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COMMENTARY ON THE VISIT TO BURKINA FASO

BY MARGARETE KALIN

Boojum Research Ltd

DRAFT REPORT FOR COMMENT

to

Mr. Craig Andrews

The World Bank

Industry and Mining Division

Industry and Energy Department

1818 H Street, N.W.

Washington, DC 20433

August, 1995

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SUMMARY

This report is a commentary summarizing in Appendix 1 through 10 the information which is has been obtained in the 2 days prior to departing to Burkina Faso, during the various meetings held, while on site and after the return. The terms of references which were defined for the project (Appendix 10) can not be satisfactorily addressed, given the time frame of the visit and the limited funds available.

The consultants duties are repeated for ease of reference and comments are provided below:

1) " Assess the extent and adequateness of current environmental legislation and regulations, the government administrative set-up for environmental management, and the skill capabilities of local public and private staff. Based on this assessment, the consultant will prepare the major activities and terms of reference (including rough cost estimates) for technical assistance to complete the legislative framework and build capacity. Particular emphasis should be placed on training requirements, encouraging private sector response, education and public sensitization campaigns, and requirements for laboratory and testing equipment."

Reference was made to some regulations in existence in the 1993 Mining Journal Article. Unfortunately these are not available and thus no comments can be made regarding regulations. The facilities visited are discussed in detail in the commentary.

2) " Numerous artisanal workings exist throughout the country. The consultant will prepare an initial preliminary assessment of the environmental problems associated with these workings. The consultant will propose project activities and terms of reference (including rough cost estimates) for any remedial and site rehabilitation work, if warranted."

Some references have been presented in the report but the literature has to be consulted in more detail to address the problem in order to arrive at detailed project activities and terms of references.

3) " The consultant will visit the Poura gold mine and make a preliminary assessment of the environmental problems and conditions which may be associated with it. The consultant will prepare terms of reference, including cost estimates, for consultancy services for an environmental audit of the mine. Based on the consultant's experience, a rough estimate should also be made of the scope and cost of services required for any remediation of environmental problems."

Selected site specific information has been assembled during the site visit and with the site staff. Details are summarized in Appendix 3 and some assessment is given in the running commentary. Some problems have been identified but terms of references have to be prepared based on further data collection in conjunction with mine/mill on site staff.

4) " Numerous local and international companies are active exploring in Burkina Faso. It is likely that over the next several years one or more major gold mines could be developed. The consultant will prepare terms of reference (including cost estimates) for environmental baseline studies to be prepared for selected areas considered the most prospective for mine development. The baseline studies would provide the fundamental environmental parameters to be considered by the government and private sector investors regarding the impacts and protective measures required for mine development. "

A conceptual approach is presented below. The approach is recommended, given the explosion of mining claims in the country, documented in the commentary report. The baseline data collection in Phase I provides the framework on a geographical basis

to facilitate environmental assessments of potential mining activities.
It was concluded that all the data are avaialbe in the country and no additional studies *are required to collect data. The task is to assemble them in a cohesive form.*

Phase I

The different ecological sectors of Burkina Faso where mining would produce an impact have to be identified, such that environmental assessment can address these issues:

i areas of acid generating potential

- derived from mineralogical data and weathering characteristics of the rocks

ii areas for groundwater recharge and discharge for each sub-drainage basin

- derived from hydrological records
- precipitation data
- seasonal fluctuations

iii areas of erosion patterns - predominant wind direction

- derived from geomorphological/pedological information

iv areas of land use and vegetation coverage.

- derived from aerial photography interpretation ,ecological literature

This list is not comprehensive and should be expanded based on more literature review.

PHASE II

Based on the information collected in technical data under items i - iv in phase II it is proposed that areas of the country are identified where mining activities require specific environmental measures:

- risks can be quantified and requirements for environmental impact assessments can be specified on a regional basis for the country,
- the results can be related easily to the requirements for mining activities - total cycle,
- environmental impact statements can be derived for each region,
- the country wide identification of requirements for regions would reduce the administrative requirements for the regulatory arms of the country,
- restorations / reclamation goals can be defined realistically for each region.

OPERATIONAL ASPECTS

Coordinating of Phase I could be carried out by the University of Ouagadougou2

- it would strengthen the university programm as students could be utilized,
- the university has large body of information available,
- Institute Geographique du Burkina can become with its facilities the information processing and distribution unit, to produce the maps,
- Consultant takes the terms of references and evaluates the costs in Burkina Faso, so that the project can be carried out by local persons.

In Phase II consultants from outside the country, familiar with mining and the environment could develop the next phase of the project based on the information collected in Phase I.

5) Other duties as may be requested by the task manager during the mission.

A running commentary was requested (Appendix 10, Fax dated July 29th 1995). and has been provided. It was only possible to marginally assess the professional and scientific skills of the country. Some documentation has been provided in form of reports collected during meetings in Burkina and some CV's have been obtained. In general, I do not believe the skill base is the problem.

It is suggested that the project be developed in the context of the avaialbe information on Mining in Africa CD-ROM :

"Any company seriously active in the developing African market should consider purchasing a copy of this CD-ROM offered by the Multilateral Investment Guarantee Agency of the World Bank. Priced at US$1,995 each, the first edition covers 20 African countries and is a huge library of information, comprising over 100 full colour maps covering geology, mineral occurrences and other subjects, as well as thousands of pages of text on mining laws, investment codes, etc., etc." Quoted from: CAMESE newsletter, 4th of August 1995.

