the necessity.

## **6.2 Organizational Evaluation**

The organizations being proposed under this study are evaluated here from the following two points :

- whether or not the proposed organizations have an effect on improvement of the existing organizations ;
- whether or not the proposed organizations have a possibility of realization.

### **(1) An effect on improvement of existing organizations**

There are a lot of organizations for water resources management at present. And this may cause the fragmentation of management functions and the dispersion of water resources management.



And such fragmentation of management function , i.e. sectarian water resources management, have produced some harmful effects on water resources development and management.

a) **Water Authority and Basin Water Agency**

The creation of Water Authority and three (3) Basin Water Agencies aims at an integrated management of water resources to resolve the problems caused by sectarian management. Therefore, that is believed to improve sufficiently the existing organizations and administrative method of water resources management.

b) **National Water Committee and Basin Water Committees**

The creation of “National Water Committee” and three (3) “Basin Water Committees” is believed to meet the spirit of Water Law,. Because the members of the committee shall be chosen from three (3) different fields, namely, ① planners, deciders and specialist, ② operator and ③ users

Local assemblies and users’ participation in the Committees may reflect their voices/opinions to water sector development.

c) **Inter – Ministries Committee**

It is believed that the creation of “Inter – Ministries Committee” fits the purpose of Water Law. Because the Committee shall compose of the representatives from ministries implicated into water sector services. It is expected this committee may play an important role in discussing about water projects which have multiple objectives.

**(2) A possibility of realization**

It may be sure that a possibility of realizing proposed organizations depend upon ensuring of budget and development of human resources. Judging from the present situation of Cote d’Ivoire, an assistance from foreign countries for both funds and development of human resources may be the key point whether or not to realize the proposed organizations early.

The adjustment of the relation ship between Water Authority and other existing ministries concerned to water sector is also an important fact to realize the proposed organizations. The organization to be newly created such as Water Authority should keep in close contact and use jointly its privilege with other existing ministries concerned.

**6.3 Economic and financial evaluation**

**(1) methodology**

The degree of details reached by a master plan study allows to calculate :

- For the projects with a management profile, the amount of the investment part is not enough large to calculate an internal rate of return. But one can estimate the operation and maintenance costs of the most important ones : in the case of our actions programme, the construction of the institutional and legal framework. In fact this project aims to structure all the sector and surpass in consequences the only fact of insuring the maintenance of a new building. The implementation of the entities forming this framework will have to allow a big increase in terms of planning and programming. And these two items are certainly the most important issues of the sector, from the point of view of the administration.
- For the projects with a development profile, with assumptions concerning the future benefits of the project, it computes a yearly outflow (or balance) which is the result of the difference between the yearly flow of capital expenditures and the successive yearly receipts (future benefits of the project). This set of yearly balances does not include any O&M costs or current expenditures or provision for renewal, and provision for amortisation. These different items will be analysed later during a new stage of the project. The analyse carried out here focuses on economic costs (so the capital expenditures) and calculates :
  - the internal rate of return (IRR) in % at different periods (after 15 years, 20 years and 25 years)
  - the net present value (NPV) with the same different periods and an actualisation rate of 5%
  - the return on investment (ROI) which defines the number of years necessary to cover the capital costs by the benefits expected of the project

This set of rates has been calculated for the most important and the largest projects *belonging to the priority list*, these are three among five projects concerning by integrated operations for river basins.

That does not mean that other projects have inefficient IRR or bad NPV or too longer ROI. The only understanding is that the three most important projects respond effectively for these IRR (at least positive), NPV (with a 5% actualisation rate, must be nil or quasi nil) and last ROI below 12 years.

These different hypothesis are the result of many experience within the country, even if some of them can seem leveraged (the ROI under 12 years can seem hard to obtain but it represents often the conditions offered by the international financial institutions), and other seem too easy (reaching just a positive IRR is certainly not sufficient for the same institutions) but both are a first analysis which claims to be confirmed and detailed at a later step.

## **(2) Results**

The three selected projects are integrated operations for the river basin of the three main rivers of the country:

- Marahou e, this project would have a duration of 8 years of which half would have developed for preliminary studies and half for the construction. With an estimated total cost raising FCFA 51,300 millions, the capital expenditures count for more than FCFA 50,000 millions.
- Comoe, this project is the most important one, as well for its amount (more than FCFA 279,000 millions) as for its strategic importance, the preliminary studies are planned for a duration of four years while the construction period reaches 5 years.
- Agneby is the longest-in-time project (10 years) but the preliminary steps gather also several studies which will be used also for the other projects. Its construction cost is estimated at FCFA 63,180 million out of FCFA 8,830 millions for preliminary studies. The duration of the only construction would reach 4 years.

	B/C Ratio	IRR	NPV, 5%	ROI
Marahoue				
15 years	0.89	-7%	-122,110	6,9 years
20 years	1.6	+ 5%	869	
25 years	2.3	+ 9%	157,307	
Comoe				
15 years	2.5	+ 8%	214,715	8,1 years
20 years	4.0	+ 16%	1,560,271	
25 years	5.6	+ 19%	3,153,929	
Agneby				
15 years	0.31	+ 4%	-21,850	8,6 years
20 years	2.2	+ 11%	206,751	
25 years	3.1	+ 14%	473,062	

At the level of details known presently, it would be reasonable to admit the feasibility of these projects as correct of IRR > 10 % in the case of project with 80 % of components in Hydro-electrically while IRR can be lower when the project includes often components such as irrigation.

#### 6.4 Social impact aspects

At the stage of the master plan, social aspects will be limited to the creation of jobs implied by the creation, or the extension, of administrative entities. This creation of employment must be understood as a permanent one while many investment projects will produce more jobs but only at a temporary level.

All concerns for moving of population due to investment could not be measured at the level of details this master plan reached.

The extent of the improvement of way of life for the different categories of consumers thanks to the improvement of the water quality and to the increase of the water quantity, is depending on the part of income reserved for water consumption.

For a first approach as required in this type of study, we only suppose that the part of the income reserved for the water in urban areas will remain approximately the same : no more than 5%. But as in the meantime our forecasts intend to a global growth rate of the GDP per capita from six hundred equivalent dollars to seven hundred during the next fifteen years, the effect on water consumption at least follows the same rate (globally 17%).

For the rural area, it will be completely different as the level of the consumption is largely under any international standards. We only suppose that, at least, the rural population would be able to consume 20 litres per day per capita in the year 2015. These two main assumptions concern the consumption and its effect on the households (and , from a matter of fact, the administration as well). Their effects will be more important in health for the rural area while the urban one will win in a more comfortable daily life.

The effect on the other categories of consumers such as enterprises (whatever be industrial or in business agriculture), or other particular ones (energy, water producing) would enable to :

- improve the quality of products : agricultural ones, fruits, vegetables notably;
- increase the quantity of these products and consequently, their supply and, finally, having a result on higher competitiveness and pressure to moderate prices;
- and, of course while improving the management of the resource, improve the water balance

## **6.5 Environmental Aspect**

It must take a notice of the following items in order to implement of the master plan.

### **(1) Social Condition**

- Less job opportunity and low income in the rural area by low agricultural productivity due to lack of irrigation and insufficient rural infrastructure
- Negative effects and sanitary risks (hydrous diseases) developed from mosquitoes, flies living in the vast stretches of surface water and responsible for malaria, onchocercosis, etc
- Conflicts relative to among peoples
- Decamping, resettlement, and compensation problems
- Perturbation of economic activities relative to the combine action of the too intense evapo-transpiration under a wet tropical climate, the seasonal variation of precipitation and the technical failure at the level of the infrastructures of artificial reservoirs

## **(2) Natural Condition**

- Lands consisting of weathered granite and ferrallitic soil which are easily eroded by heavy rain
- Rainfall and surface water with very scarce amount in dry season which is rather difficult to maintain ecological system and use for the human life
- Large devastated forest area and accelerating soil erosion
- Insufficient survey result and data for distribution of wild animals and aquatic fauna and flora
- The massive destruction of the rare, and in great demand, natural flora and of certain plants on vast occupied by the water of lakes
- The disturbing, the death and the forced flight of natural faunas and protected species far from their usual ecosystems invaded by reservoirs
- The perturbations and interruption of the natural cycle of fluvial fertilization of agricultural grounds which formerly received mud, zoo-plankton, limes, slit, etc, by the help of important rising flooding vast plains downstream big artificial reservoirs
- The perturbations and modification of the hydrologic flow of certain surface waterways invaded by artificial reservoirs

The pollution of surface waters and the massive death of fish in the fish breeding stations related to the human life and industrial drainage without control

# **10 WATER QUALITY AND ENVIRONMENT**

## 10 WATER QUALITY AND ENVIRONMENT

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## **CHAPTER 1. WATER QUALITY**

### **1.1 Water Quality at the R.N.O Station**

#### **1.1-1 Monitoring Organization and System**

##### **(1) Organization**

The center of Ivorian pollution control (CIAPOL) is a national public establishment with administrative characters, created by the decree N. 91-662 of October 09, 1991. It is on the authority of the administrative and technical department of the Ministry of Environment and Forest. The CIAPOL is managed by the consultative commission of management. The main roles are as follows.

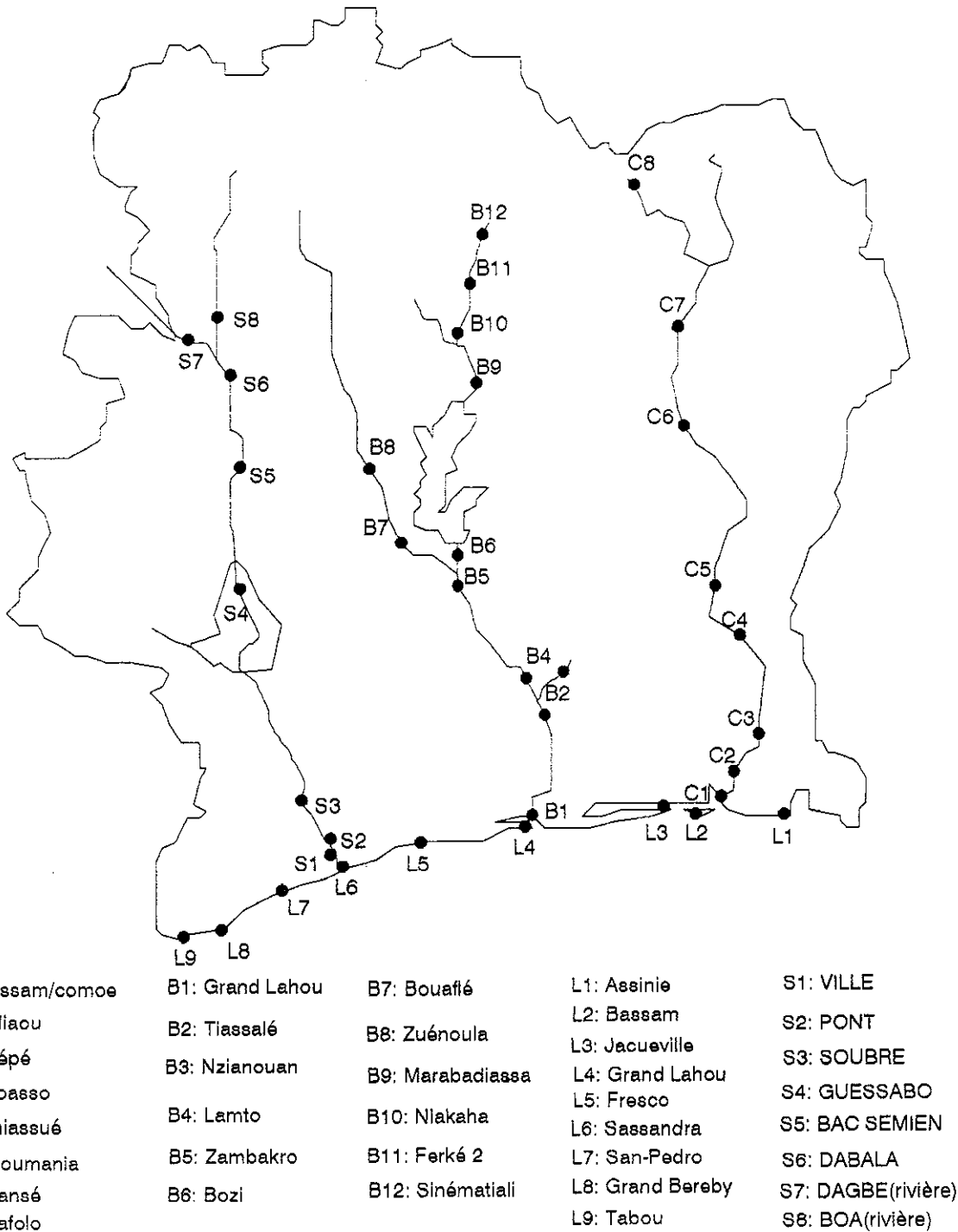
- The systematic analysis of natural water, waste and residue according to the national observation network called as RNO
- The valuation of the pollution and nuisance of different receptors area, water, air, and soil
- The collection, evaluation and spread of environmental data
- The regular supervision of the marine area and lagoon with the patrol group
- The control of wrecked pollution in the sea and lagoon

##### **(2) Monitoring Station**

The National Observation Network Stations for monitoring of surface water are established to 28 points in the Comoe, Bandama and Sassandra river basin, 9 points at coastal area and lagoon of Ebrie.



# RESEAU NATIONAL D'OBSERVATION DE LA COTE D'IVOIRE - QUALITE DES EAUX STATIONS CONTINENTALES ET LITTORALES



**Figure 1.1-1 The National Observation Network Stations**

Table 1.1-1 Water Quality at the R.N.O Stations in the Sasandra Basin, in March

du 04 au 12 mars 1998

Stations	Paramètres	T°c	pH	O <sub>2</sub> %	Conductivité µS/cm	Salinité ‰	N-NO <sub>2</sub> mg/l	N-NO <sub>3</sub> mg/l	P-PO <sub>4</sub> mg/l	N-NH <sub>4</sub> mg/l	Chlorophile mg/m <sup>3</sup>	Phéopigments mg/m <sup>3</sup>	M.E.S
Vialadougou	surf	25,0	7,68	130,0	25,0	0,0	0,031	0,000	0,106	0,000	1,2	0,1	
Dabala		26,5	5,59	10,0	0,0	0,0	0,011	0,012	0,186	0,014	1,5	0,4	
Touba		27,5	7,92	148,0	80,0	0,0	0,020	0,021	0,266	0,045	2,3	0,5	
Semien (Man)	surf	27,0	8,22	176,0	50,0	0,0	0,021	0,020	0,078	0,000	2,6	0,6	
	fond	26,5	8,21	169,0	50,0	0,0	0,019	0,009	0,164	0,000	0,0	0,0	
Guiglo	surf	30,0	7,51	161,0	80,0	0,0	0,023	0,007	0,270	0,000	8,7	1,5	
	fond	28,0	7,31	137,0	100,0	0,0	0,017	0,015	0,278	0,002	5,8	3,8	
Guessabo	surf	31,0	7,48	89,0	85,0	0,0	0,014	0,050	0,291	0,000	10,5	3,8	
	fond	28,5	7,48	125,0	82,0	0,0	0,013	0,051	0,244	0,019	8,7	1,1	
Soubré		30,0	7,81	174,0	70,0	0,0	0,014	0,051	0,266	0,010	9,0	4,0	
Sassandra Pont S.		31,0	7,91	179,0	70,0	0,0	0,013	0,027	0,110	0,114	4,7	0,6	
	fond	30,5	7,89	42,0	75,0	0,0	0,000	0,003	0,047	0,103	2,6	1,5	
Sassandra Emb. S.		30,0	7,90	148,0	1600,0	1,0	0,000	0,003	0,050	0,033	2,9	1,4	
	fond	28,0	7,87	141,0	20800,0	15,5	0,000	0,013	0,095	0,026	1,5	1,8	

Table 1.1-2 Water Quality at the R.N.O Stations in the Sasandra Basin, in November

du 31 Octobre au 04 Novembre 1998

Stations	Paramètres	T°c	pH	O <sub>2</sub> %	Conductivité µS/cm	Salinité ‰	N-NO <sub>2</sub> mg/l	N-NO <sub>3</sub> mg/l	P-PO <sub>4</sub> mg/l	N-NH <sub>4</sub> mg/l	Chlorophile mg/m <sup>3</sup>	Phéopigments mg/m <sup>3</sup>	M.E.S
Vialadougou	surf	26,1	6,46	81,6	100	0	0,001	0,000	0,200	0,340			
	fond	27,2	6,80	76,7	50	0	0,002	0,000	0,210	0,249			
Dabala		26,7	6,59	59,0	90	0	0,003	0,000	0,119	0,243			
Touba		27,4	6,74	103,0	60	0	0,001	0,000	0,057	0,287			
Semien (Man)		27,0	6,60	149,0	70	0	0,002	0,000	0,079	0,431			
Guiglo		26,5	6,36	51,8	50	0	0,008	0,034	0,053	0,325			
Guessabo		29,3	6,42	58,0	75	0	0,003	0,000	0,057	0,286			
Soubré		30,0	6,83	63,1	75	0	0,003	0,000	0,054	0,237			
Sassandra Pont S.		28,4	6,70	57,5	75	0	0,002	0,002	0,000	0,344			
	fond	28,9	6,92	55,8	70	0	0,012	0,000	0,063	0,443			
Sassandra Emb.		29,0	6,46	80,0	80	0	0,004	0,000	0,070	0,357			

Table 1.1-3 Water Quality at the R.N.O Stations in the Comoce and Bandama Basin, in April

du 08 au 17 Avril 1998

Stations	Paramètres	T°c	pH	O <sub>2</sub> %	Conductivité µS/cm	Salinité ‰	N-NO <sub>2</sub> mg/l	N-NO <sub>3</sub> mg/l	P-PO <sub>4</sub> mg/l	N-NH <sub>4</sub> mg/l	Chlorophille mg/m <sup>3</sup>	Phéopigments mg/m <sup>3</sup>	M.E.S
M'Basso		30,25	6,37	118,7	88,0	0,04	0,001	0,020	0,033	0,026	2,0	4,5	
Anekouadiokro		29,23	7,34	108,2	79,0	0,03	0,000	0,004	0,035	0,019	3,8	2,9	
Groumania	surf	29,17	7,68	101,9	82,0	0,03	0,003	0,013	0,055	0,017	3,5	0,6	
	fond	28,42	7,69	93,6	82,0	0,03	0,002	0,029	0,036	0,028	1,2	1,7	
Gansé		29,96	7,16	112,2	77,0	0,03	0,001	0,009	0,033	0,019	0,0	0,0	
Tortiya		25,19	7,30	97,0	104,5	0,04	0,002	0,039	0,037	-	2,9	2,0	
Ferkessedougou		30,43	7,17	96,8	82,0	0,03	0,003	0,035	0,040	0,004	1,8	0,3	
Sinematiali	surf	29,31	6,65	102,0	70,0	0,03	0,002	0,052	0,032	0,027	2,3	0,1	
	fond	26,12	6,55	62,6	69,0	0,03	0,001	0,001	0,033	0,040	1,8	3,6	
Kafolo		29,21	7,46	142,6	102,0	0,04	0,006	0,060	0,036	0,025	0,0	0,0	
Marabadiassa		30,93	7,31	129,0	103,0	0,04	0,001	0,000	0,037	0,043	1,2	1,1	
Zambakro	surf	29,84	7,13	109,8	78,0	0,03	0,000	0,000	0,019	0,035	1,8	0,7	
	fond	29,86	7,05	106,7	79,0	0,03	0,007	0,016	0,017	0,014	0,0	0,0	
Bozi		27,23	7,12	97,2	79,0	0,03	0,006	0,033	0,015	0,027	2,9	4,0	
Bouaflé		29,09	6,97	23,0	235,0	0,10	-	-	2,293	0,020	42,3	53,6	
Zuenoula		28,37	6,98	27,7	348,0	0,15	0,012	0,000	0,107	0,501	290,0	12,0	
Lamito		27,86	7,35	48,6	82,0	0,03	0,006	0,023	0,020	0,218	1,8	5,2	
N'Zianoua		29,37	7,82	116,9	102,0	0,04	0,001	0,000	0,024	0,019	15,2	5,2	
Tiassalé	surf	29,52	7,40	114,6	81,0	0,03	0,003	0,000	0,024	0,024	1,8	1,9	
	fond	29,32	7,37	109,2	81,0	0,03	0,001	0,000	0,022	0,016	0,0	0,0	
Alépé	surf	26,46	6,53	113,3	745,0	0,35	0,004	0,003	0,020	0,020	11,1	10,5	
	fond	24,19	6,42	13,3	22433,0	13,30	0,008	0,000	0,019	0,111	3,5	3,0	
Adiahou	surf	29,74	6,40	104,0	6941,0	3,53	0,005	0,003	0,018	0,102	14,0	6,0	
	fond	29,13	6,21	24,5	18329,0	10,24	0,004	0,000	0,019	0,062	5,1	6,8	
Bassam	surf	30,82	6,77	114,2	13425,0	6,83	0,008	0,000	0,019	0,109	14,0	8,5	
	fond	29,71	6,70	63,7	20160,0	10,90	0,004	0,000	0,021	0,024	8,2	5,3	
Grd-Lahou	surf	28,43	7,55	97,0	112,0	0,05	0,009	0,003	0,024	0,018	2,9	4,0	

Source: Data from CIAPOL (1998)

Table 1.1-4 Water Quality at the R.N.O Stations in the Comoe and Bandama Basin, in October

du 14 au 24 Octobre 1998

Paramètres Stations	T °c	pH	O <sub>2</sub> %	Conductivité µS/cm	Salinité ‰	N-NO <sub>2</sub> mg/l	N-NO <sub>3</sub> mg/l	P-PO <sub>4</sub> mg/l	N-NH <sub>4</sub> mg/l	Chlorophille mg/m <sup>3</sup>	Phéopigments mg/m <sup>3</sup>	M.E.S
M'Basso	29,6	6,9	90,8	89	0	0,005	0,040	0,073	0,347			
	29,1	7,0	89,6	60	0	0,004	0,054	0,046	0,925			
Groumania surf	27,3	6,8	-	60	0	0,016	0,116	0,030	0,285			
fond	27,3	6,5	78,3	85	0	0,014	0,117	0,031	0,616			
Gansé surf	29,5	6,1	87,9	70	0	0,007	0,115	0,033	0,110			
fond	28,5	6,8	76,0	68	0	0,007	0,115	0,032	0,162			
Tortiya	27,3	6,6	120,6	60	0	0,004	0,032	0,024	0,183			
	27,6	6,6	101,9	65	0	0,006	0,051	0,030	0,362			
Ferkessedougou	29,1	6,5	117,5	55	0	0,006	0,095	0,029	0,387			
	29,1	6,6	109,5	70	0	0,009	0,118	0,034	0,270			
Sinemayiali surf	28,0	6,6	98,0	50	0	0,005	0,004	0,035	0,102			
fond	28,0	6,7	80,0	60	0	0,006	0,086	0,022	0,241			
Kafolo	30,7	6,9	112,5	52	0	0,004	0,034	0,021	0,279			
	30,0	6,5	110,5	52	0	0,004	0,070	0,019	0,242			
Marabadiassa	27,6	6,9	100,0	50	0	0,003	0,030	0,056	0,155			
	27,6	6,9	84,0	61	0	0,007	0,032	0,030	0,691			
Zambakro surf	28,5	6,9	121,8	80	0	0,003	0,049	0,075	0,194			
fond	28,3	7,0	120,0	82	0	0,007	0,061	0,037	0,633			
Bozi	28,6	6,5	109,5	90	0	0,003	0,014	0,027	0,161			
Bouafié surf	28,5	6,8	-	175	0	0,012	0,119	0,041	0,546			
fond	28,5	6,9	-	85	0	0,023	0,106	0,180	0,768			
Zuenoula surf	27,0	6,9	-	60	0	0,005	0,060	0,062	0,275			
fond	27,0	6,9	-	60	0	0,013	0,046	0,082	0,527			
Lamto	27,7	6,6	70,0	80	0	0,023	0,083	0,084	0,183			
N'Zianoua surf	28,9	6,5	-	70	0	0,043	0,054	0,270	0,919			
fond	28,9	6,7	-	78	0	0,042	0,065	0,222	0,808			
Tiassalé surf	29,4	6,6	-	82	0	0,022	0,041	0,152	0,281			
fond	29,2	6,6	-	85	0	0,023	0,044	0,126	0,325			

Source: Data from CIAPOL (1998)

Table 1.1-5 Water Quality at the R.N.O Stations in the Comoe and Bandama Basin, in October (continue)

Stations	Paramètres	T°c	pH	O <sub>2</sub> %	Conductivité µS/cm	Salinité ‰	N-NO <sub>2</sub> mg/l	N-NO <sub>3</sub> mg/l	P-PO <sub>4</sub> mg/l	N-NH <sub>4</sub> mg/l	Chlorophile mg/m <sup>3</sup>	Phéopigments mg/m <sup>3</sup>	M.E.S
Alépé	surf	29,6	6,80	-	62,0	0,000	0,027	0,063	0,122	0,246			
	mil	29,2	6,90	-	65,0	0,000	0,029	0,065	0,125	0,426			
	fond	29,2	6,60	-	65,0	0,000	0,028	0,063	0,114	0,428			
Adiahou	surf	28,7	6,60	-	62,0	0,000	0,026	0,069	0,130	0,254			
	mil	28,6	6,80	-	65,0	0,000	0,026	0,066	0,012	0,389			
	fond	28,9	7,00	-	65,0	0,000	0,026	0,066	0,125	0,297			
Bassam	surf	29,4	6,40	-	60,0	0,000	0,025	0,070	0,190	0,271			
	mil	29,5	6,60	-	70,0	0,000	0,028	0,080	0,109	0,523			
	fond	29,0	6,50	-	70,2	0,000	0,026	0,053	0,116	0,431			
Grd-Lahou	surf	28,5	7,10	67,9	46,0	0,004	0,027	0,050	0,190	0,272			
	fond	28,4	7,22	62,9	87,0	0,004	0,027	0,052	0,350	0,345			

Source: Data from CIAPOL (1998)

**Table 1.1-6 Micro Organisms at the R.N.O Stations in the Comoé and Bandama Basin, in November**

**CAMPAGNE R.N.O CONTINENTAL  
SUR LES FLEUVES COMOÉ ET BANDAMA  
du 13 au 22 Novembre 1995**

Paramètres Stations	Coliformes totaux	Coliformes fécaux	Streptocoques fécaux	Streptocoques perfringens
M'basso	248	188	74	157
Aniassué	225	150	90	85
Groumania	2400	0	3000	10
Ganse	1800	25	35	10
Kafolo	235	13	75	0
Sinématiali	2170	10	485	20
Ferké 2	300	180	15	0
Niakaha	170	0	20	0
Marabadiassa	1400	0	23	20
Zambakro	3000	0	15	40
Zuenoula	2800	0	65	0
Bouafé	1300	0	64	30
Bozi	800	0	85	140
Lamto	300	0	215	0
N'zianouan	2100	80	370	60
Tiassalé	1300	30	194	10
Grand Lahou	20000	1400	114	10
Embouchure Grand Lahou	30000	13000	75	50
Alépé	68500	268	80	60
Adiahou	86000	388	10	47
Bassam	31500	183	20	20

Source: Data from CIAPOL (1995)

**Table 1.1-7 Water Quality at the Jacquville in the Lagoon, in April**

STATION PARAMETRE	Jacquville
T°C	31, 4
PH	8,28
Cond (µs/ Cm)	38 600
Sal ‰	
N-NO <sub>2</sub> <sup>-</sup> (mg/l)	0, 007
N-NO <sub>3</sub> <sup>-</sup> (mg/l)	0, 013
N-NH <sub>4</sub> (mg/l)	0, 091
P- PO <sub>4</sub> <sup>3-</sup> (mg/l)	0, 032
Chlorophylle a (mg/l)	< 0, 001
K (mg/l)	
Ca (mg/l)	
Mg (mg/l)	
Coliformes Totaux (100ml)	2
Coliformes Fécaux (100ml)	<1
Streptocoques (100ml)	10
Clostridium (100ml)	<1
MES (mg/l)	8, 4
Hydrocarbures Totaux (µg/l)	10, 6

Source: Data from CIAPOL (1999)

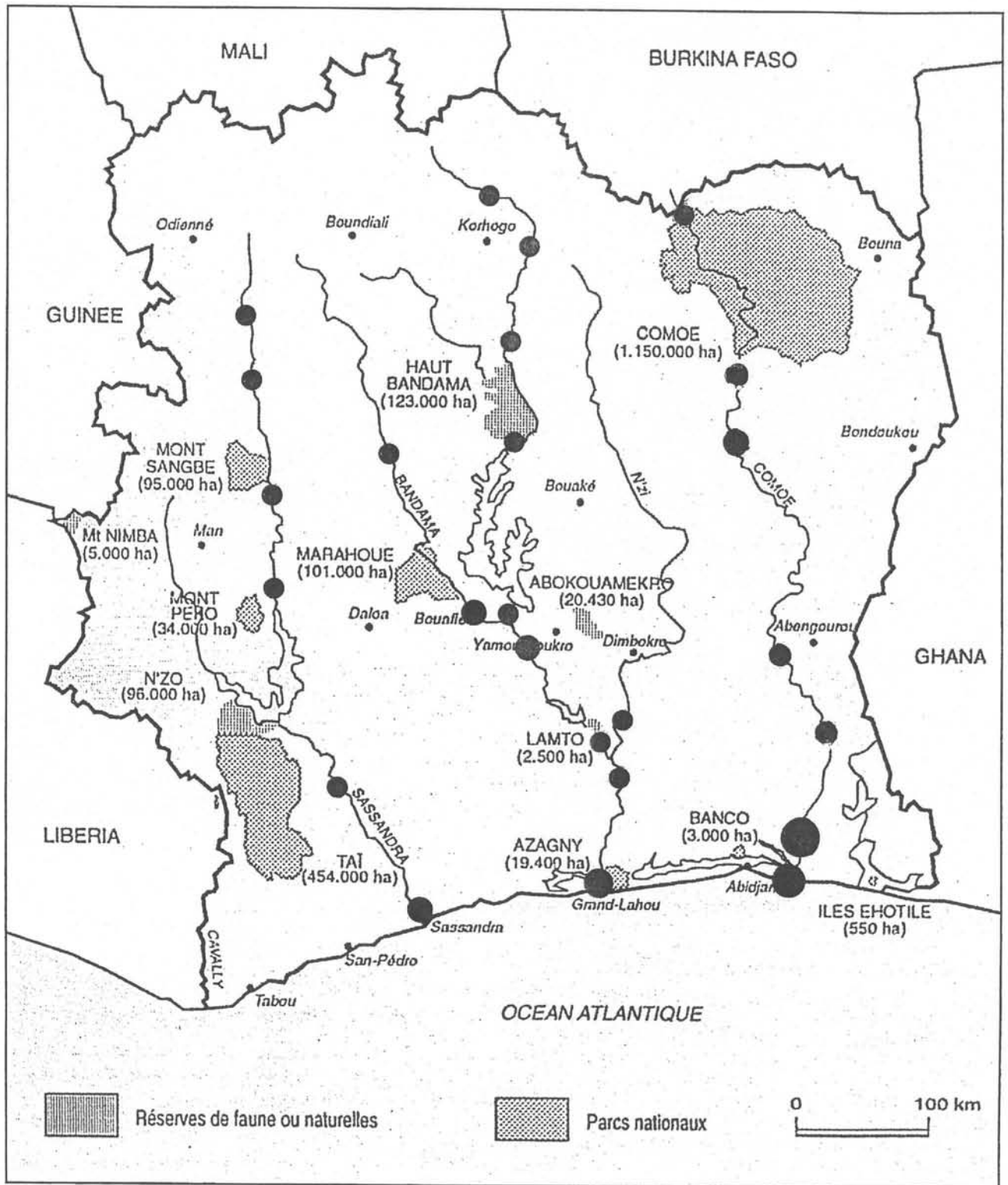


Figure 1.1-2 Change of River Water Quality of EC, Analyzed by CIAPOL in the National Observation Network Station between 1998 from 1995



Table 1.1-8 Surface Water Quality in the National Observation Station between 1998 from 1995

Year	Date (from - to)	No.	Station	T (°C)	pH	O <sub>2</sub> (%)	EC (μS/cm)	Salinity (‰)	N-NO <sub>2</sub> (mg/l)	N-NO <sub>3</sub> (mg/l)	P-PO <sub>4</sub> (mg/l)	N-NH <sub>4</sub> (mg/l)	Chloro- phile (mg/m <sup>3</sup> )	Pheopig- ments (mg/m <sup>3</sup> )	Coli. total	Coli. fecal	Strepto- coccus fecal	Strepto- coccus perfringen
1995	Nov 11	B01	Grand Lahou												4,200	20	293	30
1996	Nov 13	B01	Grand Lahou												20,000	1,400	114	10
1998	Mar 26	B01	Grand Lahou	surf	29.00	127.0	1,200.0	0.90	0.000	0.014	0.070	0.056	2.3	0.0				
1998	Mar 26	B01	Grand Lahou	fond	29.00	114.0	28,000.0	16.00	0.000	0.044	0.031	0.143	9.0	0.4				
1998	Apr 8	B01	Grand Lahou	surf	28.43	75.5	112.0	0.05	0.009	0.003	0.024	0.018	2.9	4.0				
1998	Oct 14	B01	Grand Lahou	surf	28.50	7.10	46.0	0.00	0.027	0.050	0.190	0.272						
1998	Oct 14	B01	Grand Lahou	fond	28.40	7.22	62.9	0.00	0.027	0.052	0.350	0.345						
1995	Nov 11	B02	Tiassalé												365	5	158	38
1996	Nov 13	B02	Tiassalé												1,300	30	194	10
1998	Mar 26	B02	Tiassalé	surf	34.00	142.0	80.0	0.00	0.000	0.025	0.045	0.072	1.2	0.5				
1998	Mar 26	B02	Tiassalé	fond	33.00	128.0	80.0	0.00	0.000	0.000	0.158	0.078	0.0	0.0				
1998	Apr 8	B02	Tiassalé	surf	29.52	74.0	81.0	0.03	0.003	0.000	0.022	0.024	1.8	1.9				
1998	Apr 8	B02	Tiassalé	fond	29.32	73.7	109.2	0.03	0.001	0.000	0.020	0.016	0.0	0.0				
1998	Oct 14	B02	Tiassalé	surf	29.40	6.60	82.0	0.00	0.022	0.041	0.152	0.281						
1998	Oct 14	B02	Tiassalé	fond	29.20	6.60	85.0	0.00	0.023	0.044	0.126	0.325						
1995	Nov 11	B03	N'Zianouan												420	305	178	20
1996	Nov 13	B03	N'Zianouan												2,100	80	370	60
1998	Mar 26	B03	N'Zianoua		38.50	151.0	120.0	0.00	0.000	0.022	0.053	0.084	60.6	3.4				
1998	Apr 8	B03	N'Zianoua		29.37	7.82	116.9	0.04	0.001	0.000	0.024	0.019	15.2	5.2				
1998	Oct 14	B03	N'Zianoua	surf	28.90	6.50	70.0	0.00	0.043	0.054	0.270	0.919						
1998	Oct 14	B03	N'Zianoua	fond	28.90	6.70	78.0	0.00	0.042	0.065	0.222	0.808						
1995	Nov 11	B04	Lamto												388	243	220	0
1996	Nov 13	B04	Lamto												300	0	215	0
1998	Mar 26	B04	Lamto		29.00	60.0	82.0	0.00	0.000	0.000	0.047	0.129	7.6	1.0				
1998	Apr 8	B04	Lamto		27.86	7.35	82.0	0.03	0.006	0.023	0.024	0.218	1.8	5.2				
1998	Oct 14	B04	Lamto		27.70	6.60	80.0	0.00	0.023	0.083	0.084	0.183						
1995	Nov 11	B05	Zambakro												223	155	80	0
1996	Nov 13	B05	Zambakro												3,000	0	15	40
1998	Mar 26	B05	Zambakro	surf	30.20	7.49	180.0	0.00	0.000	0.018	0.027	0.075	7.0	1.2				
1998	Mar 26	B05	Zambakro	fond	30.00	7.26	138.0	0.00	0.000	0.148	0.082	0.120	7.6	0.2				
1998	Apr 8	B05	Zambakro	surf	29.84	7.13	109.8	0.03	0.000	0.000	0.019	0.035	1.8	0.7				
1998	Apr 8	B05	Zambakro	fond	29.86	7.05	106.7	0.03	0.007	0.016	0.017	0.014	0.0	0.0				
1998	Oct 14	B05	Zambakro	surf	28.50	6.90	80.0	0.00	0.003	0.049	0.075	0.194						
1998	Oct 14	B05	Zambakro	fond	28.30	7.00	82.0	0.00	0.007	0.061	0.037	0.633						
1995	Nov 11	B06	Bozi												70	5	162	15
1996	Nov 13	B06	Bozi												800	0	85	140
1998	Mar 26	B06	Bozi		31.00	7.05	100.0	0.00	0.000	0.022	0.085	0.076	11.1	1.6				
1998	Apr 8	B06	Bozi		27.23	7.12	97.2	0.03	0.006	0.033	0.015	0.027	2.9	4.0				
1998	Oct 14	B06	Bozi		28.60	6.50	109.5	0.00	0.003	0.014	0.027	0.161						
1995	Nov 11	B07	Bouafilé												133	50	68	10
1996	Nov 13	B07	Bouafilé												1,300	0	64	30
1998	Mar 26	B07	Bouafilé	surf	30.00	6.72	260.0	0.00	0.000	0.000	0.052	0.222	105.9	25.9				
1998	Mar 26	B07	Bouafilé	fond	38.00	6.60	390.0	0.00	0.000	0.000	0.058	0.499	159.3	17.5				