Inquires were made on the contents of the CD-ROM on Burkina Faso and apparently large amounts of information is contained therein on this country. Other World Bank projects were accessed for information, namely the IPPS data bank (Appendix 10) and the reply is quoted below:

"Thank you for your inquiry regarding the IPPS and your research on the environmental impact of gold in Burkina Faso. Unfortunately, for the purposes of your research, the IPPS applies only to the manufacturing sectors (i.e., ISICs 310 through 390). The IPPS has not calculated labour-based, value of output or value added intensities for the mining sector or other coefficients to evaluate environmental degradation. We are sorry we could not be of more help to you on this. Finally, should you use or publish any of the IPPS information, we would appreciate attribution and a copy of your work. Thank you for contacting us".

A proposal is being prepared by Boojum Technologies Limited to integrate the environmental aspects of mining disturbances into the IPPS approach.

In conclusion the site visit to Burkina Faso indicated that the need of streamlining activities in the environmental sector is quite urgent as indicated by the Review of the Environmental Procedures of International Organizations: A Preliminary Evaluation (Appendix 10).

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July 6, 1995 - Visit with Indu Hewawasam at Laboratoire Central O.N.E.A., Ouagadougou

With respect to equipment for chemical and microbiological determinations, the laboratory appears to be functional. All equipment is newly installed or in the process of being set up. However, there appears to be a lack of staff and a lack of work, i.e., samples to be analyzed. We saw one microbiological technician working on some plates getting ready to count. The possibility exists that the technicians were away from the laboratory collecting samples. If this is the case they are even more understaffed.

The analytical capability is there with respect to the available equipment but the staffing is not compatible with the equipment. A list of equipment is given in Appendix 1. Two (2) chemical and two (2) microbiological technicians are listed as being on staff but they were not present during my visit. The laboratory would still be understaffed, even including the above-mentioned technicians, if all the analyses is carried out with the equipment available.

Generally, in order to carry out metal and general chemistry analysis, it is expected that one technician can process about 200 to 300 analyses per day. If one technician tries to do all the determinations, including the organic chemistry along with atomic adsorption determinations, then not more then 70-80 analyses can be expected. The gas chromatographic determinations would slow down the output of the laboratory even further, as one technician would produce about 10 results per day.

The analytical facilities are provided with assistance from Denmark (see address at bottom of Appendix 1) which also provides technical assistance. From my point of view, if this is the case, the technical assistance should be utilized and the appropriate funds provided for staffing.

The laboratory has apparently been functioning for about one year. From discussions

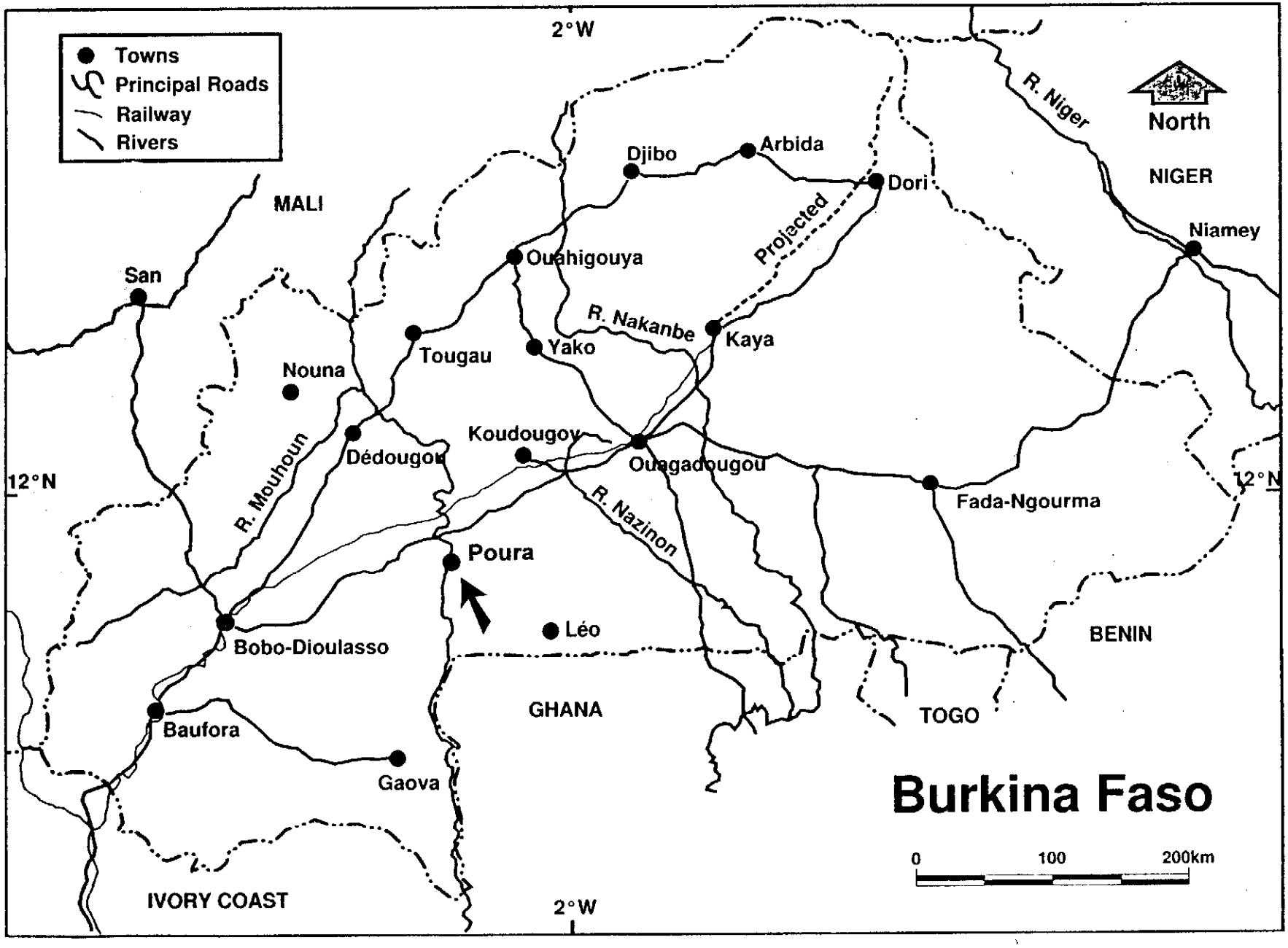
with the chemist, I understand the analytical facility is installing an atomic adsorption unit in the near future. This will facilitate the analysis of metals which are relevant to the mining/environmental sector. In order to utilize the equipment on the list and the anticipated atomic adsorption units and function as an operational laboratory, additional staffing is required.