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Year	Date (from – to)	No.	Station	T (°C)	pH	O <sub>2</sub> (%)	EC (µS/cm)	Salinity (‰)	N-NO <sub>2</sub> (mg/l)	N-NO <sub>3</sub> (mg/l)	P-PO <sub>4</sub> (mg/l)	N-NH <sub>4</sub> (mg/l)	Chloro- phile (mg/m <sup>3</sup> )	Pheopig- ments (mg/m <sup>3</sup> )	Coli. total	Coli. fecal	Strepto- coccus fecal	Strepto- coccus perfringen
1998	Apr 8	Apr 17	B07	Bouafilé	29.09	6.97	23.0	235.0	0.10	-	2.293	0.020	42.3	53.6				
1998	Oct 14	Oct 24	B07	Bouafilé	surf	28.50	6.80	175.0	0.00	0.012	0.119	0.041	0.546					
1998	Oct 14	Oct 24	B07	Bouafilé	fond	28.50	6.90	85.0	0.00	0.023	0.106	0.180	0.768					
1995	Nov 11	Nov 17	B08	Zuenoula											95	0	134	40
1996	Nov 13	Nov 22	B08	Zuenoula											2,800	0	65	0
1998	Mar 26	Apr 4	B08	Zuenoula	30.00	7.29	114.0	130.0	0.00	0.000	0.015	0.078	114.8	20.2				
1998	Apr 8	Apr 17	B08	Zuenoula	28.37	6.98	27.7	348.0	0.15	0.012	0.000	0.107	0.501	12.0				
1998	Oct 14	Oct 24	B08	Zuenoula	surf	27.00	6.90	60.0	0.00	0.005	0.060	0.062	0.275					
1998	Oct 14	Oct 24	B08	Zuenoula	fond	27.00	6.90	60.0	0.00	0.013	0.046	0.082	0.527					
1995	Nov 11	Nov 17	B09	Marabadiassa											310	195	91	5
1996	Nov 13	Nov 22	B09	Marabadiassa											1,400	0	23	20
1998	Mar 26	Apr 4	B09	Marabadiassa	29.00	7.31	112.0	120.0	0.00	0.000	0.096	0.100	0.117	1.6				
1998	Apr 8	Apr 17	B09	Marabadiassa	30.93	7.31	129.0	103.0	0.04	0.001	0.000	0.037	0.043	1.1				
1998	Oct 14	Oct 24	B09	Marabadiassa	27.60	6.90	100.0	50.0	0.00	0.003	0.030	0.056	0.155					
1998	Oct 14	Oct 24	B09	Marabadiassa	27.60	6.90	84.0	61.0	0.00	0.007	0.032	0.030	0.691					
1995	Nov 11	Nov 17	B10	Tortiya											50	15	103	10
1996	Nov 13	Nov 22	B10	Niakaha											170	0	20	0
1998	Mar 26	Apr 4	B10	Toriya	30.00	-	123.0	110.0	0.00	0.000	0.033	0.068	0.166	0.2				
1998	Apr 8	Apr 17	B10	Toriya	25.19	7.30	97.0	104.5	0.04	0.002	0.039	0.037	2.9	2.0				
1998	Oct 14	Oct 24	B10	Toriya	27.30	6.60	120.6	60.0	0.00	0.004	0.032	0.024	0.183					
1998	Oct 14	Oct 24	B10	Toriya	27.60	6.60	101.9	65.0	0.00	0.006	0.051	0.030	0.362					
1995	Nov 11	Nov 17	B11	Ferké 2											205	183	110	5
1996	Nov 13	Nov 22	B11	Ferké 2											300	180	15	0
1998	Mar 26	Apr 4	B11	Ferkessedougou	31.00	-	126.0	2,000.0	0.00	0.000	0.067	0.099	4.1	0.2				
1998	Apr 8	Apr 17	B11	Ferkessedougou	30.43	7.17	96.8	82.0	0.03	0.003	0.035	0.040	1.8	0.3				
1998	Oct 14	Oct 24	B11	Ferkessedougou	29.10	6.50	117.5	55.0	0.00	0.006	0.095	0.029	0.387					
1998	Oct 14	Oct 24	B11	Ferkessedougou	29.10	6.60	109.5	70.0	0.00	0.009	0.118	0.034	0.270					
1998	Mar 26	Apr 4	B12	Sinematiali	surf	32.00	-	118.0	88.0	0.00	0.000	0.080	0.078	0.067	4.7	0.2		
1998	Mar 26	Apr 4	B12	Sinematiali	fond	30.00	-	76.0	110.0	0.00	0.000	0.072	0.089	12.2	3.9			
1998	Apr 8	Apr 17	B12	Sinematiali	surf	29.31	6.65	102.0	70.0	0.03	0.002	0.032	0.027	2.3	0.1			
1998	Apr 8	Apr 17	B12	Sinematiali	fond	26.12	6.55	62.6	69.0	0.03	0.001	0.033	0.040	1.8	3.6			
1998	Oct 14	Oct 24	B12	Sinematiali	surf	28.00	6.60	98.0	50.0	0.00	0.005	0.004	0.035	0.102				
1998	Oct 14	Oct 24	B12	Sinematiali	fond	28.00	6.70	80.0	60.0	0.00	0.006	0.086	0.022	0.241				
1995	Nov 11	Nov 17	B12	Sinématiali											135	30	137	10
1996	Nov 13	Nov 22	B12	Sinématiali											2,170	10	485	20
1995	Nov 11	Nov 17	C01	Bassam											2,700	70	215	10
1996	Nov 13	Nov 22	C01	Bassam											31,500	183	20	20
1998	Mar 26	Apr 4	C01	Bassam	surf	31.00	-	116.0	23,000.0	12.50	0.000	0.018	0.037	0.124	9.6	0.0		
1998	Mar 26	Apr 4	C01	Bassam	fond	31.00	-	100.0	24,500.0	13.10	0.000	0.000	0.029	0.167	8.2	1.0		
1998	Apr 8	Apr 17	C01	Bassam	surf	30.82	6.77	114.2	13,425.0	6.83	0.008	0.000	0.019	0.109	14.0	8.5		
1998	Apr 8	Apr 17	C01	Bassam	fond	29.71	6.70	63.7	20,160.0	10.90	0.004	0.000	0.021	0.024	8.2	5.3		
1998	Oct 14	Oct 24	C01	Bassam	surf	29.40	6.40	60.0	0.00	0.025	0.070	0.190	0.271					
1998	Oct 14	Oct 24	C01	Bassam	mil	29.50	6.60	70.0	0.00	0.028	0.080	0.109	0.523					
1998	Oct 14	Oct 24	C01	Bassam	fond	29.00	6.50	70.2	0.00	0.026	0.053	0.116	0.431					
1995	Nov 11	Nov 17	C02	Adiahou											1,243	25	89	10

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Year	Date (from - to)	No.	Station	T (°C)	pH	O <sub>2</sub> (%)	EC (µS/cm)	Salinity (‰)	N-NO <sub>2</sub> (mg/l)	N-NO <sub>3</sub> (mg/l)	P-PO <sub>4</sub> (mg/l)	N-NH <sub>4</sub> (mg/l)	Chloro- phile (mg/m <sup>3</sup> )	Pheopig- ments (mg/m <sup>3</sup> )	Coli. total	Coli. fecal	Strepto- coccus fecal	Strepto- coccus perfringen
1996	Nov 13	Nov 22	C02	Adiahou											86,000	388	10	47
1998	Mar 26	Apr 4	C02	Adiahou	surf	31.00	145.0	7,000.0	3.50	0.000	0.136	0.129	19.8	0.4				
1998	Mar 26	Apr 4	C02	Adiahou	fond	30.50	116.0	9,000.0	4.80	0.000	0.041	0.029	25.3	0.2				
1998	Apr 8	Apr 17	C02	Adiahou	surf	29.74	6.40	6,941.0	3.35	0.005	0.003	0.019	14.0	6.0				
1998	Apr 8	Apr 17	C02	Adiahou	fond	29.13	6.21	18,329.0	10.24	0.004	0.000	0.019	5.1	6.8				
1998	Oct 14	Oct 24	C02	Adiahou	surf	28.70	6.60	62.0	0.00	0.026	0.069	0.130	0.254					
1998	Oct 14	Oct 24	C02	Adiahou	mil	28.60	6.80	62.0	0.00	0.026	0.066	0.125	0.389					
1998	Oct 14	Oct 24	C02	Adiahou	fond	28.90	7.00	65.0	0.00	0.026	0.066	0.125	0.297					
1995	Nov 11	Nov 17	C03	Alépé											523	108	98	0
1996	Nov 13	Nov 22	C03	Alépé											68,500	268	80	60
1998	Mar 26	Apr 4	C03	Alépé	surf	30.50	121.0	2,500.0	1.00	0.000	0.022	0.053	61.2	3.4				
1998	Mar 26	Apr 4	C03	Alépé	fond	30.50	106.0	12,000.0	3.00	0.000	0.000	0.046	-	-				
1998	Apr 8	Apr 17	C03	Alépé	surf	26.46	6.53	745.0	0.35	0.004	0.003	0.019	11.1	10.5				
1998	Apr 8	Apr 17	C03	Alépé	fond	24.19	6.42	22,433.0	13.30	0.008	0.000	0.018	1.11	3.0				
1998	Oct 14	Oct 24	C03	Alépé	surf	29.60	6.80	62.0	0.00	0.027	0.063	0.122	0.246					
1998	Oct 14	Oct 24	C03	Alépé	mil	29.20	6.90	65.0	0.00	0.029	0.065	0.125	0.426					
1998	Oct 14	Oct 24	C03	Alépé	fond	29.20	6.60	65.0	0.00	0.028	0.063	0.114	0.428					
1995	Nov 11	Nov 17	C04	M'Basso											248	188	74	157
1996	Nov 13	Nov 22	C04	M'Basso														
1998	Mar 26	Apr 4	C04	M'Basso	surf	32.00	7.27	159.0	0.00	0.100	0.123	0.045	2.7	4.9				
1998	Apr 8	Apr 17	C04	M'Basso	surf	30.25	6.37	88.0	0.04	0.001	0.020	0.033	2.0	4.5				
1998	Oct 14	Oct 24	C04	M'Basso	surf	29.60	6.90	89.0	0.00	0.005	0.040	0.073	0.347					
1998	Oct 14	Oct 24	C04	M'Basso	surf	29.10	7.00	60.0	0.00	0.004	0.054	0.046	0.925					
1995	Nov 11	Nov 17	C05	Aniassué											488	10	120	0
1996	Nov 13	Nov 22	C05	Aniassué											225	150	90	85
1998	Apr 8	Apr 17	C05	Aniassué	surf	29.23	7.34	79.0	0.03	0.000	0.004	0.035	3.8	2.9				
1995	Nov 11	Nov 17	C06	Goumania											220	160	150	5
1996	Nov 13	Nov 22	C06	Goumania											2,400	0	3,000	10
1998	Mar 26	Apr 4	C06	Groumania	surf	30.00	8.35	185.0	0.00	0.000	0.023	0.012	24.5	1.2				
1998	Mar 26	Apr 4	C06	Groumania	fond	27.00	8.20	175.0	0.00	0.000	0.114	0.126	8.7	0.6				
1998	Apr 8	Apr 17	C06	Groumania	surf	29.17	7.68	101.9	0.03	0.003	0.013	0.055	0.017	3.5	0.6			
1998	Apr 8	Apr 17	C06	Groumania	fond	28.42	7.69	93.6	0.03	0.002	0.029	0.036	1.2	1.7				
1998	Oct 14	Oct 24	C06	Groumania	surf	27.30	6.80	60.0	0.00	0.016	0.116	0.030	0.285					
1998	Oct 14	Oct 24	C06	Groumania	fond	27.30	6.50	85.0	0.00	0.014	0.117	0.031	0.616					
1995	Nov 11	Nov 17	C07	Ganse											185	160	72	20
1996	Nov 13	Nov 22	C07	Ganse											1,800	25	35	10
1998	Mar 26	Apr 4	C07	Ganse	surf	31.50	8.88	141.0	0.00	0.000	0.169	0.068	14.6	0.5				
1998	Mar 26	Apr 4	C07	Ganse	fond	29.80	8.47	102.0	0.00	0.000	0.099	0.070	1.2	0.9				
1998	Apr 8	Apr 17	C07	Ganse	surf	29.96	7.16	112.2	0.03	0.001	0.009	0.033	0.019	0.0				
1998	Oct 14	Oct 24	C07	Ganse	surf	29.50	6.10	87.9	0.00	0.007	0.115	0.033	0.110					
1998	Oct 14	Oct 24	C07	Ganse	fond	28.50	6.80	68.0	0.00	0.007	0.115	0.032	0.162					
1995	Nov 11	Nov 17	C08	Kafolo											245	130	28	5
1996	Nov 13	Nov 22	C08	Kafolo											235	13	75	0
1998	Mar 26	Apr 4	C08	Kafolo	surf	31.20	6.84	66.0	0.00	0.000	0.107	0.081	2.3	4.2				
1998	Apr 8	Apr 17	C08	Kafolo	surf	29.21	7.46	142.6	0.04	0.006	0.060	0.036	0.025	0.0				

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Year	Date (from – to)	No.	Station	T (°C)	pH	O <sub>2</sub> (%)	EC (µS/cm)	Salinity (‰)	N-NO <sub>2</sub> (mg/l)	N-NO <sub>3</sub> (mg/l)	P-PO <sub>4</sub> (mg/l)	N-NH <sub>4</sub> (mg/l)	Chloro- phile (mg/m <sup>3</sup> )	Pheopig- ments (mg/m <sup>3</sup> )	Coli. total	Coli. fecal	Strepto- coccus fecal	Strepto- coccus perfringen
1998	Oct 14	C08	Kafolo	30.70	6.90	112.5	52.0	0.00	0.004	0.034	0.021	0.279						
1998	Oct 14	C08	Kafolo	30.00	6.50	110.5	52.0	0.00	0.004	0.070	0.019	0.242						
1999	Apr 19	L01	Assoume 1./Plage Valtour												33	20	50	<1
1999	Apr 19	L02	Bassam 2./Embouchure												125	23	65	<1
1999	Apr 19	L03	Jacquerville 3./Hotel Campement												2	<1	10	<1
1999	Apr 20	L03	Jacquerville	31.40	8.28		38,600.0	-	0.007	0.013	0.032	0.091	<0.001		2	<1	10	<1
1999	Apr 19	L04	GD-Lahou 4./Village Kpanda												<1	<1	2	<1
1999	Apr 19	L05	Fresco F1 Embouchure												150	70	50	<1
1999	Apr 19	L05	Fresco P2 Plage												275	150	20	<1
1999	Apr 19	L05	Fresco F2 Baie. Antenne												425	185	40	30
1999	Apr 19	L05	Fresco F3 Debarcadere												200	<1	<1	55
1999	Apr 19	L06	Sassandra P6 Plage S/prefecture												90	57	10	150
1999	Apr 19	L07	San Pedro SP1 Club House												59	10	16	<1
1999	Apr 19	L07	San Pedro SP2 Port-peche												4,500	2,900	3,800	350
1999	Apr 19	L07	San Pedro SP3 Mairie												4	<1	39	10
1999	Apr 19	L07	San Pedro SP4 Hotel Balmer												45	22	27	40
1999	Apr 19	L07	San Pedro SP5 Village Digboue												60	>1	30	10
1999	Apr 19	L08	GD Bereby GBR Hotel Campement												10	<1	120	<1
1999	Apr 19	L09	Tabou T1 Phare												675	575	1,750	<1
1999	Apr 19	L09	Tabou T2 Cours d'eau												1,100	325	460	330
1995	Oct 11	S01	Sassandra Emb.												55	13	0	45
1998	Mar 4	S01	Sassandra Emb. surf	30.00	7.90	148.0	1,600.0	1.00	0.000	0.003	0.050	0.033	2.9	1.4				
1998	Mar 4	S01	Sassandra Emb. fond	28.00	7.87	141.0	20,800.0	15.50	0.000	0.013	0.095	0.026	1.5	1.8				
1998	Oct 31	S01	Sassandra Emb.	29.00	6.46	80.0	80.0	0.00	0.004	0.000	0.070	0.357						
1995	Oct 11	S02	Sassandra Pont															
1998	Mar 4	S02	Sassandra Pont surf	31.00	7.91	179.0	70.0	0.00	0.013	0.027	0.110	0.114	4.7	0.6	275	73	0	40
1998	Mar 4	S02	Sassandra Pont fond	30.50	7.89	42.0	75.0	0.00	0.000	0.003	0.047	0.103	2.6	1.5				
1998	Oct 31	S02	Sassandra Pont surf	28.40	6.70	57.5	75.0	0.00	0.002	0.002	0.000	0.344						
1998	Oct 31	S02	Sassandra Pont fond	28.90	6.92	55.8	70.0	0.00	0.012	0.000	0.063	0.443						
1995	Oct 11	S03	Soubre												115	70	150	100
1998	Mar 4	S03	Soubre	30.00	7.81	174.0	70.0	0.00	0.014	0.051	0.266	0.010	9.0	4.0				
1998	Oct 31	S03	Soubre	30.00	6.83	63.1	75.0	0.00	0.003	0.000	0.054	0.237						
1998	Mar 4	S04	Guessabo surf	31.00	7.48	89.0	85.0	0.00	0.014	0.050	0.291	0.000	10.5	3.8				
1998	Mar 4	S04	Guessabo fond	28.50	7.48	125.0	82.0	0.00	0.013	0.051	0.244	0.019	8.7	1.1				
1998	Oct 31	S04	Guessabo	29.30	6.42	58.0	75.0	0.00	0.003	0.000	0.057	0.286						
1995	Oct 11	S05	Semien (Man)												240	0	60	80
1998	Mar 4	S05	Semien (Man) surf	27.00	8.22	176.0	50.0	0.00	0.021	0.020	0.078	0.000	2.6	0.6				
1998	Mar 4	S05	Semien (Man) fond	26.50	8.21	169.0	50.0	0.00	0.019	9.000	0.164	0.000	0.0	0.0				
1998	Oct 31	S05	Semien (Man)	27.00	6.60	149.0	70.0	0.00	0.002	0.000	0.790	0.431						
1995	Oct 11	S06	Dabala												19,050	9,650	75	45
1998	Mar 4	S06	Dabala	26.50	5.59	10.0	0.0	0.00	0.011	0.012	1.186	0.014	1.5	0.4				
1998	Oct 31	S06	Dabala	26.70	6.59	59.0	90.0	0.00	0.003	0.000	0.119	0.243						
1995	Oct 11	S07	Vialadougou												1,650	587	1,118	73
1998	Mar 4	S07	Vialadougou	25.00	7.68	130.0	25.0	0.00	0.031	0.000	1.106	0.000	1.2	0.1				
1998	Oct 31	S07	Vialadougou surf	26.10	6.46	81.6	100.0	0.00	0.001	0.000	0.200	0.340						

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Year	Date (from - to)	No.	Station	T (°C)	pH	O <sub>2</sub> (%)	EC (μS/cm)	Salinity (‰)	N-NO <sub>2</sub> (mg/l)	N-NO <sub>3</sub> (mg/l)	P-PO <sub>4</sub> (mg/l)	N-NH <sub>4</sub> (mg/l)	Chloro- phile (mg/m <sup>3</sup> )	Pheopig- ments (mg/m <sup>3</sup> )	Coli. total	Coli. fecal	Strepto- coccus fecal	Strepto- coccus perfringen
1998	Oct 31	Nov 4	S07	Vialadougou	fond	27.20	6.80	76.7	50.0	0.00	0.002	0.000	0.210	0.249				
1995	Oct 11	Oct 15	S08	Dagbe											1,100	438	390	33
1998	Mar 4	Mar 12	S08	Dagbe		27.50	7.92	148.0	80.0	0.00	0.020	0.021	0.266	0.045				
1998	Oct 31	Nov 4	S08	Dagbe		27.40	6.74	103.0	60.0	0.00	0.001	0.000	0.057	0.287				

Source: Centre Ivoirien Anti-Pollution (GIAPOL), 1999

## 1.2 Metal Analysis of Ebrie Lagoon Sediment

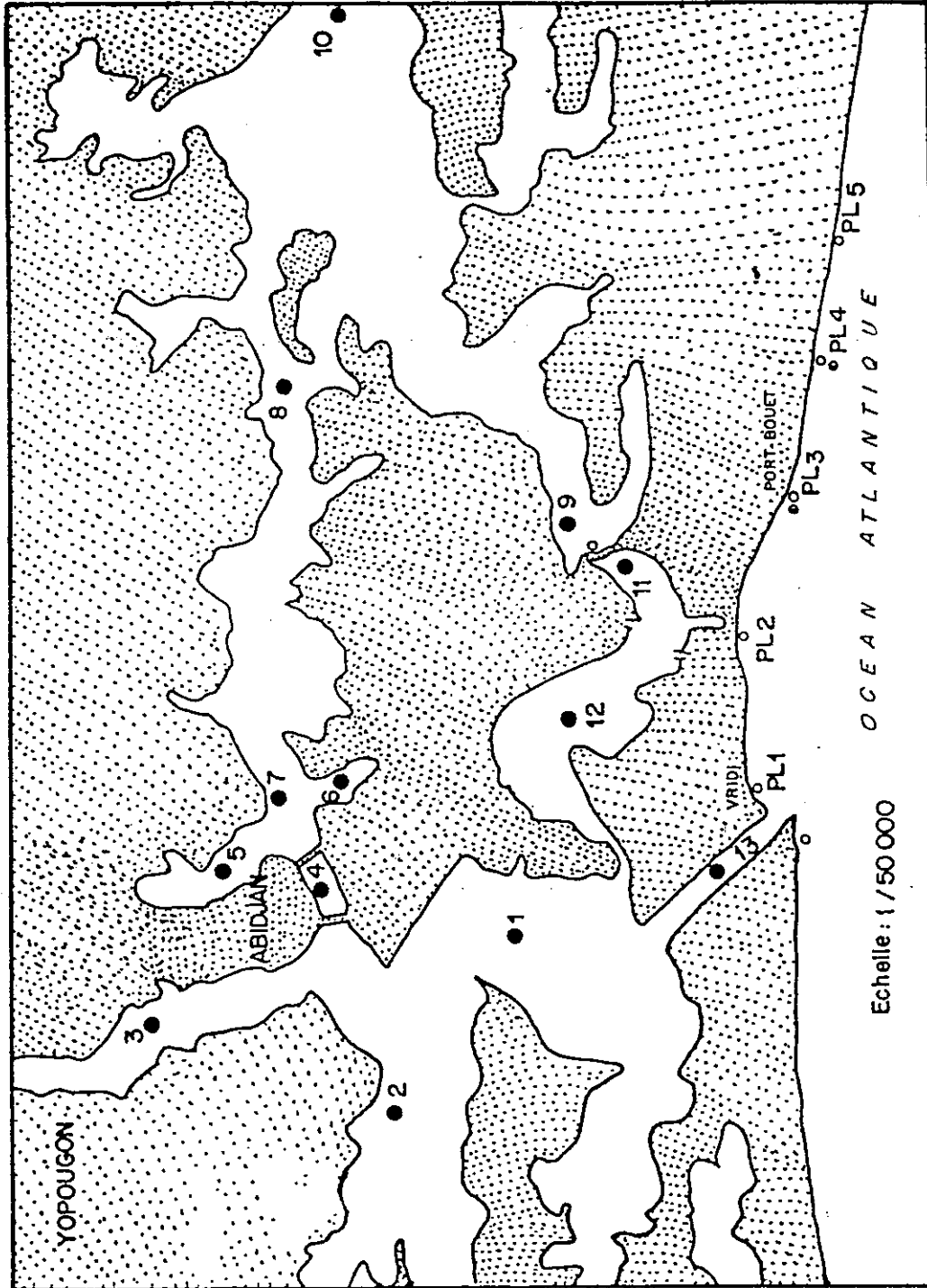


Figure 1.2-1 Sampling Points for Metal Analysis of Ebrie Lagoon Sediments and the Beach in Abidjan Area

Source: Data from CIAPOL (1994)

**Table 1.2-1 Content of Metals of Ebrie Lagoon Sediments and the Beach**

Station	Cr(ppm)	Cu(ppm)	Fe(g/Kg)	Hg(ppm)	Mn(ppm)	Pb(ppm)	Zn(ppm)
Lagune							
1	156	30	48	0.1	404	31	158
2	119	43	50	0.3	221	17	79
3	1718	3	61	0.4	234	54	232
4	465	30	41	0.1	156	10	47
5	286	55	67	0.3	169	61	139
6	429	76	52	0.5	182	89	269
7	358	41	56	0.3	208	17	56
8	135	43	57	0.1	365	18	46
9	135	52	61	0.3	378	41	139
10	109	33	51	0.1	430	16	93
11	69	13	20	0.3	521	11	88
12	120	49	62	0.5	534	41	398
13	21	3	1	0.1	24	4	6
Plage							
PL1	17	6	8	0.1	40	4	10
PL2	118	9	7	0.1	68	2	10
PL3	57	6	12	0	69	3	16
PL4	29	5	17	0	88	2	18
PL5	24	8	11	0	112	2	16

Source: CIAPOL(1994)

**Table 1.2-2 Variation of the Concentration of Total Hydrocarbon and the Waste Organic Chloride in the Sediment of Abidjan Lagoon**

Station	HC (ppm)	PCB (ppb)	Lindane (ppb)	DDE (ppb)	DDD (ppb)	DDT (ppb)	Σ DDT (ppb)
Chenal Central Ouest	46-596	3-77	0.6-19	0-4.5	0.5-11	0-18	2.0-25
Baie du Banco	408-1790	117-170	0.5-7	4.0-8	5.5-23	0-30	13-60
Baie de Cocody	636-1606	40-55	0.5-1.7	7	0.5-7	0-2	8.0-16
Zone Portuaire	293-455	36-46	3.3	5	4.9-12	3-7.6	19
Baie de Marcory	2440	187	9.7	149	803	45	997
Baie de Bietri	57-1194	4-194	0.5-0.9	1.0-17	0.2-47	0-7	2.0-72
Baie de Koumassi	35-314	2-151	0.5-4.2	2.0-18	1.0-11	0-2.5	6.0-32
Chenal Central Est	191-565	3-213	0.5-2.2	0-10	0.2-35	0-113	1.0-159
Ile Boulay	477	2-32	0.5-1.1	0-3.4	0.5-7	0-6.4	2.0-17

Source: CIAPOL(1994)

## **1.3 Water Quality Survey by JICA Study Team**

### **(1) Sampling Sites**

The purpose of the Study is to define the physical-chemical and bacteriologic characteristics of groundwater and surface water of different regions. It has been taken in 13th to 20th October 1999, during rainy season and 7th to 13th January, 2000 that total of 21 samples distributed as follows through out the territory.

### **(2) Analysis Items**

All samples are kept in good conditions and carried to Abidjan within 24 hours. Only the measurements of temperature and pH have been made on the sites of sampling by using portable pH-meter. The other items are examined in the laboratory. The analysis items for groundwater are water temperature, pH, electric conductivity (EC), calcium, magnesium, sodium, potassium, iron, manganese, ammonium, carbonate, bicarbonate, sulfate, chlorine, nitrite, nitrate, fluoride, arsenic, totally 18 items.

On the other hand, the analysis items for surface water are water temperature, water level, suspended solids (SS), turbidity, pH, EC, ammonium, nitrite, nitrate, phosphate, manganese, fluoride, arsenic, total coliformes, dissolved oxygen (DO), chemical oxygen demand (COD), totally 17 items.



# 1.3 Water Quality Survey by JICA Study Team

GESTION INTEGREE DES RESSOURCES EN EAU  
 BASIN AND CONTROL POINT MAP WITH CARTOGRAPHIC FEATURES

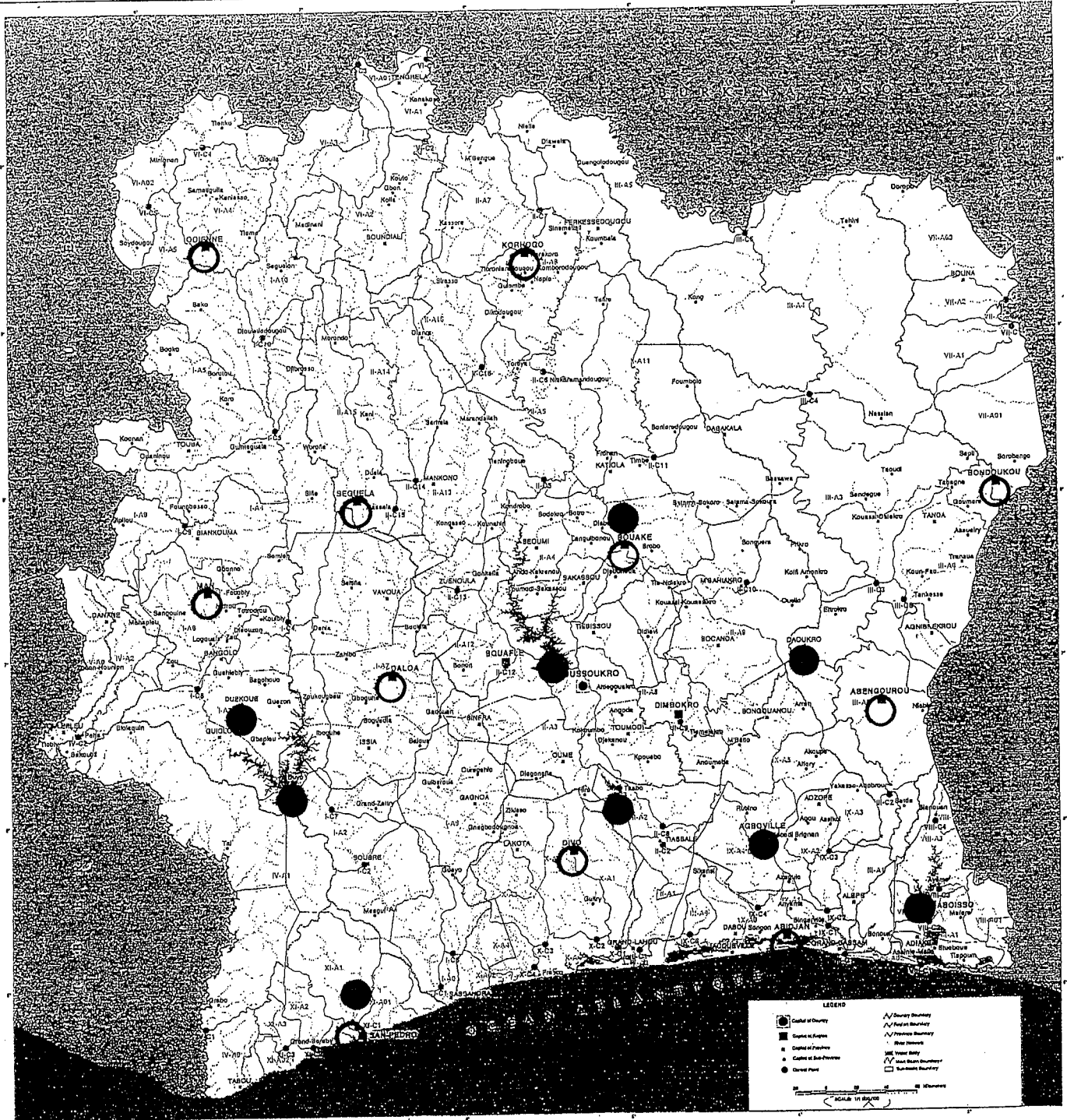


Figure 1.3-1 Location of Sampling Site for Water Quality Survey

Groundwater ○  
 Surface Water ●

Table 1.3-1 Water Quality of Groundwater in the Rainy Season

## (1) Groundwater ( Pumps )

	Aben-Gourou	Abidjan	Bondoukou	Bouaké	Daloa	Divo	Korhogo	Man	Odienné	San Pédro	Séguéla
<b>T</b> (°C)	27.8	30.9	27.7	29.8	26.6	28.7	29.3	28.1	27.3	28.6	27.9
<b>pH</b>	5.4	6.9	7.4	7.8	6.7	6.7	7.2	6.0	6.3	6.7	7.0
<b>EC</b> (µs/cm)	111	962	580	429	79	143	283	76	110	263	224
<b>Ca</b> (mg/l)	0.50	60.50	31.70	28.60	1.95	3.20	9.30	2.20	4.60	5.85	7.65
<b>Mg</b> (mg/l)	0.85	6.45	6.15	17.70	1.70	1.30	6.30	0.85	1.00	4.50	6.85
<b>Na</b> (mg/l)	10.30	90.70	43.10	18.60	7.70	18.20	20.70	8.80	10.50	27.70	15.90
<b>K</b> (mg/l)	2.15	27.40	37.60	5.25	4.10	3.80	7.50	2.65	2.90	5.50	4.30
<b>Fe</b> (mg/l)	1.60	0.50	1.10	2.50	0.02	0.26	0.12	0.02	0.02	2.42	4.00
<b>NH<sub>4</sub></b> (mg/l)	0.07	0.79	0.17	0.36	0.12	0.13	0.18	0.08	0.08	0.22	0.62
<b>HCO<sub>3</sub></b> (mg/l)	9.8	124.4	116.0	273.3	46.4	58.6	61.0	18.30	24.40	110.0	144.0
<b>CO<sub>3</sub></b> (mg/l)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Cl</b> (mg/l)	17.75	130.64	55.00	2.84	5.30	20.24	22.70	4.26	5.70	25.10	1.80
<b>SO<sub>4</sub></b> (mg/l)	< 0.50	75.70	39.50	15.60	< 0.50	< 0.50	< 0.50	2.70	2.80	14.85	3.60
<b>NO<sub>2</sub></b> (mg/l)	< 0.01	0.03	0.03	< 0.01	< 0.01	0.03	0.03	< 0.01	< 0.01	< 0.01	< 0.01
<b>NO<sub>3</sub></b> (mg/l)	24.72	62.00	104.58	10.02	13.26	11.10	29.82	30.42	24.72	13.38	10.08
<b>Mn</b> (mg/l)	0.07	0.10	< 0.02	0.30	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
<b>F</b> (mg/l)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
<b>As</b> (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Note: The survey was done by JICA Study Team.

**Table 1.3-2 Water Quality of Surface Water in the rainy Season****(2) Surface Water ( Dams )**

	CIE Buyo	CIE Kossou	CIE Taabo	CIE Ayamé 1	CIE Ayamé 2	San Pédro (GRAH)	SODECI Agboville	SODECI Daoukro	KAN Bouaké	SODECI Duékoué
<b>Cote (m)</b>	7.48	-	11.90	89.26	68.57	21.04	-	-	12.40	0.73
<b>T (°C)</b>	30.6	28.0	27.4	30.3	32.4	28.0	27.1	25.4	28.2	29.8
<b>pH</b>	8.1	7.6	7.2	7.1	7.4	7.0	7.4	7.1	8.0	6.6
<b>SS (mg/l)</b>	70	64.0	92.0	86	90	71.0	250	114	320	26.0
<b>Turbi. (NTU)</b>	6.90	1.90	22.00	4.10	3.20	22.00	8.00	45.00	4.00	13.00
<b>EC (µs/cm)</b>	69	63	90	85	89	70	248	113	319	25
<b>NO<sub>2</sub> (mg/l)</b>	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02	0.02	< 0.01
<b>NO<sub>3</sub> (mg/l)</b>	1.80	1.62	13.62	13.62	10.80	2.34	10.98	9.78	9.78	0.84
<b>NH<sub>4</sub> (mg/l)</b>	0.10	0.17	0.18	0.13	0.13	0.23	0.20	0.20	0.20	0.15
<b>PO<sub>4</sub> (mg/l)</b>	0,44	0.15	0.37	0.04	0.07	0.30	0.11	0.11	0.10	0.05
<b>Mn (mg/l)</b>	< 0.02	< 0,02	< 0.02	< 0.02	0.03	< 0.02	0.03	0.13	0.04	< 0.02
<b>F (mg/l)</b>	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
<b>As (mg/l)</b>	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
<b>Colif. UFC / 100 ml</b>	0	11	12	0	0	6	> 150	0	10	0
<b>DO (mg/l)</b>	6.5	7.2	6.5	7.0	7.1	6.0	6.5	7.5	3.5	6.2
<b>COD (mg/l)</b>	7.90	2.50	5,80	12.60	16.10	12.90	15.30	12.80	4.00	6.40

Note: The survey was done by JICA Study Team.

**Table 1.3-3 Water Quality of Groundwater in the Dry Season**

**(1) Groundwater ( Pumps )**

	Aben-gourou	Abidjan	Bondo-ukou	Bouaké	Daloa	Divo	Korho-go	Man	Odienné	San Pédro	Séguéla
<b>T (°C)</b>	25,6	30,2	25,9	28,2	27,1	29,2	28,4	27,1	26,4	27,5	28,3
<b>pH</b>	5,2	6,0	6,5	7,8	6,4	6,1	6,3	5,6	5,7	6,45	6,7
<b>EC (µs/cm)</b>	110	893	228	494	90	146	287	79	128	294	249
<b>Ca (mg/l)</b>	0,65	61,30	8,16	55,00	2,10	3,50	10,20	2,40	6,45	7,45	10,90
<b>Mg (mg/l)</b>	0,95	5,45	2,95	22,45	1,60	1,30	6,85	0,78	1,16	6,20	9,00
<b>Na (mg/l)</b>	14,45	107,00	22,20	18,90	7,80	17,45	20,50	7,60	11,75	27,25	10,85
<b>K (mg/l)</b>	1,35	23,20	3,50	3,90	2,80	2,30	6,40	1,70	2,20	4,65	12,35
<b>Fe (mg/l)</b>	0,09	0,16	0,27	0,50	<0,02	0,03	0,06	0,03	0,03	1,60	0,25
<b>NH<sub>4</sub> (mg/l)</b>	0,20	0,80	0,20	0,40	0,10	0,10	0,20	0,10	0,10	0,20	0,60
<b>HCO<sub>3</sub> (mg/l)</b>	3,7	65,9	134,2	268,4	45,1	59,8	54,9	18,3	28,0	114,7	152,5
<b>CO<sub>3</sub> (mg/l)</b>	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
<b>Cl (mg/l)</b>	16,33	130,64	3,20	31,95	4,26	12,07	23,43	5,32	6,70	24,85	1,42
<b>SO<sub>4</sub> (mg/l)</b>	< 0,50	70,50	36,50	15,50	<0,50	<0,50	13,20	2,50	2,20	12,80	4,00
<b>NO<sub>2</sub> (mg/l)</b>	< 0,01	< 0,01	< 0,01	< 0,01	<0,01	<0,01	< 0,01	<0,01	< 0,01	<0,01	<0,01
<b>NO<sub>3</sub> (mg/l)</b>	25,70	60,00	95,60	11,00	13,10	10,10	30,10	29,50	20,70	13,50	10,00
<b>Mn (mg/l)</b>	< 0,02	< 0,02	< 0,02	< 0,02	<0,02	<0,02	< 0,02	<0,02	< 0,02	<0,02	<0,02
<b>F (mg/l)</b>	< 0,02	< 0,02	< 0,02	< 0,02	<0,02	<0,02	< 0,02	<0,02	< 0,02	<0,02	<0,02
<b>As (mg/l)</b>	< 0,05	< 0,05	< 0,05	< 0,05	<0,05	<0,05	< 0,05	<0,05	< 0,05	<0,05	<0,05

Note : The survey was done by JICA Study Team.

**Table 1.3-4 Water Quality of Surface Water in the Dry Season**

**(2) Surface Water ( Dams )**

	CIE Buyo	CIE Kossou	CIE Taabo	CIE Ayamé 1	CIE Ayamé 2	San Pédro (GRAH)	SODECI Agboville	SODECI Daoukro	KAN Bouaké	SODECI Duékoué
<b>Cote (m)</b>	6,90	-	10,50	87,70	68,90	20,18	-	-	-	0,61
<b>T (°C)</b>	29,8	28,5	27,8	29,9	31,2	30,4	26,2	28,9	27,6	28,7
<b>pH</b>	7,10	7,51	7,80	7,40	7,10	7,50	7,25	7,50	8,50	7,40
<b>SS (mg/l)</b>	59	70	83	81	94	82	222	424	332	31
<b>Turbi. (NTU)</b>	2,30	2,80	2,50	3,50	7,70	6,10	5,20	7,60	7,40	2,50
<b>EC (µs/cm)</b>	59,10	70,00	83,00	81,00	93,00	81,90	221,00	423,00	331,00	30,50
<b>NO<sub>2</sub> (mg/l)</b>	<0,01	< 0,01	<0,01	< 0,01	< 0,01	< 0,01	< 0,01	<0,01	< 0,01	<0,01
<b>NO<sub>3</sub> (mg/l)</b>	2,00	1,16	14,10	14,60	11,20	2,30	11,00	9,60	10,80	0,80
<b>NH<sub>4</sub> (mg/l)</b>	0,10	0,20	0,20	0,10	0,10	0,20	0,20	0,20	0,20	0,15
<b>PO<sub>4</sub> (mg/l)</b>	0,40	0,18	0,42	0,05	0,08	0,25	0,10	0,10	0,15	0,05
<b>Mn (mg/l)</b>	<0,02	< 0,02	<0,02	< 0,02	< 0,02	< 0,02	< 0,02	<0,02	< 0,02	<0,02
<b>F (mg/l)</b>	<0,02	< 0,02	<0,02	< 0,02	< 0,02	< 0,02	< 0,02	<0,02	< 0,02	<0,02
<b>As (mg/l)</b>	<0,05	< 0,05	<0,05	< 0,05	< 0,05	< 0,05	< 0,05	<0,05	< 0,05	<0,05
<b>Colif. UFC/ 100 ml</b>	> 150	> 150	7	0	0	> 150	> 150	0	0	> 150
<b>DO (mg/l)</b>	6,00	7,00	6,80	7,00	7,00	5,80	6,00	7,00	3,50	6,00
<b>COD (mg/l)</b>	6,90	12,00	5,60	12,00	15,10	7,00	16,30	10,70	4,50	6,60

Note : The survey was done by JICA Study Team.