I tried to establish what types of samples were being processed at the laboratory. Generally, the emphasis appears to be on water samples (drinking water, industrial water etc.). A sampling interval of once every three months was indicated and sampling locations appeared to be settlements in Burkina Faso (Map 1). This was derived from a map on the wall. I deducted from this that sampling of drinking water was taking place. I tried to determine if the concept of a QA/QC procedure was in place but it was not possible to ascertain.

I located an organizational chart for the Ministry of Environment and Water at OSTROM (Appendix 2). Although the laboratory could not be located as a separate unit on this chart, it might be included under ONEA.

In conclusion, if the laboratory is the environmental laboratory of Burkina Faso responsible for the analysis of drinking water quality (this should be a health aspect), the laboratory equipment is effective but the organization and staffing are entirely inadequate.

The importance of QA/QC procedures, as well as the independence of the laboratory from the regulatory agencies, could not be ascertained. Assuming the Ministry of Environment and Water has regulatory authority, the laboratory should report to a different section or division, otherwise a conflict of interest is created. The organizational chart (Appendix 2) suggests that the laboratory reports directly to the Secretariat General which, in turn, reports to the Minister of the Cabinet Ministre d'Etat. The laboratory should be a separate unit or department to avoid conflict of interest and allow for action if water is contaminated. The Ministry cannot prosecute itself.



Map 1: Location of Poura

(ref: *Advertisement Supplement to Mining Journal*, London, August 13, 1993)

July 6, 1995 - Afternoon

Attended meeting with the working group together with the mission leader. It was an information meeting about the mission and I intended to report my preliminary findings at the end of my visit. However it became clear that this was not a technical group. Hence I did not report back to the group at the end of the week.

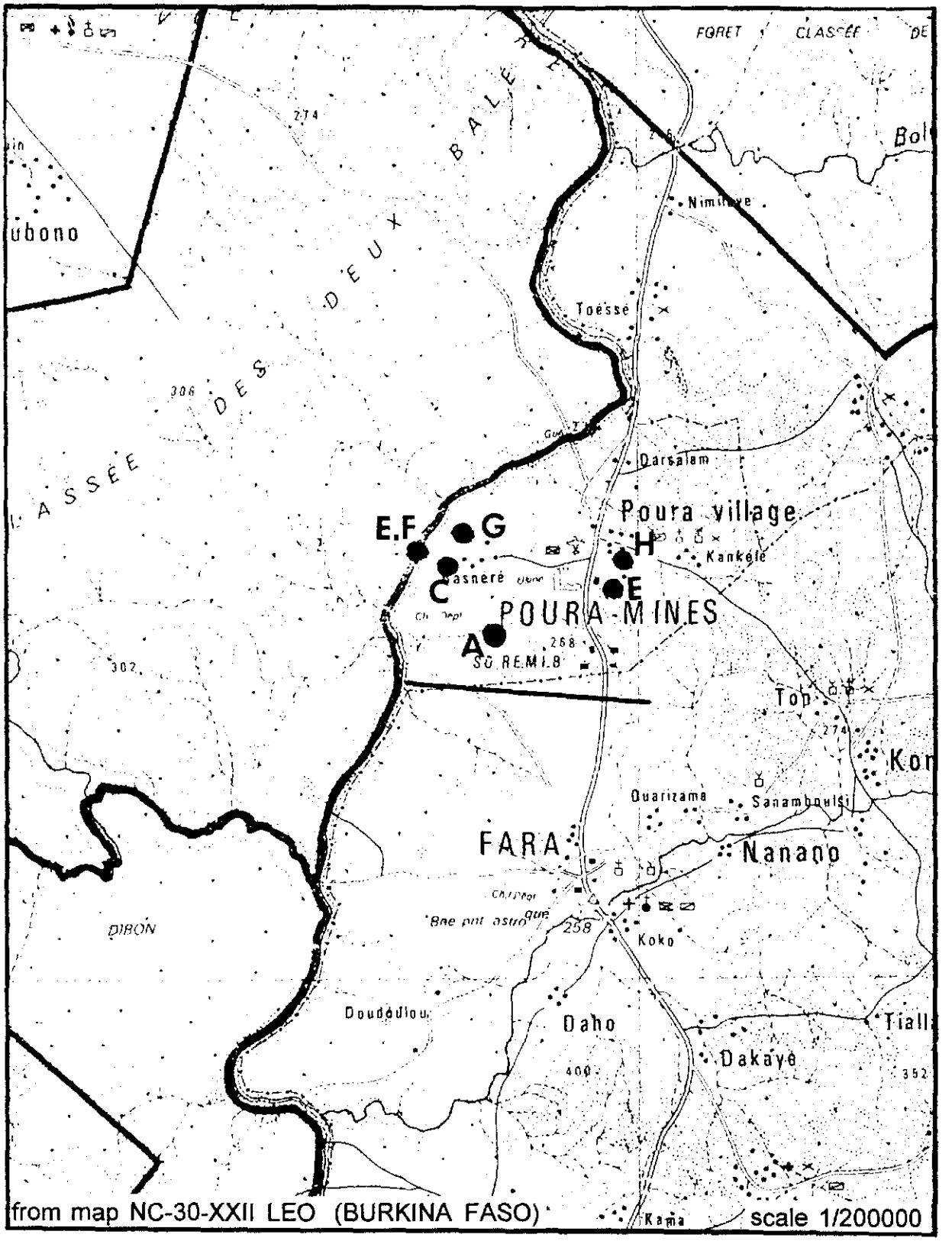
July 7, 1995 - Site Visit at Poura

We arrived on site around 9.30 am and proceeded, after a short meeting with the mine manager, to inspect the abandoned open pits and the tailings pond. Information collected and summarized is presented in Appendix 3. Map 2 and Map 3 give locations and details of the site. The key features of the assessment are summarized below in point form:

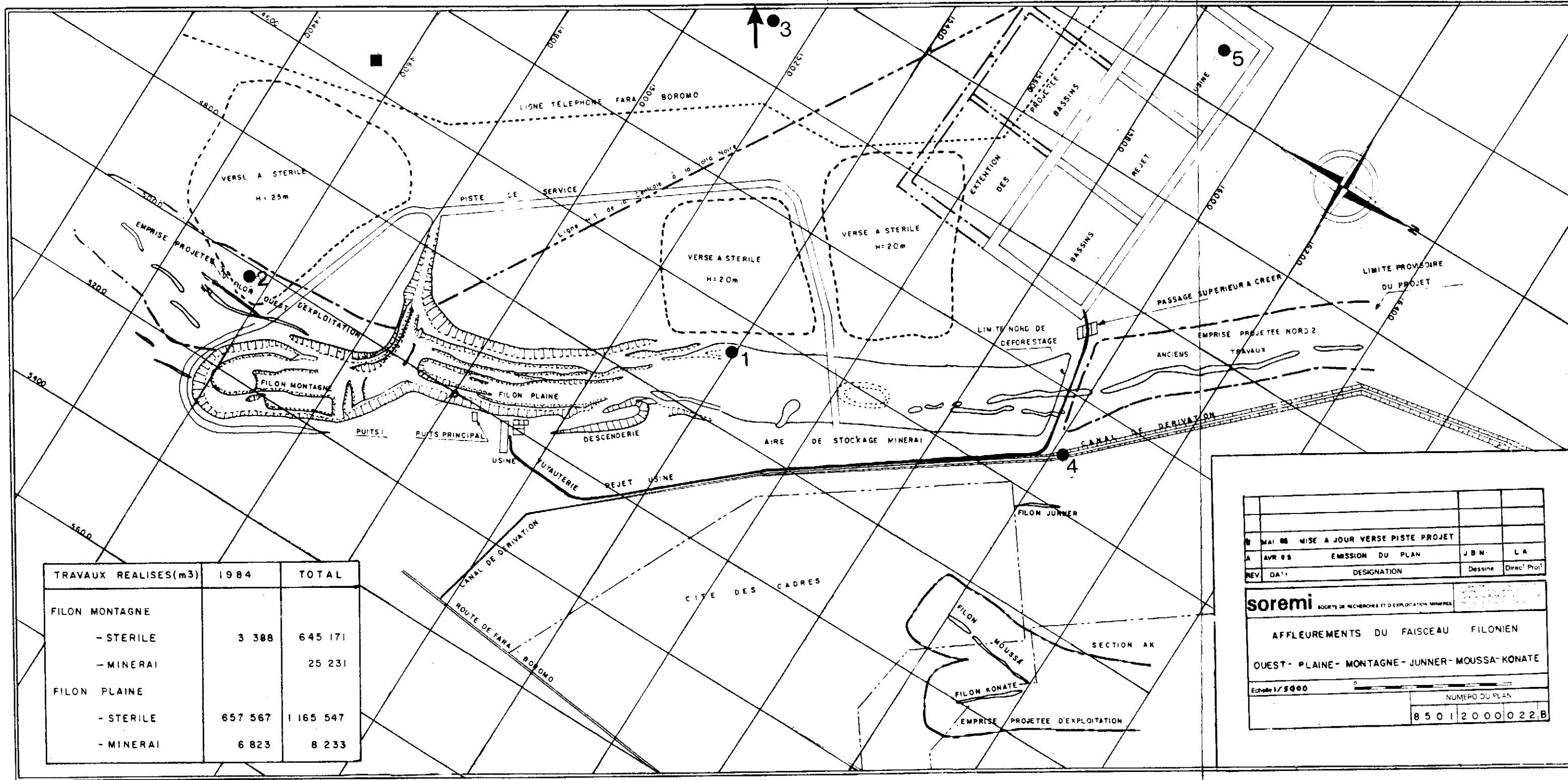
- The tailings ponds are full. Although I did not determine the pumping capacity for reclaimed water during rain periods, I would suspect that the flotation tailings facility is overflowing; it then follows that increased tailings pond capacity is required. One of the cells of the tailings pond was overflowing while we were visiting the site. Restoration of the tailings pond surface does not seem to be a problem since the ponded areas are already colonized by cattails. Ecological engineering approaches to the decommissioning of the tailings would be highly appropriate. A small effort on water management would cover the tailings surface with vegetation (seeding cattails).