## 1.4 Water Quality Analysis

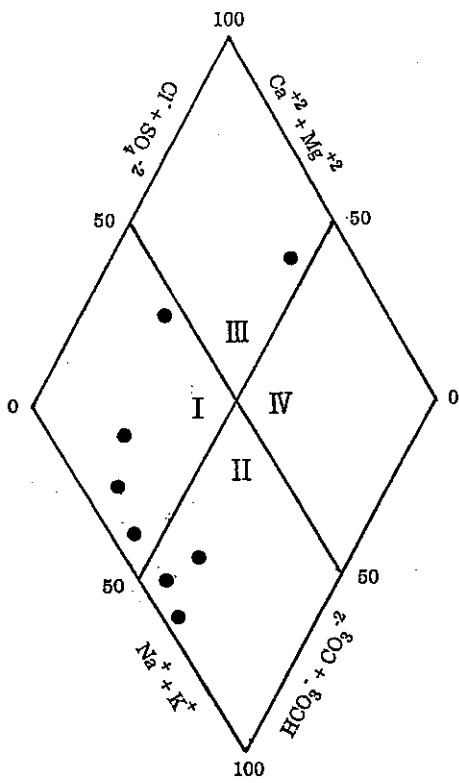


Figure 1.4-1 Investigation Area for Groundwater Quality Analysis

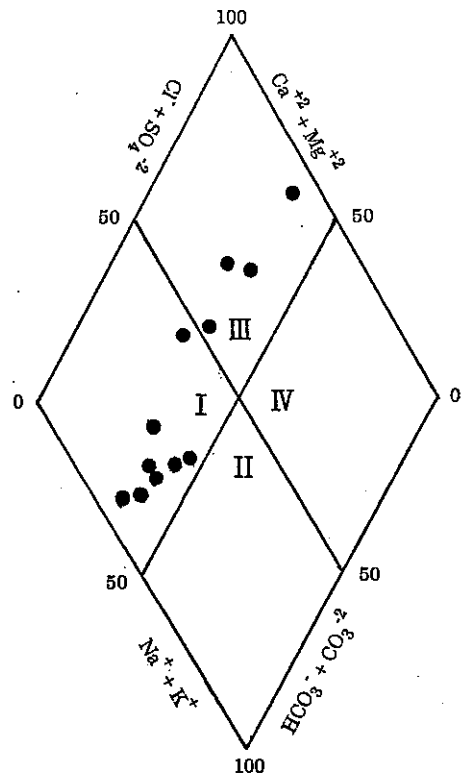
Table 1.4-1 Type of Groundwater Quality by Linear Diagram

Regional Area	Number	Groundwater Type (%)			
		I	II	III	IV
1. Savanes	8	4 (50)	3 (38)	1 (12)	0 (0)
2. Vallee Du Bandama	12	8 (67)	0 (0)	4 (33)	0 (0)
3. Moyen Comoe	11	7 (64)	3 (27)	1 (10)	0 (0)
4. Lacs and N'zi Comoe	6	4 (66)	1 (17)	1 (17)	0 (0)
5. Haut and Sassandra	7	3 (43)	1 (14)	2 (29)	1 (14)
6. Montagnes	4	2 (50)	1 (25)	1 (25)	0 (0)
7. Sud-Comoe	5	2 (40)	0 (0)	2 (40)	1 (20)
8. Agneby	6	0 (0)	1 (17)	2 (33)	3 (50)
9. Lagunes	5	0 (0)	1 (20)	1 (20)	3 (60)

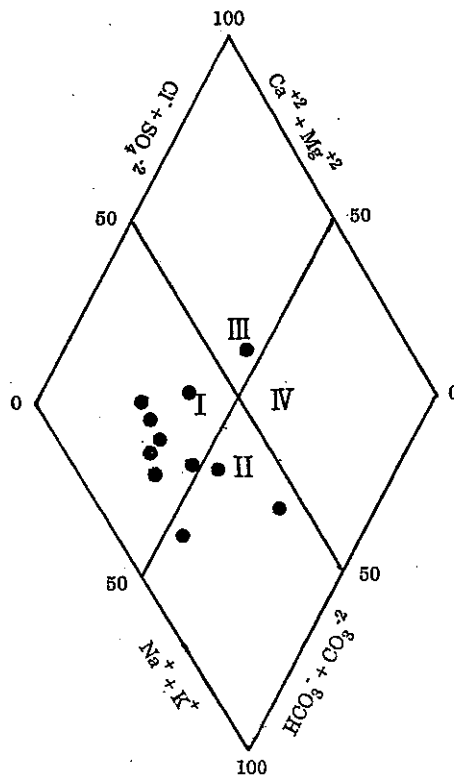
note: I ;Calcium Bicarbonate, II ;Sodium Bicarbonate, III;Non Calcium Bicarbonate,  
IV;Non Sodium Bicarbonate,



1. Savanes Area



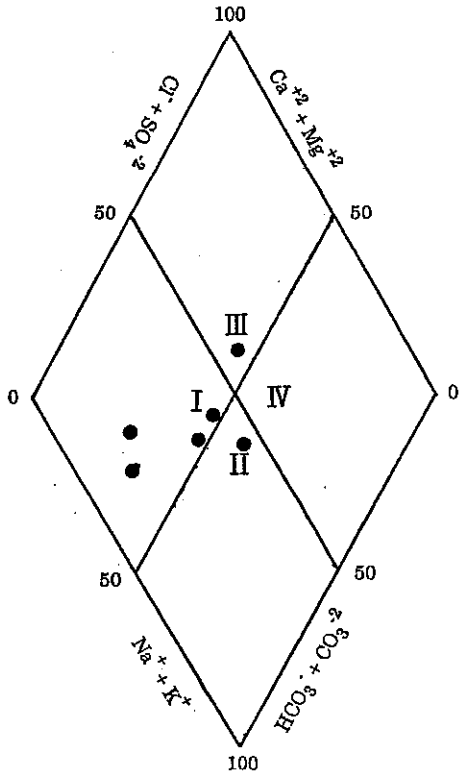
2. Vallee Du Bandama Area



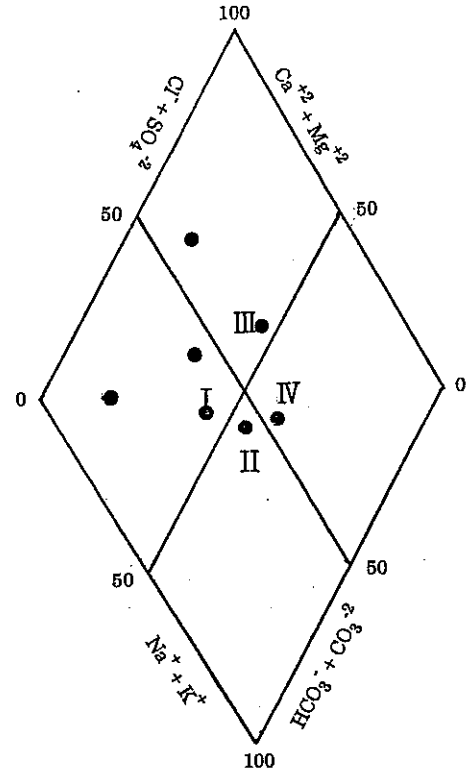
3. Moyen Comoe Area

Figure 1.4-2 Type of Groundwater Quality by Linear Diagram (1)

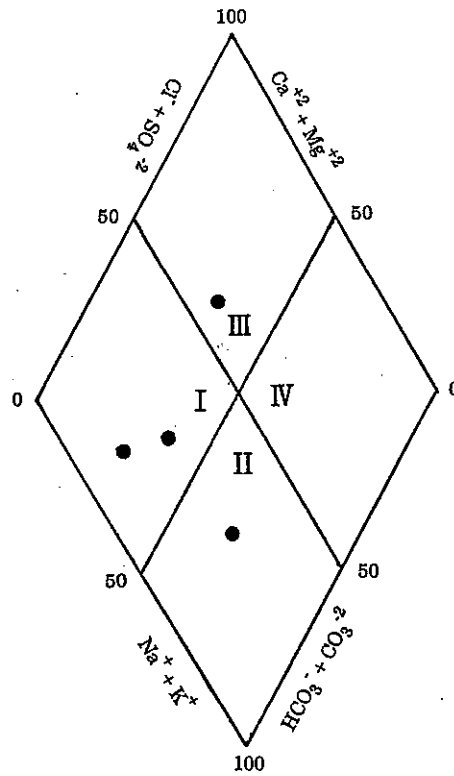




4. Lacs and N'zi Comoe Area

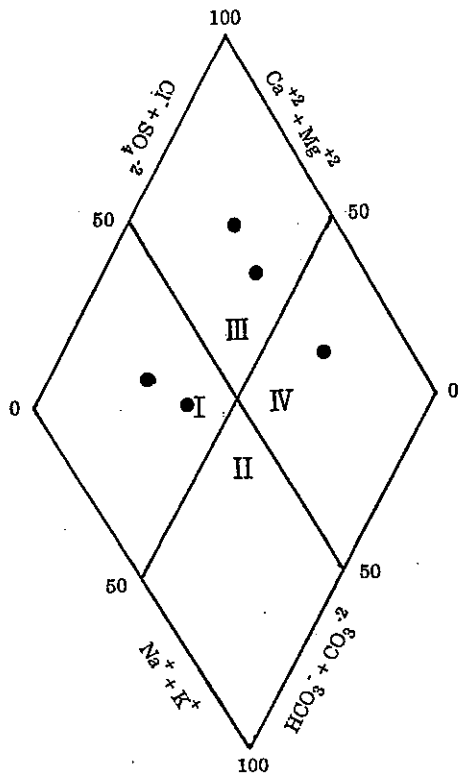


5. Haut and Sassandra Area

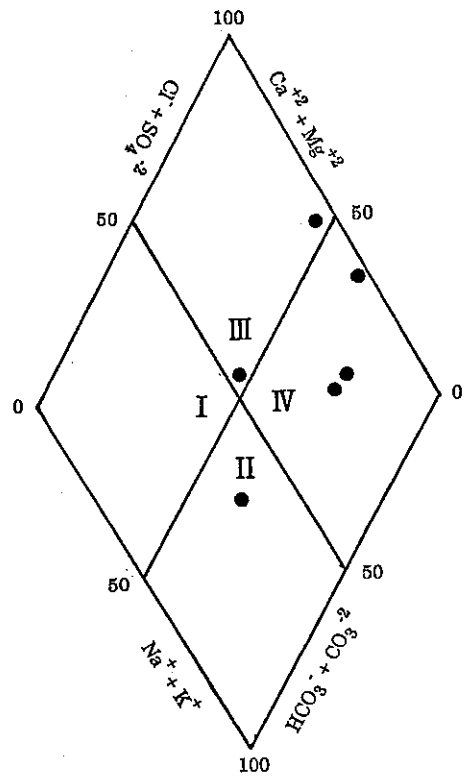


6. Montagnes Area

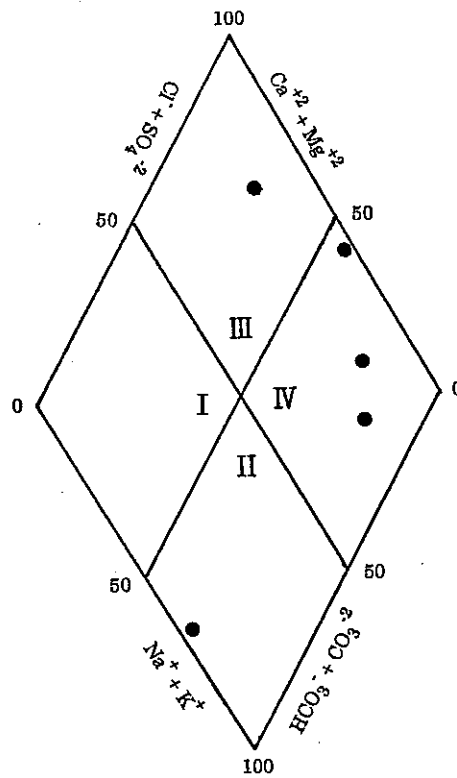
Figure 1.4-2 Type of Groundwater Quality by Linear Diagram (2)



7. Sud-Comoe Area



8. Agneby Area



9. Lagunes Area

Figure 1.4-2 Type of Groundwater Quality by Linear Diagram (3)

## 1.5 Groundwater Quality around Abidjan

Table 1.5-1 Ground Water Quality around Abidjan

Station	Code	Date	T (°C)	EC (μ S/cm)	TURB (NTU)	Color (mg/l)	pH	Cl <sup>-</sup> (mg/l)	Fe (mg/l)	Mn (mg/l)	O <sub>2</sub> dis (mg/l)	Silice (mg/l)	PO <sub>4</sub> (mg/l)	NH <sub>4</sub> (mg/l)	NO <sub>3</sub> <sup>-</sup> (mg/l)	NO <sub>2</sub> <sup>-</sup> (mg/l)	mat org (mg/l)	SO <sub>4</sub> <sup>-</sup> (mg/l)
NIANGON NORD NN1	301	28/6/95	26.1	39.4	0.20	<5	4.47	39.1	0.05	0.07		2.8	0.09	0.1	4.9	0.001	0.3	
NIANGON NORD NN1	301	14/2/94	27.5	38.0	0.60	5	4.76	12.4	0.03	0.00		0.8	0.70	0.0	7.5	0.003	0.8	
NIANGON NORD NN2	302	14/2/94	28.0	27.7	0.80	5	4.87	7.1	0.03	0.00		1.2	0.79	0.0	7.5	0.007	0.8	
NIANGON NORD NN2	302	14/6/93	21.1	33.7	0.00	<2.5	4.40	2.3	0.15	0.03	7.0	2.2	0.28	0.0	1.3	0.096	0.3	
NIANGON NORD NN3	303	14/2/94	28.0	32.2	0.50	5	4.68	14.2	0.03	0.00		3.3	0.23	0.0	6.6	0.000	0.4	
NIANGON NORD NN3	303	14/6/93	21.0	31.1	1.00	<2.5	4.50	3.0	<0.06	0.03	7.4	2.9	0.78	0.0	1.0	0.070	0.5	
NIANGON NORD NN4	304	28/6/95	26.3	33.2	0.40	<5	4.47	23.1	0.06	0.05		3.2	0.02	0.3	4.9	0.004	1.0	
NIANGON NORD NN4	304	14/2/94	28.0	31.4	0.50	5	4.70	10.7	0.08	0.20		3.5	0.04	0.0	4.4	0.003	0.0	
NIANGON NORD NN5	305	28/6/95	26.4	34.5	0.40	<5	4.44	16.0	0.06	0.05		3.1	0.03	0.3	5.7	0.004	0.8	
NIANGON NORD NN5	305	14/2/94	28.0	33.5	0.60	5	4.67	7.1	0.09	0.00		0.4	0.10	0.0	8.4	0.010	0.8	
NIANGON NORD NN6	306	28/6/95	26.2	34.9	0.40	<5	4.48	17.8	0.06	0.03		3.5	0.02	0.4	5.9	0.006	0.2	
NIANGON NORD NN6	306	14/2/94	27.9	32.4	0.60	5	4.70	12.4	0.00	0.10		0.5	0.08	0.0	12.3	0.003	0.8	
NIANGON NORD NN7	307	28/6/95	26.1	36.8	0.60	<5	4.40	17.8	0.07	0.02		3.2	0.03	0.4	5.8	0.006	0.1	
NIANGON NORD NN7	307	14/2/94	27.7	34.3	0.90	5	4.97	8.9	0.04	0.10		3.2	0.06	0.0	6.6	0.016	0.8	
NIANGON NORD NN8	308	28/6/95	26.1	33.1	0.50	<5	4.53	16.0	0.07	0.03		3.5	0.06	0.4	4.0	0.001	0.2	
NIANGON NORD NN8	308	14/2/94	27.7	35.6	0.60	5	4.68	8.9	0.01	0.00		2.1	0.09	0.0	7.9	0.003	0.4	
NIANGON NORD NN9	309	14/2/94	27.9	31.3	0.60	5	4.79	10.7	0.44	0.00		0.5	0.18	0.0	5.3	0.000	0.8	
NIANGON NORD NN9	309	14/6/93	23.4	31.8	0.00	<2.5	4.80	3.0	0.00	0.03	6.9	3.0	0.80	0.0	0.7	0.006	0.1	
NIANGON NORD NN10	310	28/6/95	26.1	32.3	0.80	<5	4.46	19.5	0.07	0.02		3.5	0.05	0.4	4.5	0.003	0.2	
NIANGON NORD NN10	310	14/2/94	27.4	29.5	0.40	5	5.24	8.9	0.40	0.00		0.9	0.07	0.0	5.3	0.007	0.0	
NORD RIVIERA NR1	321	16/2/94	26.9	38.1	0.30	5	4.77	8.9	0.02	0.00		0.5	0.17	0.0	6.6	0.007	0.0	
NORD RIVIERA NR1	321	15/7/93	24.6	39.6	0.00	<2.5	4.46	2.0	0.07	<0.03	7.7	8.8	1.14	0.0	4.5	0.003	0.0	
NORD RIVIERA NR2	322	21/6/95	26.6	36.6	0.90	<5	4.37		0.05	0.02		3.2	0.03	0.1	20.8	0.021		
NORD RIVIERA NR2	322	16/2/94	28.0	31.5	0.60	5	4.63	10.7	0.01	0.00		0.7	0.06	0.0	7.5	0.040	0.8	
NORD RIVIERA NR3	323	21/6/95	26.7	37.2	0.50	<5	4.38		0.05	0.10		3.2	0.06	0.2	20.7	0.014		
NORD RIVIERA NR3	323	16/2/94	26.7	34.7	0.70	5	4.68	8.9	0.20	0.20		1.1	0.09	0.0	6.2	0.003	0.1	
NORD RIVIERA NR4	324	21/6/95	26.7	34.0	0.30	<5	4.34		0.05	0.02		3.1	0.02	0.1	20.8	0.015		
NORD RIVIERA NR4	324	16/2/94	26.9	35.3	0.70	5	4.70	10.7	0.13	0.10		1.0	0.07	0.0	5.7	0.040	0.8	
NORD RIVIERA NR5	325	16/2/94	26.9	29.1	0.30	5	4.71	10.7	0.03	0.10		1.0	0.06	0.0	9.2	0.016	0.5	
NORD RIVIERA NR5	325	15/7/93	25.1	35.1	0.00	<2.5	4.30	2.5	0.06	<0.03	9.0	6.2	1.16	0.0	4.4	0.003	0.0	
NORD RIVIERA NR7	327	21/6/95	27.1	32.7	0.20	<5	4.41		0.05	0.12		3.1	0.02	0.1	20.6	0.016		
NORD RIVIERA NR7	327	16/2/94	27.0	32.1	0.40	5	4.71	7.1	0.03	0.00		1.5	0.07	0.0	8.6	0.023	0.4	
NORD RIVIERA NR8	328	16/2/94	26.8	36.1	0.40	5	4.68	10.7	0.03	0.10		0.9	0.08	0.0	8.8	0.000	0.9	