- Environmental monitoring of water quality has essentially been absent since 1989. Wells were monitored for CN and several other parameters at some time. There was no evidence of monitoring for As in the water. Water sampled during the site visit was submitted to a laboratory in Canada. The As concentrations reported are low (Appendix 3).

- The pits are slowly filling up with water. The water is neutral to alkaline. No



Map 2: Location of Monitored Wells



TRAVAUX REALISES(m3)	1984	TOTAL
FILON MONTAGNE		
- STERILE	3 388	645 171
- MINERAI		25 231
FILON PLAINE		
- STERILE	657 567	1 165 547
- MINERAI	6 823	8 233

REV.	DATE	DESIGNATION	Dessiné	Direct. Proj.
B	MAI 88	MISE A JOUR VERSE PISTE PROJET		
A	AVR 85	EMISSION DU PLAN	J.B.N.	L.A.

soremi — SOCIETE DE RECHERCHES ET D'EXPLOITATION MINIERES

AFFLEUREMENTS DU FAISCEAU FILONIEN

OUEST - PLAINE - MONTAGNE - JUNNER - MOUSSA - KONATE

Echelle 1/5000

NUMERO DU PLAN

8501 2000 022 B

● WATER SAMPLING STATION

■ CN TAILS STORAGE

Map 3: Surface Water Sampling Locations

evidence of acid mine drainage was found. The slopes are being colonized with vegetation and generally the pits appear not to pose any immediate danger. Questions arose with respect to the long term such as:

- the effects of open water bodies are breeding grounds for malaria;

- effects on the ground water;

- final water table in the pits and final water quality cannot be addressed with the information available. The water at present is neutral to alkaline with elevated electrical conductivity.

- Extensive oil spillage was evident in the diversion channel, likely originating from the machine shop and/or generators.

July 8, 1995 - Read documents provided to me by mission members

- Artisanal Mining Internal Report from the World Bank; the document did not contain much technical information; there was a brief introduction and overview of artisanal mining with some specific information on sites. A large middle section of the report contained political and regulatory information. The end section indicated some health problems. Essentially, the document did not contain any relevant environmental information. Returned to Craig Andrews.

- Burkina Faso: Environmental Management Project: Staff appraisal Report. It contained interesting information in general, but was more of a policy statement with respect to what a project should be like. It contained some interesting maps on migration patterns of human populations in Burkina Faso and an ecological zones. No references were found in the text to the maps.

Read documents obtained by Boojum Research

- Newspaper clippings assembled prior to departing to Burkina Faso (Appendix 4).

It is interesting to note that according to these sources, the European Commission and the African Development Bank are considering 1.1 and 1.2 U.S. million dollar grants to assist in mining sector development. These were clippings from 1993 (October and December). In April 1994 the European community was considering supporting the Poura Mine with U.S. $520,000.

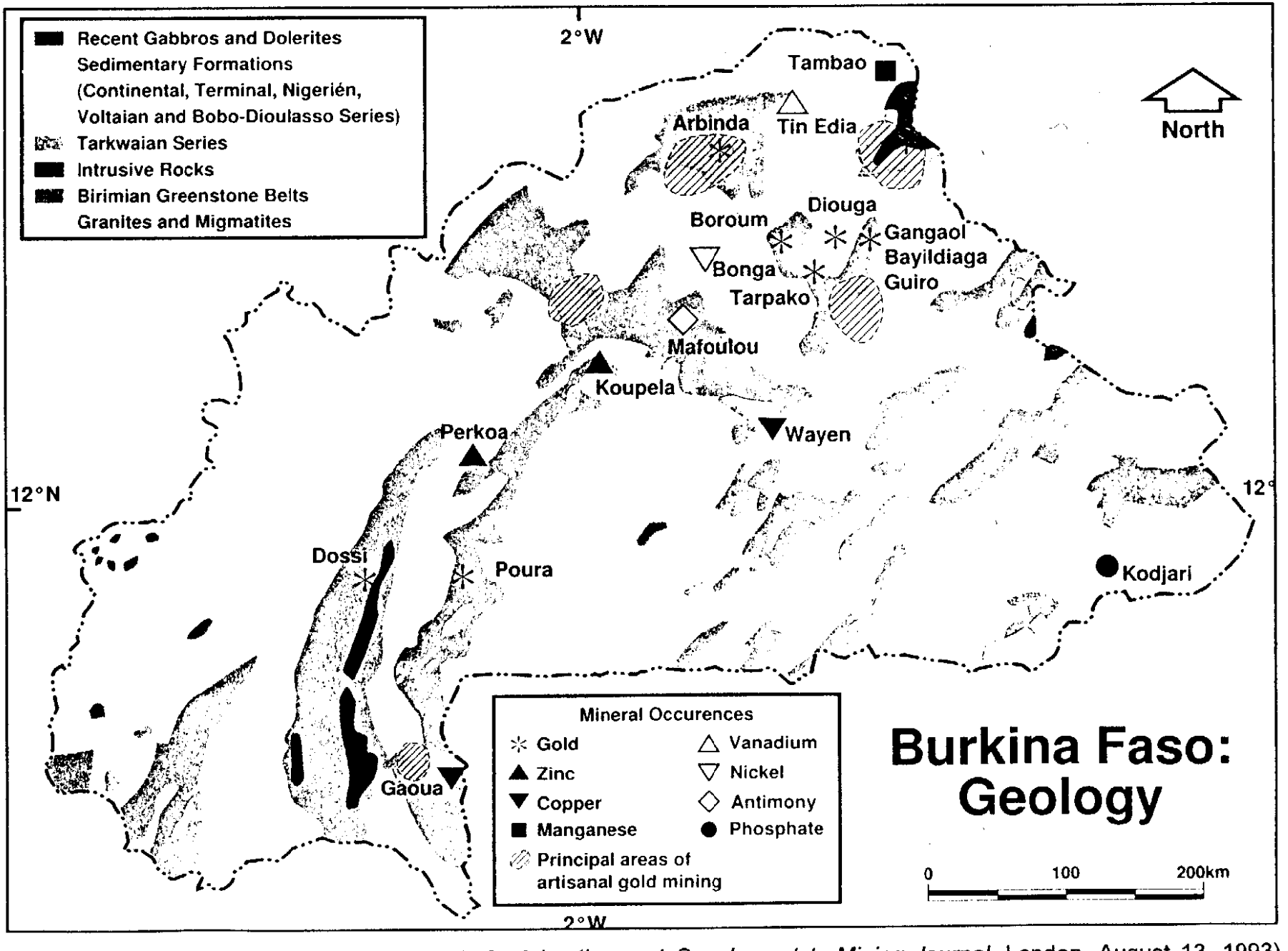
It would be useful to examine what these funds have achieved to date and whether the funds were actually given. If the funds have been expended, the activities of the proposed project by the World Bank should be streamlined.

- Article on Burkina Faso, Mining Journal, August 1993 (Appendix 4).
General information which is useful to relate to all activities of the mining sector. The question arises whether anything has changed since this article was written. On Map 4 mineral occurrences are given in Burkina Faso. Why is the World Bank only focusing on developing gold?

Fees for a prospecting permit are quoted as $370 and $550. Mining permits and dollar values are also given. There is reference to a new mining code adopted in 1993 by the National Assembly which indicates that companies operating in Burkina Faso should respect the environment. No other details given!!

July 9, 1995 - All Day

Visited Ouaga with Mr. Karim Kindo, Mining Engineer Head of Mine Safety. In discussions, it became clear that some waste water treatment and environmental monitoring is being done at the site, but not regularly. A list of questions was developed to obtain data from the site which would be useful to have for the Poura site



Map 4: Mineral Occurences

(ref: *Advertisement Supplement to Mining Journal*, London, August 13, 1993)

assessment. We then visited Mr.Boureima Ouedraogo to discuss with him if these data could be made available. A package was delivered to my hotel the following Friday, July 14. This information is summarized in Appendix 3.