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Station	Code	Date	T (°C)	EC ( $\mu$ S/cm)	TURB (NTU)	Color (mg/l)	pH	Cl <sup>-</sup> (mg/l)	Fe (mg/l)	Mn (mg/l)	O <sub>2</sub> dis (mg/l)	Silice (mg/l)	PO <sub>4</sub> (mg/l)	NH4 (mg/l)	NO <sub>3</sub> (mg/l)	NO <sub>2</sub> (mg/l)	mat org (mg/l)	SO <sub>4</sub> (mg/l)
NORD RIVIERA NR9	329	21/6/95	26.6	33.0	0.60	<5	4.33		0.05	0.10		3.1	0.03	0.2	20.7	0.014		
NORD RIVIERA NR9	329	16/2/94	27.2	33.7	0.30	5	4.73	8.9	0.01	0.00		0.6	0.05	0.0	6.2	0.016	0.4	
NORD RIVIERA NR10	330	16/2/94	27.6	29.1	1.40	5	4.85	10.7	0.06	0.20		1.4	0.08	0.0	6.2	0.007	0.4	
NORD RIVIERA NR10	330	15/7/93	25.1	34.0	0.00	<2.5	4.25	2.0	0.07	<0.03	8.9	3.3	0.80	0.0	4.5	0.003	0.0	
RIVIERA CENTRE RC1	331	17/8/95	25.1	39.1		<5	4.12	7.1	0.04	0.03		3.2	0.04	0.2	4.6	0.030	0.5	
RIVIERA CENTRE RC1	331	7/7/93	26.1	47.3	0.00	<2.5	4.47	1.5	0.06	0.06	8.5	2.6	0.80	<0.5	12.8	0.003	0.1	
RIVIERA CENTRE RC2	332	17/8/95	25.6	27.0		<5	3.91	14.2	0.04	0.14		3.1	0.04	0.2	6.2	0.028	0.5	
RIVIERA CENTRE RC2	332	7/7/93	26.9	32.2	1.00	<2.5	4.48	2.0	<0.06	0.03	6.7	3.9	0.81	0.0	12.8	0.003	0.2	
RIVIERA CENTRE RC3	333	17/8/95	25.0	32.5		<5	4.16	14.2	0.04	0.01		3.1	0.04	0.2	9.7	0.028	0.5	
RIVIERA CENTRE RC3	333	7/7/93	26.6	31.6	0.00	<2.5	4.46	1.5	<0.06	0.03	7.0	4.4	0.79	<0.5	11.9	0.006	0.1	
RIVIERA CENTRE RC4	334	17/8/95	25.2	28.5		<5	4.17	17.8	0.04	0.06		3.2	0.04	1.1	6.7	0.029	0.6	
RIVIERA CENTRE RC4	334	7/7/93	26.6	30.5	1.00	<2.5	4.44	2.0	<0.06	0.00	7.9	4.9	0.88	<0.5	12.3	0.006	0.1	
RIVIERA CENTRE RC5	335	17/8/95	25.4	30.2		<5	4.12	12.4	0.04	0.01		3.1	0.04	0.2	9.7	0.028	0.4	
RIVIERA CENTRE RC5	335	7/7/93	26.9	31.0	0.00	<2.5	4.42	1.5	0.08	0.03	7.3	4.8	0.76	0.0	12.8	0.003	0.2	
RIVIERA CENTRE RC6	336	17/8/95	25.3	36.9		<5	4.11	10.7	0.05	0.02		3.2	0.04	0.2	9.3	0.028	0.4	
RIVIERA CENTRE RC6	336	7/7/93	26.9	32.2	0.00	<2.5	4.40	1.5	<0.06	0.03	8.4	4.2	0.80	<0.5	13.2	0.003	0.2	
ZONE OUEST Z01	341	12/6/95	25.2	57.6	0.30		4.87	28.8	0.05	0.02		2.7	0.01	0.1	19.7	0.008	0.5	
ZONE OUEST Z01	341	1/2/94	28.1	56.2	0.50	5	4.83	10.7	0.09	0.00		40.4	0.06	0.0	26.1	0.162	0.4	
ZONE OUEST Z02	342	1/2/94	28.8	63.1	0.40	5	4.58	10.7	0.11	0.00		49.0	0.09	0.0	18.1	0.003	0.2	
ZONE OUEST Z02	342	5/7/93	25.0	62.5	0.00	<2.5	4.28	2.5	<0.06	0.03	6.8	3.8	1.37	0.0	15.8	0.000	0.2	
ZONE OUEST Z03	343	3/7/95	26.7	57.6	0.30		4.79	21.3	0.04	0.10		3.5	0.02	0.4	9.7	0.006	0.6	
ZONE OUEST Z03	343	1/2/94	28.5	54.1	0.30	5	4.63	14.2	0.03	0.00		50.3	0.05	0.0	20.6	0.200	0.4	
ZONE OUEST Z04	344	12/6/95	25.2	42.1	0.30		4.40	24.9	0.05	0.03		3.1	0.02	0.2	19.3	0.007	1.2	
ZONE OUEST Z04	344	1/2/94	28.3	34.3	0.60	5	5.00	10.7	0.13	0.00		44.2	0.06	0.0	16.9	0.000	0.2	
ZONE OUEST Z05	345	1/2/94	27.2	61.1	0.50	5	4.79	14.2	0.06	0.00		41.4	0.03	0.0	14.5	0.000	0.2	
ZONE OUEST Z05	345	5/7/93	25.4	46.3	0.00	<2.5	4.52	4.0	<0.06	<0.03	7.6	3.4	1.18	0.0	9.2	0.000	0.2	
ZONE OUEST Z06	346	3/7/95	26.7	82.1	0.20		4.46	19.5	0.04	0.13		3.3	0.01	0.6	15.1	0.004	0.5	
ZONE OUEST Z06	346	1/2/94	26.7	68.9	1.10	5	4.78	14.2	1.03	0.00		42.7	0.10	0.0	19.6	0.003	0.2	
ZONE OUEST Z07	347	12/6/95	25.4	37.9	0.60		4.39	17.8	0.05	0.02		2.9	0.01	0.1	19.8	0.005	1.7	
ZONE OUEST Z07	347	1/2/94	26.9	49.8	0.40	5	4.62	14.2	0.02	0.00		48.6	0.08	0.0	20.7	0.003	0.1	
ZONE OUEST Z08	348	3/7/95	26.7	64.6	0.30		4.35	21.3	0.04	0.12		3.2	0.02	0.4	10.4	0.003	0.7	
ZONE OUEST Z08	348	1/2/94	26.8	49.5	0.40	5	4.63	14.2	0.03	0.00		41.5	0.07	0.0	13.8	0.003	0.5	
ZONE OUEST Z09	349	12/6/95	25.3	63.7	1.00		4.34	17.8	0.05	0.02		3.2	0.02	0.3	19.9	0.007	1.1	
ZONE OUEST Z09	349	1/2/94	26.9	58.0	0.60	5	4.62	21.3	0.03	0.00		47.6	0.07	0.5	12.4	0.003	0.3	
ZONE OUEST Z010	350	3/7/95	26.8	36.5	2.70		4.58	17.8	0.29	0.21		3.5	0.03	0.4	4.9	0.006	0.7	

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Station	Code	Date	T (°C)	EC (µ S/cm)	TURB (NTU)	Color (mg/l)	pH	Cl <sup>-</sup> (mg/l)	Fe (mg/l)	Mn (mg/l)	O <sub>2</sub> dis (mg/l)	Silice (mg/l)	PO <sub>4</sub> (mg/l)	NH <sub>4</sub> (mg/l)	NO <sub>3</sub> <sup>-</sup> (mg/l)	NO <sub>2</sub> <sup>-</sup> (mg/l)	mat org (mg/l)	SO <sub>4</sub> <sup>-</sup> (mg/l)
ZONE OUEST Z010	350	5/7/93	25.7	36.6	0.00	<2.5	4.55	2.0	<0.06	<0.03	6.6	5.1	2.01	0.0	4.4	0.023	0.4	
ZONE OUEST Z011	351	1/2/94	26.4	37.4	0.30	5	4.63	10.7	0.02	0.00		45.1	0.06	0.0	10.3	0.007	0.2	
ZONE OUEST Z011	351	5/7/93	24.9	35.8	0.00	<2.5	4.43	1.5	<0.06	0.00	7.0	6.4	0.85	0.0	4.4	0.023	0.2	
ZONE NORD ZN6	356	13/7/93	25.7	71.5	1.00	<2.5	4.53	2.5	0.06	0.03	6.2	5.4	1.07	0.0	13.2	0.003	0.0	
ZONE NORD ZN7	357	7/6/95	20.9	48.8	0.30	<5	4.26	11.0	0.05	0.25	3.3		0.07	0.2	52.4	1.642	0.8	
ZONE NORD ZN7	357	13/7/93	26.2	36.6	0.00	2.5	4.53	2.5	0.07	0.00	7.6	4.0	0.94	0.0	5.7	0.003	0.0	
ZONE NORD ZN8	358	13/7/93	26.2	56.6	0.00	2.5	4.46	2.5	0.06	0.03	7.6	4.3	1.01	0.0	12.3	0.003	0.0	
ZONE NORD ZN9	359	7/6/95	20.9	51.4	0.30	<5	4.21	11.0	0.05	0.18		3.1	0.17	0.3	49.2	1.646	0.8	
ZONE NORD ZN9	359	13/7/93	26.5	43.3	0.00	<2.5	4.37	2.0	0.06	0.03	6.5	3.9	1.10	0.0	5.0	0.006	0.0	
ZONE NORD ZN10	360	13/7/93	25.9	53.9	1.00	<2.5	4.30	2.5	0.06	0.03	6.0	4.3	0.98	0.0	7.9	0.003	0.0	
ZONE NORD ZN11	361	7/6/95	20.7	43.0	0.30	<5	4.48	11.0	0.05	0.12		3.1	0.09	0.3	28.0	0.120	0.8	
ZONE NORD ZN11	361	13/7/93	26.2	36.3	1.00	<2.5	4.41	4.5	0.42	0.06	6.6	4.7	0.89	0.0	4.3	0.003	0.0	
ZONE NORD ZN13	363	13/7/93	26.0	47.6	0.00	<2.5	4.33	3.0	0.07	0.03	7.0	3.7	0.90	0.0	10.1	0.006	0.0	
ZONE EST ZE1	371	19/6/95	25.0	33.9	0.20	<5	4.70	25.0	0.05	0.13		3.1	0.07	0.1	20.9	0.011	0.4	
ZONE EST ZE1	371	19/7/93	25.6	37.2	0.00	5	4.58	2.0	0.06	<0.03	6.6	4.0	16.07	0.0	4.4	0.001	0.0	
ZONE EST ZE2	372	19/6/95	25.1	33.7	0.20	<5	4.43	18.0	0.05	0.11		3.0	0.06	0.1	21.0	0.014	0.5	
ZONE EST ZE2	372	19/7/93	26.0	31.0	0.00	3	4.55	2.0	0.06	<0.03	6.8	3.9	0.73	0.0	4.0	0.001	0.0	
ZONE EST ZE3	373	19/7/93	25.8	37.2	0.00	5	4.36	2.5	0.06	0.03	6.6	4.0	0.98	0.0	6.2	0.001	0.0	
ZONE EST ZE4	374	19/6/95	25.1	35.7	0.20	<5	4.39	21.0	0.05	0.13		3.0	0.06	0.2	21.4	0.014	0.5	
ZONE EST ZE7	377	19/7/93	24.6	36.4	0.00	2	4.52	2.0	0.09	<0.03	7.6	3.8	1.09	0.0	6.2	0.001	0.0	
ZONE EST ZE8	378	19/7/93	24.5	36.4	0.00	0	4.35	2.0	0.07	0.00	6.4	4.0	1.15	0.0	6.6	0.002	0.0	
ZONE EST ZE9	379	19/7/93	24.9	41.6	0.00	0	4.50	2.0	0.16	0.05	6.8	3.5	1.08	0.0	8.8	0.001	0.0	
ZONE EST ZE10	380	19/7/93	24.8	30.8	0.00	2	4.55	2.5	0.10	0.06	7.0	4.6	0.96	0.0	5.7	0.003	0.0	
ZONE EST ZE11	381	19/7/93	24.5	32.6	0.00	0	4.30	2.5	0.10	<0.03	6.7	3.5	0.89	0.0	5.3	0.003	0.0	
PLATEAU C4	382	7/6/95	20.7	230.0	0.30	<5	4.06	6.5	0.05	0.20		3.4	<1	0.6	86.6	1.668	0.4	
PLATEAU C4	382	9/2/94	26.0	353.0	0.50	5	4.43	78.1	0.11	0.10		1.1	0.03	0.9	44.0	0.007	0.8	
ADJAME NORD AN1	391	8/2/94	26.4	69.5	0.60	5	4.79	17.8	0.03	0.00		0.2	0.09	0.5	13.2	0.040	0.4	
ADJAME NORD AN1	391	12/7/93	24.6	58.7	0.00	<2.5	4.58	0.1	<0.06	<0.03	7.6	4.4	1.11	0.0	9.2	0.006	0.2	
ADJAME NORD AN2	392	7/6/95	25.0	154.8	0.20	<5	4.27	28.0	0.05	0.17		3.2	0.05	0.8	20.7	0.020	0.3	
ADJAME NORD AN2	392	8/2/94	26.2	129.5	0.40	5	4.49	21.3	0.09	0.10		1.0	0.06	0.8	32.1	0.040	0.2	
ADJAME NORD AN3	393	8/2/94	26.9	39.2	1.10	5	4.69	7.1	0.06	0.10		0.4	0.16	0.0	8.8	0.003	0.1	
	393	12/7/93	24.8	46.0	1.00	2.5	4.58	2.0	0.20	0.03	6.8	5.3	1.46	0.0	4.4	0.000	0.1	
ADJAME NORD AN4	394	20/1/68		22,000.0	3.00	3	4.70	9.0	0.00			12.0		0.0	0.0	0.000	2.1	0.4
ADJAME NORD AN5	395	1972					4.60	10.6	0.00				0.70	0.0	0.0	0.000	0.8	
ADJAME NORD AN5	395	20/1/68		24,000.0	3.00	3	4.60	9.0	0.00			12.0		0.0	0.0	0.000	1.5	0.4
ADJAME NORD AN7	397	7/6/95	24.8	270.0	0.30	<5	4.35	25.0	0.05	0.17		3.5	0.06	1.6	21.5	0.020	0.3	

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Station	Code	Date	T (°C)	EC ( $\mu$ S/cm)	TURB (NTU)	Color (mg/l)	pH	Cl <sup>-</sup> (mg/l)	Fe (mg/l)	Mn (mg/l)	O <sub>2</sub> dis (mg/l)	Silice (mg/l)	PO <sub>4</sub> (mg/l)	NH <sub>4</sub> (mg/l)	NO <sub>3</sub> <sup>-</sup> (mg/l)	NO <sub>2</sub> <sup>-</sup> (mg/l)	mat org (mg/l)	SO <sub>4</sub> <sup>-</sup> (mg/l)
ADJAME NORD AN7	397	8/2/94	26.5	142.0	1.10	5	4.33	24.9	0.13	0.20		5.9	0.03	1.3	40.9	0.003	0.5	
ADJAME NORD AN8	398	7/6/95	25.0	250.0	0.51	<5	4.16	25.0	0.06	0.19		3.4	0.07	1.7	21.9	0.034	1.7	
ADJAME NORD AN8	398	8/2/94	26.0	167.4	0.90	5	4.40	21.3	0.37	0.00		0.2	0.08	1.8	48.0	0.040	0.3	
ANOKOUAKOUTE AK1	551	26/6/95	26.3	42.4	0.20	<5	4.52	14.2	0.05	0.04		3.4	0.01	0.1	5.7	0.005	0.3	
ANOKOUAKOUTE AK1	551	18/1/94	25.0	32.5	0.40	5	4.69	10.7	0.04	0.00		33.7	0.73	0.0	11.7	0.000	0.4	
ANOKOUAKOUTE AK2	552	26/6/95	26.1	30.9	0.30	<5	4.46	17.0	0.08	0.03		3.4	0.02	0.1	4.6	0.003	0.4	
ANOKOUAKOUTE AK2	552	18/1/94	25.2	34.7	0.80	5	4.77	14.2	0.12	0.00		28.6	0.21	0.0	12.8	0.000	0.1	
ANOKOUAKOUTE AK3	553	26/6/95	26.0	34.9	0.20	<5	4.37	17.0	0.05	0.02		3.4	0.01	0.2	4.1	0.002	0.5	
ANOKOUAKOUTE AK3	553	18/1/94	25.1	37.6	0.70	5	4.70	7.1	0.03	0.00		39.1	0.25	0.0	11.2	0.000	0.2	
ANOKOUAKOUTE AK4	554	26/6/95	26.1	33.2	0.16	<5	4.55	17.0	0.05	0.02		3.1	0.01	0.1	6.4	0.006	0.5	
ANOKOUAKOUTE AK4	554	18/1/94	24.3	34.9	0.70	5	4.83	3.6	0.01	0.00		40.4	0.65	0.0	10.3	0.000	0.2	
ANOKOUAKOUTE AK5	555	18/1/94	25.0	30.7	0.40	5	4.96	10.7	0.14	0.00		30.5	0.73	0.0	18.7	0.000	0.2	
ANOKOUAKOUTE AK5	555	28/7/93	24.8	29.8	0.00	<2.5	4.52	2.5	0.20	0.03	8.2	1.9	0.10	0.0	5.7	0.006	0.7	
ANOKOUAKOUTE AK6	556	26/6/95	26.2	36.9	0.30	<5	4.62	14.2	0.06	0.05		3.2	0.02	0.1	4.4	0.001	0.3	
ANOKOUAKOUTE AK6	556	18/1/94	25.1	34.4	0.40	5	4.85	10.7	0.05	0.00		60.8	0.66	0.0	16.3	0.000	0.1	
ANOKOUAKOUTE AK7	557	26/6/95	26.2	33.7	0.30	<5	4.46	21.3	0.06	0.04		3.3	0.01	0.1	4.1	0.018	0.7	
ANOKOUAKOUTE AK7	557	18/1/94	24.8	32.8	0.40	5	4.91	10.7	0.01	0.00		48.2	1.13	0.0	16.2	0.000	0.2	
ANOKOUAKOUTE AK8	558	26/6/95	26.3	40.1	0.20	<5	4.42	16.0	0.05	0.02		3.6	0.10	0.1	6.3	0.001	0.5	
ANOKOUAKOUTE AK8	558	18/1/94	24.9	37.0	0.40	5	4.81	14.2	0.04	0.00		54.7	2.18	0.0	17.3	0.000	0.2	

Source: Etude De La Gestion Et De La Protection De La Nappe Assurant l'Alimentation En Eau Potable d'Abidjan, Ministere Des Infrastructures Economiques,

## 1.6 Drinking Water Quality Standard

### 1. Physical Condition

Item	WHO		JAPAN
	Highest Desirable	Maximum Permissible	
Color	15	50	5
Taste	not offensive	not offensive	not offensive
Odor	not offensive	not offensive	not offensive
Turbidity	5	25	2
pH	6.5 to 8.5	6.5 to 9.2	5.8 to 8.6
Conductivity	0.5	1.5	-

### 2. Toxin

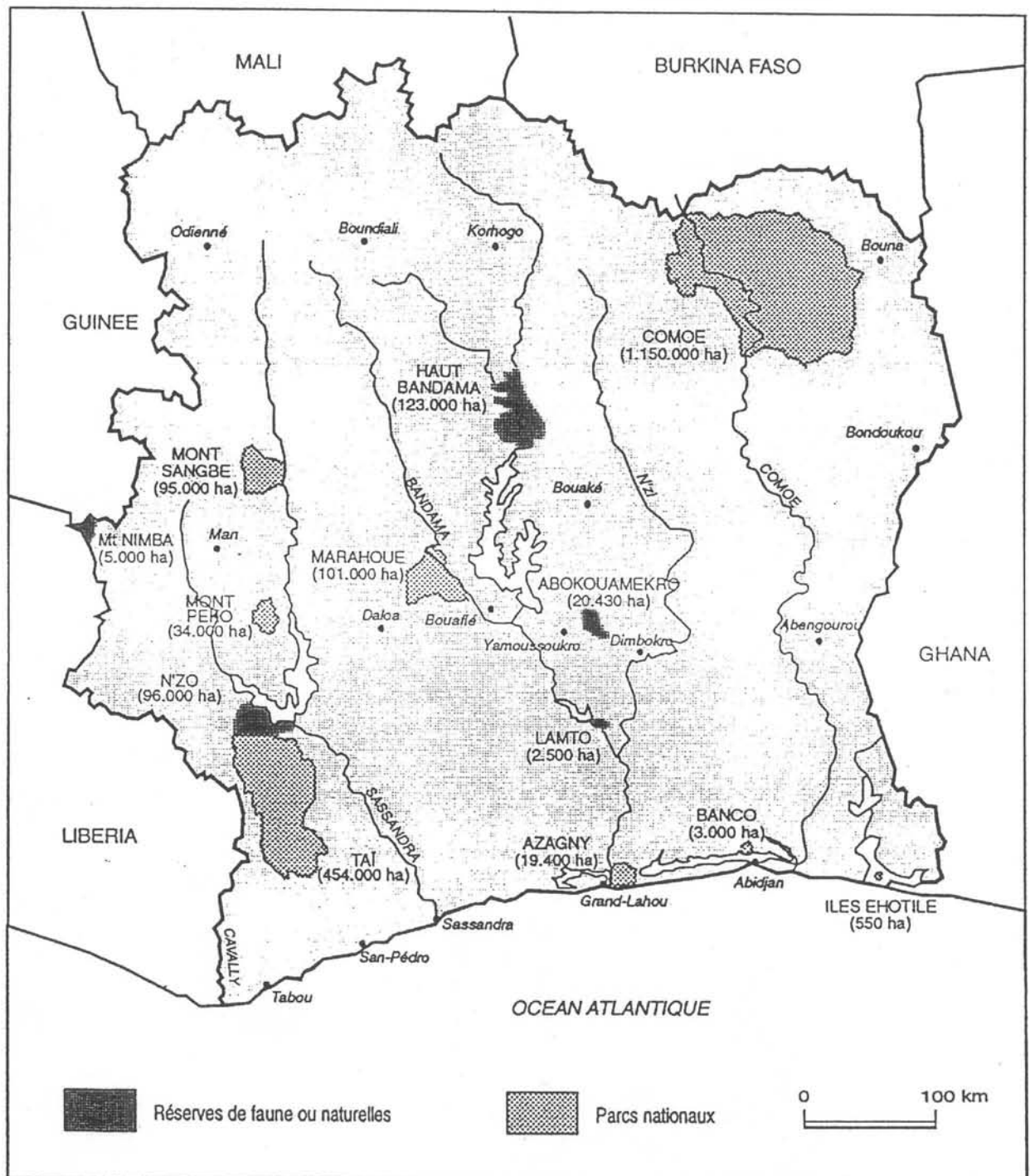
Item	WHO	JAPAN
Hg	0.001	None
Pb	0.1	0.1
As	0.05	0.05
Se	0.01	0.01
Cr <sup>6+</sup>	0.05	0.05
Cn	0.1	None
Cd	0.005	0.01
Cl <sub>2</sub>	0.1	-
Phenol	0.0	-
Zn	5.0	-
No <sub>2</sub>	10	-

### 3. Bacteriological Condition

Item	WHO	JAPAN
Standard Plate Count (Colonies / cm <sup>3</sup> )	-	100
MPN (Coliform Organism / 100 m <sup>3</sup> )	-	None
E. Coli	-	-