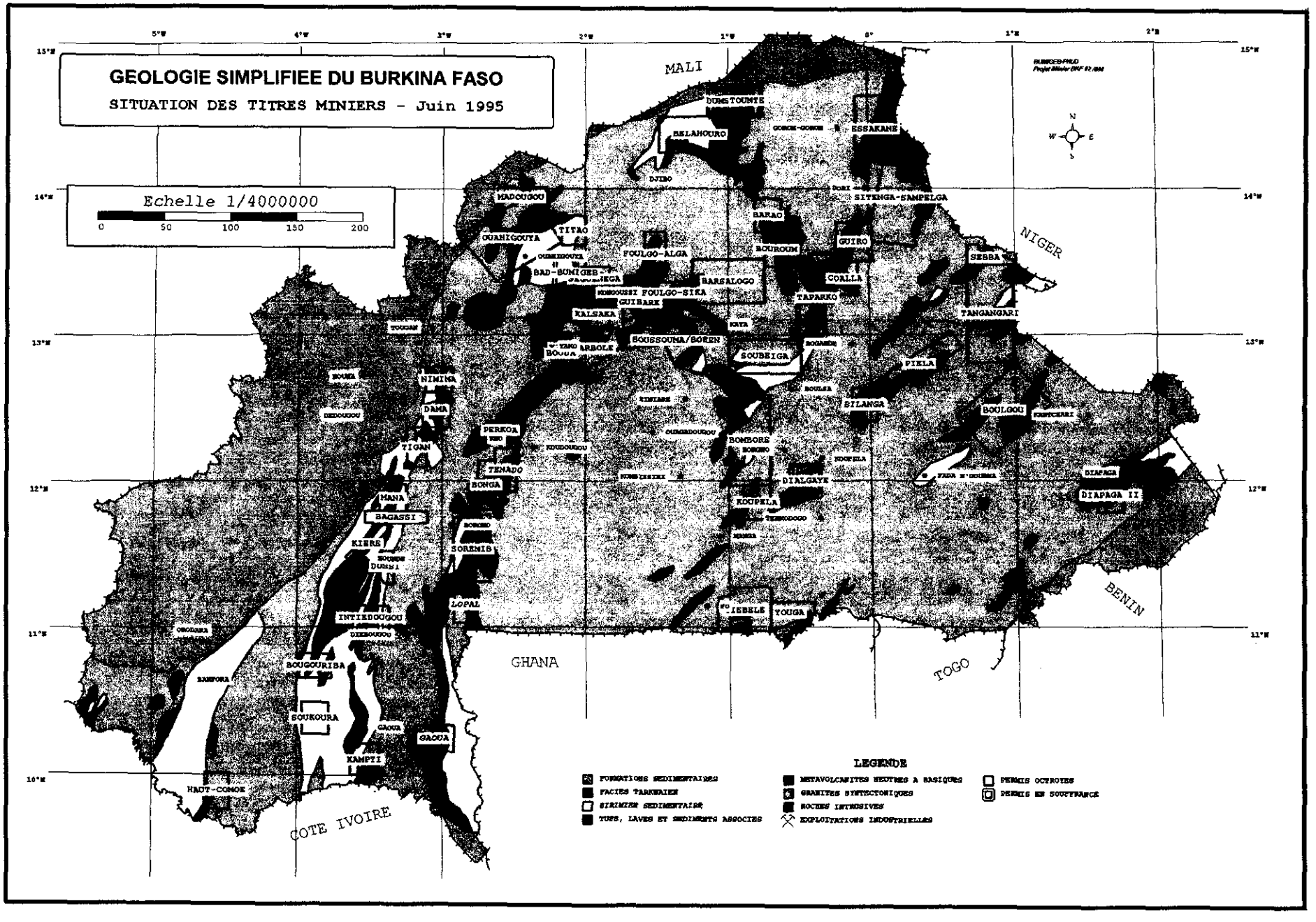
July 10, 1995 - Morning

- Discussion with Georges Grandin, ORSTOM Representant au Burkina Faso.

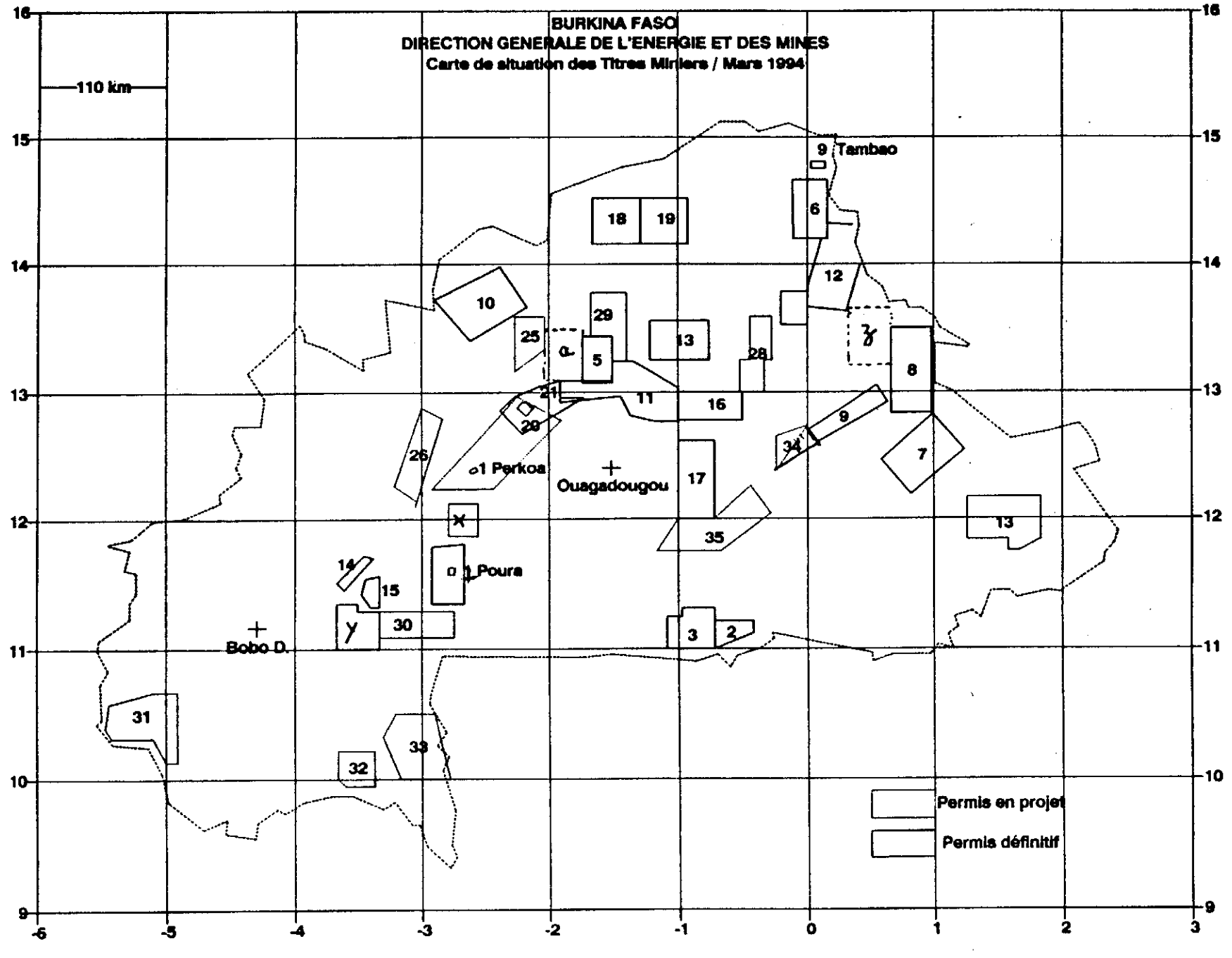
We discussed the long term problem which might face Burkina Faso if a mining sector is developed. A question repeatedly asked is: Why the gold rush? I offered my explanation.