## CHAPTER 2. PRESENT ENVIRONMENTAL CONDITION

### 2.1 National Park and Protected Area



Carte des parcs nationaux et réserves de Côte d'Ivoire

Figure 2.1-1 Distribution of National Parks and Protected Area



**Table 2.1-1 National Park**

Name	Prefecture	Decree and Creation Date	Area(ha)
Azagny National Park	Grand-Lahou	Order n°536 of 25.06.1960 Then Decree n°81-218 of 02.04.1981	19,400
Banco National Park	Abidjan	Decree of 31.10.1953	3,000
Comoe National Park	Bouna	Decree n°68-81 of 09.02.1968	1,149,150
Ehotile Island National Park	Adiaka	Decree n°74-179 of 25.04.1974	550
Maraahou National Park	Bouafle	Decree n°68-80 of 09.02.1968	101,000
Peko mountain National park	Duekoue	Decree n°68-79 of 09.02.1968	34,000
Sangbe mountain National Park	Biankouma	Decree n°76-215 of 19.02.1976	95,000
Tai National Park	Tai	Decree n°72-544 of 28.08.72 Then n°77-348 of 03.06.1977	340,000
<b>Total</b>			<b>1,742,100</b>

**Table 2.1-2 Natural Reserves Area**

Name	Prefecture	Decree and Creation Date	Area (ha)
Abokouamekro fauna reserve	Yamoussoukro	Decree n°93-695 of 19.08.93	20,430
High Banadama fauna reserve	Katiola	Decree n°73-133 of 21.03.73	123,000
Lamto scientific reserve	Toumodi Tiassale	Order n°857/AGRI/DOM of 12.07.1968	2,500
Nimba mountain integral reserve	Man	Decree of 05.07.1944	5,000
N'zo fauna reserve	Tai	Decree n°72-545 of 28.08.72; then n°73-132 of 21.03.73	96,000
<b>Total</b>			<b>246,930</b>

**Table 2.1-3 Botanical Reserves Area**

<b>Name</b>	<b>Prefecture</b>	<b>Decree and Creation Date</b>	<b>Area (ha)</b>
Bamoro reserve	Diabo	Order n°1014 of 06.07.1926 Modified by Order n°1996 of 03.08.1932	2,200
Bouafle reserve	Bouafle	Order n°285 of 14.02.1929	32,400
Divo reserve	Divo	Order n°1419/SF of 03.09.1928 Order n°3268/SF of 20.12.1932 Order gen.n°2359 of 26.10.1935 Order n°452 Minefor/DDAR Of 03.07.1975	7,350
Kassa reserve.	Tiassale	Order n°1415/SF of 01.05.1935	7,200
Katiola reserve	Katiola	Order n°1026 of 06.07.1926	200
Moni reserve	Danane	Order n°4611/SEF of 23.06.1954	10,000
Nieton mountain reserve	Danane	Order n° 838/SF of 18.07.1961	11,268
Sanguine mountain reserve	Danane	Order n°1993 of 03.08.1932	25,000
N'ganda reserve	Grand-Bassam Adiake	Order n°2020/SE of 07.04.1951 Modified by Order n°5894/SE of 13.08.1954 Order n°279/Minagri of 01.08.1958	4,400
Niangbo reserve	Niakaramandougou	Order n°1995 of 03.08.1932	1,700
Orumbo Boka reserve	Toumodi	Order n°200 of 31.01.1929	3,600
Singrobo reserve	Tiassale	Order n°999 of 22.05.1929	1,200
Tankesse reserve	Tanda	Order n°391/SF of 04.03.1929	3,600
Tiapleu reserve	Danane	Order n°2617 of 19.10.1932	28,000
Tos reserve	Bouafle, Sinfra	Order gl.n°3499/SE of 29.11.1937	23,000
Yapo reserve	Agboville	Order n°129/SF of 10.07.1947	37,300
<b>Total</b>			<b>198,418</b>

Table 2.1-4 Protected Areas in Priority

(Magazine of literature: each colon corresponds to a document cited in following reference)

- (1) IUCN, Action strategic for protected Areas in the Afrotropical Realm, 28<sup>th</sup> working section of IUCN's Commission on National Parks and Protected Areas "W" National Park, 1987
- (2) IUCN, Biodiversity in Sub-Saharan Africa and its Islands, Occasional Papers of the IUCN Species Survival commission No. 6, IUCN, Gland, Switzerland, 1991, pp. A 154-170
- (3) East R. (compiler), Antelopes – Global survey and regional action Plans – Part 3 West and central Africa, compiled by, IUCN, Gland, Switzerland, 1991, pp. 1-39, 108-111.
- (4) Collar N J and Stuart S.N., Key Forests for Threatened Birds in Africa, International Council for Bird Preservation, Monograph No. 3, Cambridge, UK, 1988, pp. 1-32
- (5) Oates J.F. (compiler), Action Plan for African Primate Conservation: 1986-90, IUCN/SSC Primate Specialist Group, IUCN, Gland, and Switzerland

Area	Statue	Surface (ha)	(1) General	(2) General	(3) Antelopes	(4) Bird group	(5) Primates
Tai	National park	330000	(Yes) (central of reforestation)		Yes (Forestry species)	1 <sup>st</sup> priority of Guinean forestry block	1 <sup>st</sup> priority in Africa
Nzo	Reserve of Fauna	95000			Yes (Forestry species)		
Comoe	National park	1150000	(Yes) (To develop tourism)	(Yes) (To develop tourism)	Yes (Savanna species)		
Haut Bandama	Reserve of Fauna	123000		(Yes) (endangered)	Yes (Savanna species)		
Marahoue	National park	101000	Yes	(Yes) (endangered)	Yes (Mixed species)		
Mont Sangbe	National park	95000		Yes	Yes (Mixed species)		
Mont Peko	National park	34000		Yes	Yes (Forestry species)		
Azagny	National park	21450	(Yes) (To develop tourism)	(Yes) (To develop tourism)			
Island Ehotilees	National park	550					
Divo	Botanic reserve	7300		Yes			
Mont Nimba	Integral reserve	5000		Yes Rich in species		5 <sup>th</sup> Priority of Guinean Forestry	
Banco	National park	3000		Yes			

Table 2.1-5 Protected Surface Area

Name	Category of protection	Surface (Ha)	Intervention in course	Classification in conservation priority	Soudanean Savanna	Transition area	Guinean forest
Tai	National Park, Reserve of the biosphere Site of World national patrimony	330000	GTZ/KFW, WWF (end 2000)	1			
Nzo	Reserve of partial Fauna (Species forestry of Tai)	95000	GTZ/KFW, WWF (end 2000)	1 (Space TAD)			X
Comoe	Reserve of Fauna and Flora	115000	WB/PSF (urgent action)	1	X	X (in the south)	X
Haut Bandama	National Park	123000	EEC (end 2/1995)	4	X		
Marahoue	National Park	101000	EEC/PRHJ (end 2000)	2		X	
Mont Samgbe	National Park	95000	WB/PSF Study	3		X	X
Mont Peko	National Park	34000	WB/PSF (Urgent action)	3			
Azagny	National Park	21450		2			X+ Coastal area
Island Ehotilees	National Park	555		4			X+ Coastal area
Abokouamekro	Reserve of Fauna	20430		5			
Divo	Reserve of Botany	7300		5			X
Mont Nimba	Strict natural reserve Site of World national patrimony	5000		2			X
Banco	National Park	3000		3			X
Lampto	Length reserve	2000		3			
<b>TOTAL</b>		2000000					

## 2.2 Distribution of Fauna in the National Park

Table 2.2-1 Distribution of Fauna in the National Park

### 1- AZAGNY

	COMMON NAME	SPECIFIC NAME	DATA IN NUMBERS	OTHER INFORMATIONS
	Elephant, buffalo, chimpanzee, hippo- tamus, royal antelope, panther, the group of cephalophe, tree daman, culin chive, swanp mangoose	Loxodonta africana cyclotis (elephant), syncherus caffer nanus (buffalo), c. diana roloway, C. mona lowei, colobus polykomos vellerosus, pan troglodytes verus, c. verus, choeropsis liberiensis,		
1- MAMMAL	crocodile, varanus, snakes, tortues	crocodylus niloticus, crocodilus cataphractus, varanus niloticus		
2- REPTILE				
3- INSECT				exist but no inventory made
4- BIRD				exist but no inventory made
5- RUMINANT	Gambia rat, diverse squirrels			
6- AQUATIC ANIMALS	Fishes,	periophthalmine	numerous	

Source: Monograph of National Park, Direction of Nature  
Protection, 1996

Table 2.2-2 Distribution of Fauna in the National Park

### 2- BANCO

	COMMON NAME	SPECIFIC NAME	DATA IN NUMBERS	OTHER INFORMATIONS
	creptant, potamocheere, buffalo, antelope, panther, chimpanzee, cephalotrophe, mangoose, monkey, colobe, demidoff galago, golden cat, culin chive, mangoose, tree daman	Loxodonta africana, potamochoerus, synccerus caffer, tragephus, troglytes verus, cephalophus sylvicultor, cephalophus niger, neotragus pygmaeus, pan troglodytes verus, colobus verus	chimpanzee (10 or 15 left)	elephant, buffalo, panther and many other animals have nearly disappeared, some mangoose, culin chive can be present in the park
1- MAMMAL				exist but are bad-known
2- REPTILE				exist but are bad-known
3- INSECT	ant, termite or white ant			exist but no inventory made
4- BIRD		anomanurus peir, protoxerus stangeri temminckii, heliosciurus rufobrachium haryi, thyonomis swinderianus, manis tetradactyla, toto rat or		the three types of pangolin have nearly disappeared, the gambia rat is certainly present
5- RUMINANT	different types of squirrel, Gambia rat, aulacode, three types of pangolin,			
6- AQUATIC ANIMAL	fish, aquatic chevrotain	Hyemoschus aquaticus,		

**Table 2.2-3 Distribution of Fauna in the National Park**

**3- COMOE**

	COMMON NAME	SPECIFIC NAME	DATA IN NUMBERS	OTHER INFORMATIONS
1- MAMMAL	antelope, doguera baboon, monkey, buffon cobe (horse for race), bubalis, ourebia, reed cobe, warthog, lion, marked hyena, rocks daman, buffalo, savanna elephant, hippopotamus, panthera, culin chive, cephaloph	kob, hippotrague, papio anubis, alcelaphus buselaphus major, ourebia ourebi, kobus defassa onctuosus, redunca redunca, phacochoerus aethiopicus, papio anubis, panthera leo, crocuta crocuta, felis libyca, canis adustus, galago senegalense		
2- REPTILE	three species of crocodile, two of tortues, varanus and many others snakes			
3- INSECT				
4- BIRD	secretary bird, egret, heron, the big calao, orns	ardeola ibis, sagittarius serpentarius, neotis denhami, eupodotis melanogaster, bucorvus abyssinicus	around 450 species with nearly 3/4 present all the year (small quantity emigrate)	
5- RUMINANT	Gambia rat, porcupine, hare with rabbit ears, aulacode, palm tree rat, pangolin			

**Table 2.2-4 Distribution of Fauna in the National Park  
4- EHOTILE ISLAND**

	COMMON NAME	SPECIFIC NAME	DATA IN NUMBERS	OTHER INFORMATION
1- MAMMAL	potamochoere, harnache guib (antelope), maxwell cephalophe, antelope,	neotragus pygmaeus, cercopithecus nictitans,cephalophus monticola maxwelli, tragelaphus scriptus,		because of the hunting pressure, formerly well- known, the manatee called trichechus senegalensis is in danger
2- REPTILE				no inventory made
3- INSECT				no inventory made
4- BIRD	bat	chiropter		
5- RUMINANT			numerous with migratory species (128 species divided into 35 families), 58 species of fishes have been discover in the Aby	
6- AQUATIC ANIMALS	shellfish, mollusc, fish (Tilapia, other species)	tilapia guineensis, ethmalosa fimbriata		an inventory has been made

**Table 2.2-5 Distribution of Fauna in the National Park  
5- MARAHOUE**

	COMMON NAME	SPECIFIC NAME	DATA IN NUMBERS	OTHER INFORMATIONS
1- MAMMAL	elephant, buffalo, buffon cobe (horse for race), antelope, panther, hyppopotamus, cephalophe, tree daman, monkey, mangoose, chimpanzee many reptiles but not specify in the document, crocodile, snakes, etc	buselaphus major, kobus kob kob, syncerus caffer brachyceros, tragelaphus scriptus scriptus, tragelaphus euryceros, bongo, panthera pardus, crocodylus niloticus	100 to 150 elephants left, buffon cobe meanly abundant, nueros buffalo, panther relatively important, numerous	monkeys are in danger and many others animals
2- REPTILE				
3- INSECT				
4- BIRD	several species for example: the roller	coracias cyanogaster, coracias abyssinica,	300 species still exist	in dry season some migrating species come to increase the number of the
5- RUMINANT				
6- AQUATIC ANIMALS	aulacode, pangolin, squirrel, Fish exist	thryonomis swinderianus		

**Table 2.2-6 Distribution of Fauna in the National Park  
6- PEKO MOUNTAIN**

	COMMON NAME	SPECIFIC NAME	DATA IN NUMBERS	OTHER INFORMATIONS
1- MAMMAL	elephant, hyppopotamus, antelope, buffalo, chimpanzee, monkeys,	hippopotamus amphibius, choeropsis liberiensis, tragelaphus euryceros, cephalophus sylvicultor, maxwell cephalophe,		
2- REPTILE				
3- INSECT				
4- BIRD	several species		156 species divided into 41 families	ex: the picathartes gymnocephalus is in danger
5- RUMINANT				



**Table 2.2-7 Distribution of Fauna in the National Park  
7- SANGBE MOUNTAIN**

	COMMON NAME	SPECIFIC NAME	DATA IN NUMBERS	OTHER INFORMATIONS
1- MAMMAL	ears, palm tree rat, gambia rat, land squirrel, antelope, cephalophe, baboon, monkeys, warthog, buffon cobe, bubalis, ourebia, rocks daman, panther, hyena, serval, lion, mangoose, golden cat, tree daman, genet, Africa buffalo, elephant, panther, mangoose, genet,	atelerix albiventris, lepus crawshayi, xerus anthropus, papio anubis, cercopithecus aethiops sabaeus, phacochoerus aethiopicus, ourebia ourebi, kobus kob kob, alcelaphus buselaphus major, procavia capensis, crocuta crocuta, felis serval, panthera leo, loxodonta africana, atilax paludinosus		cephalophe and cobe (horse for race) are hunted enough
2- REPTILE	three types of crocodile,	crocodylus niloticus, c.		
3- INSECT	varanus, snakes, tortues	cataphractus, osteolaemus tetraspis, varanus niloticus		
4- BIRD	rich with several species mainly in dry season with the migratory birds			
5- RUMINANT	pangolin, Gambia rat, squirrel, porcupine, aulacode	nystrix cristata, thryonomis swinderianus, crycetomis gambianus, manis gigantea,		aulacodes are the more hunted specie

**Table 2.2-8 Distribution of Fauna in the National Park**

**8- TAI**

	COMMON NAME	SPECIFIC NAME	DATA IN NUMBERS	OTHER INFORMATIONS
1- MAMMAL	hippopotamus, cephalophe, cercopithec, colobe (horse for race), panther, chimpanzee, forest buffalo, antelope, elephant,	neotragus, pygmaeus, colobus polykomos polykomos, cephalophus zebra, cephalophus jentinki, syncerus caffer nanus, troglodytes verus, panthera pardus, crocodylus cataphractus,		
2- REPTILE	crocodiles, varanus, water	osteolaemus tetraspis, varanus niloticus, kinixys belliana,		
3- INSECT	tortues, python (snake)	testudo sulcata, python sebae, p. regius		
4- BIRD	forest guinea-fowl, monkey eagle, the great touraco, the big hornbill, weaver bird	ageastes meleagrides, stephanoaetus coronatus, corythaeola cristata, ceratogymna atrata,		
5- RUMINANT				

### 2.3 Importation Quantities and Price of Pesticides

Category	year							
	90	91	92	93	94	95	96	97
<b>Importation quantities</b>	<b>kg</b>							
Insecticides	19,000		107,000	10,000	6,000	28,000	30,200	14,800
Herbicide	7,515		27,476	44,330	23,444	28,000	33,010	49,200
Fungicide					8,000	9,000		2,700
<b>Unit price at importation</b>	<b>F CFA/kg</b>							
Insecticides	4,495		2,246	3,140	8,304	9,321	8,973	1,557
Herbicide	4,126		4,576	3,676	2,252	9,185	16,713	14,032
Fungicide					10,920	11,064		23,280
<b>Unit price at selling</b>	<b>F CFA/kg</b>							
Insecticides	2,000		2,000	4,000	4,000	4,000	4,000	*
Herbicide	2,000		2,500	3,000	5,000	5,000	5,000	*
Fungicide					5,000	5,000		*

\* the data was not available during the inquiry.

**Source:** data from DPVQ (1998)

## **CHAPTER 3. ENVIRONMENTAL ORGANIZATION AND LAW**

### **1. Organizations Related to Environmental Control**

The Ministry of Environment and Forest was established by decree N 98-688 of November 25 1998, considering the decree N 96-725 related to the structural organization of the Ministry of Agriculture and some Animal facilities.

The central management offices are 6 directions:

- Direction of the protection of the nature, constituted of two sub-directions; mainly to charge of manage, protect the national parks, botanical and zoological gardens etc.
- Direction of the production, some forest industries, reforestation, constituted of three sub-directions; mainly to charge of initiate the actions relative to the construction of forestry public domain and private etc.
- Direction of the forestry police and contentious; mainly to charge of the forest domain supervising of the state, the community and the particulars, and its preservation against the clearing etc.
- Direction of the environment, constituted of two sub-directions; mainly to charge of coordinating the actions for protection of some aquatic areas, lagoons and marine implementation etc.
- Direction of the planning and programming of the studies; this Direction is linked with whole ministry structures to elaborate and to coordinate, the strategies of forestry development policy and the protection of environment
- Direction of the administrative and financial affairs

### **2. Environmental Law and Regulation**

#### **(1) Survey Procedure Concerning an Environmental Impact of Development Project**

In 1996, Ministry determined the role and applicable survey procedure concerning an environmental impact of development project by Decree N 96-894. Article 2 mentions related to development projects which makes the subject to the survey of environmental impact study, and locate of risked areas and ecological sensitive areas. There are as follows.

- Protected areas and analogue reserves
- Wet areas and mangroves
- Areas of scientific interest, cultural, and tourists
- Defined areas of economically sensible
- Protection points of surface water

- Seaside areas under national and international jurisdiction or the other international seas

## **(2) The survey of Environmental Impact**

The Environmental Impact Survey is an assessment report of the probable impacts of scheduled activity on the environment. The Survey composed of 5 main activities, identification, analyze, evaluation, corrective measurements and, support and control. The survey must contain as following elements.

(A) Identification; detailed description of the project

(B) Analyze; this analyze must carry on the natural environment concerned with fauna, flora, hydrographic system, climate, soil type etc., on the landscape, ecological and human environment.

(C) Evaluation; the reason for the project has been retained the presentation of the variances will be made for the following classified spheres. (a)Agriculture, (b)Forest development, (c)Mining factory, (d)Waste disposal, (e)Food industry, (f)Chemical industry, (g)Metal work, (h)Textile, leather, and wood industry.

(D) Corrective measurements; the measurements of prevention, suppression, reduction, and/or compensation have been considered by the project owner or the petitioner in order to avoid the aftermath of the project.

(E) Support and control; the impact survey is permitted with given the measurements of prevention, suppression, reduction and compensation.

## **(3) Joining Situation to International Act**

The government ratifies the international act of Convention on International Trade in Endangered Species of Wild Fauna and Flora called CITES in August 25, 1994, and Convention on Wetlands of International Importance Especially as Waterfowl Habitat called Convention of Ramsar in June 27, 1996.

### **3.1-1 Environmental Organization**

## **DECREE N 98-688 OF NOVEMBER 25, 1998 RELATING TO THE MINISTRY OF ENVIRONMENT AND FOREST ORGANIZATION**

### **CHAPTER III - THE CENTRAL MANAGEMENT OFFICES**

#### **ARTICLE VIII**

The central management offices are:

- The Direction of the protection of the nature
- The Direction of the production, some forests industries and of reforestation
- The Direction of the forestry police and of contentious
- The Direction of the environment
- The Direction of the scheduling, of the programming and some studies
- The Direction of the Administrative and Financial Affairs

#### **ARTICLE IX - THE DIRECTION OF THE PROTECTION OF THE NATURE**

- Of creating, manage , protect and valorize the national parks, analogous reserves, stations and botanical and zoological gardens
- Of assuring the conservation of the botanical and zoological species
- Of conceiving and organize a rational practice of the hunting, and prescribe the regimentation and follow its application
- Of initiating, of conducting some actions of promotion, and of breeding development of wild cash animals

The Direction of the protection of the nature comprises two sub-Directions:

- The sub-direction of the parks and reserves
- The under Direction of the fauna and some hunting facilities

#### **ARTICLE X - THE DEPARTMENT OF THE PRODUCTION, OF THE FORESTRY INDUSTRY AND OF REFORESTATION**

- Of initiating the actions relative to the construction of forestry public domain and private, to its regimentation and its implementation

- Of conceiving and implement the relative actions to the construction, to the delimitation, to the management and to the protection of public domain and private
- Of achieving the whole inventory operations of forest domain
- Of valorizing the products of forest, notably by the promotion of some secondary products and the non woody products
- Of instructing the demand of forestry concession, of the forest operators agreement and of wood industry, and also the demand of license and other exploitation means
- Of updating the woody potential file of the forest and to manage the file of the field and the factories
- Of conceiving and care of the execution of the general plan reforestation and the development work in order to increase the afforestation rate of the national territory and of proposing and implement the whole actions of fight against the desertification and the increasing of the productivity in matter of woody
- Of promoting the forestry rural and the agro-forestry
- Of encouraging the construction of forest with the local community and the particulars

The direction of the production, the forestry industries and of reforestation composes to three sub-Directions 2:

- The sub-Direction of the reforestation and the desertification control
- The sub-Direction of the forestry production
- The sub-Direction of the forestry industries and secondary product of the forest

**ARTICLE XI - THE DEPARTMENT OF THE POLICE FORESTRY AND OF THE CONTENTIOUS**

- Of the forest domain supervising of the state the community and the particulars, and of its preservation against the clearing
- Of the application of forest and fauna regimentation
- Of ensuring military training of the agents
- Of doing the forestry control
- Of searching and noting the infraction in matter of forest exploitation and the hunting offense
- Of preparing the actions of legal proceedings in the competent jurisdiction and of representing the forestry administration to the court of law

## **ARTICLE XII - THE ENVIRONMENT DEPARTMENT**

It has for mission to take of the protection of the environment, by pointing out and control all the forms of pollution and of some nuisances.

- Of conceiving, animating and coordinating the actions of protection and of some aquatic area, lagoons and marine implementation
- Of carrying out to the collection and the exploitation of data concerning the aquatic area, lagoon and marines
- Of promoting the public salubriousness in the town and the villages, of proposing and implementing all susceptible action to better the living condition
- Of defining the relative regimentation to the protection of the environment and to control its applying

The environment department is constituted of two sub-directions:

- The sub-Direction of the fight against the salubriousness
- The Sub-Direction of pollution control
- The planing department of the survey of environmental impact, that is on the authority of a team leader who as got the rank of the central administration Sub-Direction

## **ARTICLE XIII - THE DEPARTMENT OF THE PLANING AND THE PROGRAMING OF THE STUDIES**

The Department has for mission, in links with the whole ministry structures, to elaborate and to coordinate the strategies of forestry development policy and the protection of environment.

- Of assuring the concordance of the initiated actions by the structures of the ministry and those that have been implemented by the international institutions, the intergovernmental institutions and the non-governmental organism. These institutions participle to the financing of the project relative to the forest development and the protection of the environment.
- Of preparing the planing work
- Of elaborating the reference terms of studies, of following its progress and evaluating the results
- Of formulating the programs and development projects, of coordinating and following its operation and its evaluation



### **3.1-2 Project Subjected to the Survey of Environmental Impact Projects Concerning the Article 2 - 1**

The dangerous company, insalubrious or uncomfortable subject to an authorization of the nomenclature of the classified installations.

#### **1 –Agriculture :**

- a ) Project of rural regrouping
- b ) Clearing and affectation project of barren land to the intensive farming of an acreage superior than 999ha

#### **2 –Forest development**

- a ) Reforestation operation of an acreage superior than 999ha

#### **3 –Extractive factories**

- a ) Working operation and petroleum concern and natural gas
- b ) Extraction of mining resources

#### **4 –Energy industry :**

- a ) Crud oil refinery and installation of gasification and liquefaction
- b ) Thermal central and other combustion installations of high calorific power
- c ) Hydroelectric dam

#### **5 –Waste disposal :**

- a ) Installations in order to stock or to eliminate waste whatever the nature and the procedure of elimination
- b ) Non controlled discharge having or not biomedical waste
- c ) Station of waste water purification

#### **6 –Industry of food**

- a ) Industry of vegetable fatty and Animals
- b ) Canned of animals product and vegetables
- c ) Manufacturing of milk product
- d ) Brewing and Malting
- e ) Preserving and syrup maker
- f ) Installation for animal slaughtering
- g ) Starch industry
- h ) Factory of fish meal and fish oil
- i ) Station of water treatment for human nourishment

#### **7 –Chemical industry**

- a ) Installation of manufacturing chemical product, of pesticide of pharmaceutical product, of painting and varnish, of elastomer, and of peroxide

## **8 –Metal work**

- a ) Iron and steel installation and installation of metal product which are not contain iron
- b ) Stocking of old iron

## **9 –Textile industry, leather industry, of wood and of papers**

- a ) Manufacturing unit of papers and cotton
- b ) Production unit of cellulose treatment
- c ) Unit of Tanning and megisserie

## **10 –Infrastructure project**

- a ) Construction of road for the traffic of railway, for motorway and for airport that the take of and the landing are 2100 meter
- b ) Port of fish trading and for pleasure
- c ) Development works of industrial areas
- d ) Urban development works
- e ) Canalization work and the regulation of basins river
- f ) Dams or other installations which can retain water or to stock it durably
- g ) Installation of pipeline and gas-pipeline or of other type of canalization
- h ) Installation of aqueduct

## **11 –Others**

- a ) Installation of cement manufacturing
- b ) Holidays village and hotels that capacity is inferior than 150 beds
- c ) manufacturing and Conditioning, loading or insetting of powder and explosive

**Appendix 9.3-3 Project subjected to the survey of the environmental impact,  
Projects concerning the article 5**

**1 –Agriculture**

- a ) Hydraulic agriculture project
- b) Exploitation that can shield fowls
- c) Exploitation that can shield pigs and other ruminants
- d ) Installation of fish farming
- e ) Recovery of territory which are installed on the sea

**2 - forest Development**

- a ) Operation of reforestation of a surface between 100ha and 999ha
- b ) Clearing and affectation project of barren land or semi–natural surface to the intensive farming of an acreage between 100ha and 999ha.

**3 –Extractive industry**

- a ) Deep boring exception to study the quality of the soil and notably
  - 1 –Geothermal borings
  - 2 –The borings for stocking waste
  - 3 - The borings for supplying water
- b ) Extraction in underground operation of mineral resources

**4 –Industry of energy**

- a ) Industrial installation intended to the production of industry, of water vapor
- b ) Industrial installation intended to the transport of gas of water vapor, transport of electric energy by shipping airline
- c ) Airline stocking of natural gas
- d ) Stoking of combustible gas in underground storage
- e ) Stoking of fossil combustible gas
- f ) Installation intended to the production of hydroelectric energy

**5 –Metal works**

- a ) Stamping, punching of big piece
- b ) Treatment of surface of metal
- c ) Boiler-making, construction of reservoir and other type of piece
- d ) Construction and assembling of automobile vehicle and construction of motor for vehicle.
- e ) Naval site
- f ) Installation for the construction and reparation of airplane
- g ) construction of railway material
- h ) Stamping of operating charges

## **Appendix 9.3-4 Sites that the projects are subjected to the survey of Environmental Impact Study, in article 2 - 2**

- 1 –Protected areas and analogue reserves
- 2 –humid area and mangroves
- 3 –Space of scientific interest, cultural, and tourists
- 4 –Area defined economically sensible
- 5 –Surface of water point protection
- 6 –Seaside space under national and international jurisdiction or other international seas

## **Appendix 9.3-5 A model report of the survey of environment impact**

### **1 – Non technical Summarized**

#### **2 – Introduction**

- Object of the report
- Introducing of the responsible survey of the environmental impact
- Procedure and range of the survey of the environmental impact
- Short descriptions of the contain of the method and technical used to do the survey of environmental impact

#### **3 Description of the project or program**

- The author of the project
- Introducing of the responsible of the survey of environmental impact
- Implantation site of the project or program
- Necessity and justification of the project or program
- Elaboration of the objectives, target and indicators
- Description of the project : Raw material, Processed, Equipment, Manpower, Products, etc....
- Maps, Organization chart and photography if necessary
- A measure of technical characteristic, Economy and ecology is necessary for the or the program
- Application calendar is foreseen
- Necessity of the survey of the environmental impact

#### **4 – Environmental context**

- Method of data collection
- Qualitative and quantitative statement of physics, biologics, social-economics environmental after the operating of the project
- Spatial bordering in the considered environment
- Area ecologically sensible that have an ecological value recognized scientifically, social-economically or cultural space or unique
- Tendencies of the environment state
- Lack of data

#### **5 – Other option of environment**

## **6 – Environment impact of each option and control plan**

- Technical method and implicated hypothesis
- Databases
- Prevision ( fullness, importance, distribution, uncertainty )
- The attenuation measures required
- Need of supervision

## **7 – Comparison of the options, conclusion**

## **8 – Program of supervision**

## **9 – Recommendation for the evaluation of the project or program**

## **10 – Source of data and information**

communication, consultation, program of data collection on the ground, written options, participation of the public.

## **11 – References**

## **12 - Annex**

### **3.2 Organization on Ministry of Construction and Environment**

MINISTRY OF THE CONSTRUCTION  
AND ENVIRONMENT

REPUBLIC OF CÔTE D'IVOIRE  
Union- Discipline- Work

#### **DECREE N°2000-80 OF FEBRUARY 09 2000 RELATED TO THE ORGANIZATION CHART OF THE CONSTRUCTION AND ENVIRONMENT MINISTRY**

The President of the Republic

On the Construction and Environment Ministry Report;

Considering the Constitutional Act n° 1/99-PR of December 27, 1999 related to the suspension of the Constitution and temporary organization of Public Authorities;

Considering the Decree n° 2000-02 of January 04, 2000 related to the Appointment of the Government of Transition members modified by the Decree n° 2000-09 of January 13, 2000;

Considering the Decree n° 2000-13 of January 21, 2000 related to Attributions of the Government of Transition members;

The Council of Ministers

Enact:

#### **Article 1:**

For the exercise of its attributions, the Construction and Environment Ministry disposes, besides the Cabinet, of Connected Services, Central Directions, and Exterior Services, which it is charge to organize by departmental orders.

#### **CHAPTER 1: THE CABINET**

#### **Article 2:**

The Cabinet includes:

- The Director of Cabinet
- The Chief of Cabinet
- The Official Representative
- The Chief of the Particular Secretariat
- Six Technical Counselors
- Four Project Managers

## **CHAPTER II: SERVICES LINKED TO THE CABINET**

### **Article 3:**

Are linked to the Cabinet of the Minister:

- The general Inspection of Construction and Urbanization and the General Inspection of Environment and Forest;
- The Service of Unique Counter and of Habitat;
- The Service of the Urban Domain;
- The Service of Civil Buildings;
- The Service of Inspection of Classified Installations;
- The Secretariat of the National Committee of Defense and Fight against Forest Fires;
- The department of Information, Education and Sensitizing;
- The Office of Control of Projects;
- The Service of Training and Teaching.

### **Article 4: THE GENERAL INSPECTION OF CONSTRUCTION AND URBANISM AND THE GENERAL INSPECTION OF ENVIRONMENT AND FOREST**

— They are charged of:

- To apply legislative and regular texts in the services of the Ministry;
- To execute, under the Minister's instructions, all necessary operations of inspection and control;
- To control and evaluate technical activities and management of the Ministry staff;
- To watch to the respect of discipline particularly to the respect of wearing of the uniform;
- To assist the Minister in the setting up all dispositions which include the changing of behaviour.

General Inspections include two General Inspectors and Technical Inspectors appointed by decree.

### **Article 5: THE SERVICE OF UNIQUE COUNTER, LANDED AND HABITAT**

It is charge of:

- To centralize all demands of administrative acts;
- To assume the control of treatments of documents;
- To give back to interested, according to delays, the sequel reserved to their demands;
- To establish statistics;
- To inform populations on the composition and the composition of documents.

It is controlled by an office manager of the unique counter, which have the grade of Sub-Director of Central Administration.

**Article 6: THE SECRETARIAT OF THE NATIONAL COMITY OF FOREST DEFENSE AND THE FIGHT AGAINST FOREST FIRE**

It is charge of:

- To conceive and control the setting up of A National System of Defense and Fight against bush fire;
- To elaborate programs proposed to the committee;
- To insure the coordination of actions of defense and fight realized on the field;

The secretary of the National Committee of the Forest defense and fight against bush fires has the grade of Sub-Director of central Administration.

**Article 7: THE OFFICE OF PROJECTS CONTROL**

It is charge of:

- To insure the coordination of all projects on exterior financing;
- To initiate, prepare and control the execution of new projects;
- To insure the concordance of actions initiated by structures of the Ministry and ones established by international organisms, intergovernmental institutions and non-governmental organizations, which participate to the financing of projects relating to the development of the Construction and urbanism sector, the protection of the environment and the development of the forest.

The office of control of the projects is under the authority of the Director of Cabinet.

**Article 8: THE DEPARTMENT OF INFORMATION, EDUCATION AND SENSITIZING**

It is charge of:

- To conceive a policy of communication, education and sensitizing concerted within sectors of Construction, Environment and each of concerned activities;
- To control the execution of the policy of communication;
- To evaluate the impact, near populations, of actions of sensitizing and campaigns of education.

It is under the authority of an office manager, which has the grade of Sub-Director of Central administration.

**Article 9: THE SERVICE OF TRAINING AND TEACHING**

It is charge of:

- to conceive a policy of training of the department agents;
- to program and supervise several examinations organized by the Construction and Environment Ministry, in relation with competent ministerial departments;



- To control organisms of forest or environmental training in relation with other competent ministerial departments
- To elaborate and control, at a national level, the policy of permanent training and the improvement of agents of the department.

The Service of Training and Teaching is under the authority of an office manager, which has the grade of Sub-Director of Central Administration.

**Article 10: THE INSPECTION SERVICE OF CLASSIFIED INSTALLATIONS**

It is charge of:

- To inspect and control classified installations;
- To watch over the apply and respect of regulations in all industries which are in the national territory;
- To insure the management of industrial wastes (dangerous) and to promote new technologies by favoring their access;
- To associate industrials in the setting up of actions of fighting against pollution.

It is under the authority of an office manager that has the grade of Sub-Director of Central Administration.

**CHAPTER III: CENTRAL DIRECTIONS**

**Article 11: CENTRAL DIRECTIONS**

They are composed of:

- The Direction of Habitat;
- The Direction of Construction and Sanitation;
- The Direction of Urbanism;
- The Direction of Environment;
- The Direction of Protection of the Nature;
- The Forest Police Direction;
- The Direction of Forest Industries Production and Forestation;
- Administrative and Financial Affairs Direction.

**Article 12: THE DIRECTION OF HABITAT**

It is charge of:

- To elaborate, apply and control the policy of habitat;
- To improve habitat, especially by actions, which promote the production of lodgings both in urban and rural area;
- To develop mechanisms of inciting in favor of private house operators and individual initiatives;

It includes three Sub-Directions:

- The Sub-Direction of Urban Habitat;

- The Sub-Direction of Rural Habitat;
- The Sub-Direction of Construction License.

**Article 13: THE CONSTRUCTION AND SANITATION DIRECTION**

It is charge of:

- To supervise studies and control constructions realized for the State;
- To insure the keeping and maintenance of the State house patrimony;
- To elaborate and program the execution of master plans of sanitation and drainage;
- To supervise studies and works of primary networks;
- To pursue the contract with SODECI for the maintenance of sanitation and drainage networks of Abidjan.

It includes three Sub-Directions:

- The Sub-Direction of new works;
- The Sub-Direction of keeping and maintenance;
- The Sub-Direction of sanitation.

**Article 14: THE DIRECTION OF URBANISM**

It is charge of:

- To supervise studies and control the application of Urbanism Plans;
- To supervise the approving of housing plans in urban and rural area;
- To define the regulation and legislation in matter of urbanism;
- To assist local collectivities in matter of planning.

It includes two Sub-Directions:

- The Sub-Direction of urban Planning;
- The Sub-Direction of Land Arrangement.

**Article 15- ENVIRONMENT DIRECTION**

It is charge of:

- To conceive and coordinate actions of protection and valorization of aquatic and lagoon areas;
- To collect and exploit datas related to aquatic and lagoon milieus;
- To promote public healthiness in towns and villages and to propose all action susceptible to improve environment;
- To supervise the elaboration and execution of tree-planting programs;
- To define the regulation related to the environment protection and control its application;
- To study environmental impacts of development projects.

It include two Sub-Directions and an office:

- The Sub-Direction of environment;

- The Sub-Direction of fighting against pollution;
- The Office Environmental Impact Survey.

**Article 16- THE DIRECTION OF PROTECTION OF THE NATURE**

It is charge of:

- To create, manage, protect and valorize national parks;
- To insure the conservation of botanic and zoological species;
- To conceive and organize a rational practice of hunting ;
- To initiate actions of promotion and development of wild animals species.

It includes two Sub-Directions:

- The Sub-Direction of Parks and Reserves;
- The Sub-Direction of Fauna and hunting resources.

**Article 18- THE DIRECTION OF FOREST POLICE AND LITIGATION**

It is charge of:

- To supervise the Forest Domain of the State, Local Collectivities and to protect it against grubbing;
- To apply the forest regulation;
- To insure the military training of agents;
- To effect the forest control;
- To research damages in matter of forest exploitation;
- To prepare actions of pursuing in competent jurisdictions and to represent the forest administration at tribunals.

The Direction of Forest Police and Litigation includes two sub-Directions:

- The Sub Direction of Forest Police;
- The Sub-direction of Regulation and Litigation.

**Article 18- THE DIRECTION OF FOREST INDUSTRIES PRODUCTION AND FORESTATION**

It is charge of:

- To initiate actions related to the constitution of the public and private forest domain and its regulation;
- To conceive and to set up actions related to the constitution, delimitation, management and protection of the public and private forest domain
- To realize whole of the forest domain operations of inventory;
- To valorize forest products, especially by the promotion of timber wood species and secondary products.
- To instruct demands of forest concessions, agreements of forest exploiters and industrial of wood;

- To update documents of the forest potential and to manage documents of yards and factories;
- To conceive and execute the General Plan of forestation and arrangement operations and to propose to set up whole of actions of fighting against desertification;
- To promote rural forestry and agro-forestry;
- To encourage the constitution of forests by collectivities.

It include three Sub-Directions:

- The Sub-Direction of Forestation and Fighting against Desertification;
- The Sub-Direction of Forest Production;
- The Sub-Direction of Forest industries and forest Secondary Products.

**Article 19: THE DIRECTION OF ADMINISTRATIVE AND FINANCIAL AFFAIRS (DAAF)**

It is charge of:

- To prepare the functioning and investment budget of the Ministry and to supervise its execution;
- To manage human resources and the Ministry patrimony;
- To effect the Ministry accounts;
- To control operations effectuated for existing activities;
- To effect buying related to closing;
- To buy arms and munitions;
- To make up programs of forest exploitation and programs of supervision of secondary products exploitation.

It includes two Sub-Directions and an Intendance:

- The Financial and Account Direction;
- The Sub-direction of Human Resources and Logistic;
- The intendance of Water and Forests.

**CHAPTER IV- EXTERIOR SERVICES**

**Article 20: EXTERIOR SERVICES**

They are constituted of 20 Regional Directions on which depend Departmental Directions and the quartering of water and forests.

Regional Directions exercise, each in its circumscription, technical competencies trusted to the Ministry of Construction and Environment in matter of construction, urbanism, environment and forests. They organize and control regional actions of the Ministry.

## **CHAPTER V- DIFFERENT DISPOSITIONS**

### **Article 21:**

The Environment and Construction Ministry exercise the trusteeship and the technical control on establishments and organisms, which the mission is within its attributions, according to existing legislative texts and regulations.

## **CHAPTER VI- FINAL DISPOSITIONS**

### **Article 22:**

The present decree abrogates all reverse anterior dispositions.

### **Article 23:**

The Environment and Construction Ministry is in charge of the execution of the present decree which will be published in the official newspaper of Côte d'Ivoire.