ORSTOM is a facilitator for research projects carried out by France and covers all of Africa. An ORSTOM organizational chart is included for Burkina Faso as Appendix 5. All the projects are listed. Several environmentally important projects are being carried out, such as 1) The Geology of l'or 2) Infiltration et erosion 3) hydrologye regional 4) Gestion des ressources en eau 5) Ecologie agroforestiere and more (See Appendix 5). When I inquired if they were interested in joining any projects, it was evident that ORSTOM would serve as a facilitator but was not specifically interested in a joint effort.

Mr. Grandin has personally investigated the artisanal mine sites and gave me a good overview of the geology and hydrology of the Poura mine site. ORSTOM had taken water samples from there previously. I could not determine if there is any ongoing cooperation between the Poura Mine and the organization. From the mission I received a list of mine claims (Map 5) which lists approximately 80 claims. From Mr. Grandin I received a map with 39 claims reported in May 1994 (Map 6). In June 1995, according to the information issued by BUMIGEB the claims increased by about 50%. **Clearly such development calls for action rather then assessment.**



Map 5: Exploration activities June 1995



Map 6: Exploration activities May 1994

Mr. Grandin offered to convene a meeting if I would be able to conceptually define an approach to joining environmental aspects and mining together. He was essentially sceptical as he felt I would not be able to identify interested parties during my stay in Burkina. In retrospect he probably was correct, and it was only my enthusiasm and a certain degree of naivete which lead to the meeting on Thursday 13. A list of attendants is attached as Appendix 6 and the conceptual project is outlined in the summary.

Meeting with Mr. Wenmenga Urbain

Mr. Wenmenga Urbain, University of Ouagadougou, presented me with a proposal for the environmental impact of artisanal mining. I also received a summary of his faculty; there would also be students available to start working on a program. He was very interested in joining the project. At the ORSTOM meeting, I suggested that as a faculty member with students, he should be the technical leader as this would be a good place to start to get local people involved in environmental projects. Education seems to me to be a key factor to the progress at any environmental level.

July 10, 1995 - Afternoon

Visit to the Institute Geographic de Burkina with mission member, Getan.

Introduction to the Institute was given by the Director General, Ousseny Tarnanguida where we discussed the capabilities of the IGB. In summary, the meeting indicated that IGB can do everything, from numerical base mapping to GPS and air photo interpretation. Getan left and I proceeded to investigate, through ordering aerial photos. I wanted to cover the mine site for different time periods to compare the changes which have taken place due to the mining activities.

First I tried to obtain regular cartographic maps. Base maps exist for the entire country at a scale of 1: 200,000 (somewhat uncertain about the scale). There is only partial

coverage available for other scales. I saw base maps (mosaics) of other scales but an overall almanac is not available. Around Poura maps of several scales are available.

It took a long time to find the 1981 flight lines. This information is not organized and readily accessible nor is it computerized; 3 sheets of paper were located with numbers on them; in reply to my question, "why not?", the answer was "we do not have computers down here"; I found out on the second visit that all the computerized services are on the second floor.

As I was waiting in the room for the arrival of the 1981 flight lines, I saw a flight record book 1994. I investigated and found Poura flown in 1994. I indicated this record to Mr. Sawadogo Ousmane Francis who was assisting me and he acted surprised but then proceeded to find the aerials. We successfully placed an order for the photographs to be printed and I picked them up on Friday the 14th.

The conclusion is that they have no context of providing a service to an industry or no concept as to why a service is needed. In summary, similar to the laboratory, there is an institute with facilities but which lacks a sense of purpose, a reason for being, drive, organization and management. It appears that the aid industry has produced institutions which do not naturally exist and thus the interest in the institutions to perform is imposed with no awareness of the purpose.

July 11, 1995 - Site visit to Artisanal mine site

This was a most interesting trip. In May 1995 the World Bank organized a round table discussion of these activities and the conclusions are enclosed as Appendix 7. Given the magnitude of the problem it is not possible to formulate a professional opinion from one site visit. I support the conclusion from the round table. A solid summary of the conditions of the artisanal mining activities in the country should be made. A reference as a starting point might be the ARC report by: Baubacar B. Zanga and Kabore and Ouedrago. J. Etude de Base sure l'exploitation miniere artisanate au Burkina Faso and

other information based on the round table discussion.

One observation that might be of interest (depicted in photographs given in Appendix 7) is the colonization of indigenous plants taking place on the site. This would suggest that the ground is not sterile and rehabilitation is possible. Several ideas came to mind, such as collection of rain water and utilization of abandoned pits for water storage. Generally, however, an organized approach to finding solutions for rehabilitation efforts has to be based on an evaluation of several sites which have different ages and are located in different habitats or ecotones.

July 12, 1995 - Morning

Meeting with Louis Traore from S.P Pane National Environmental Action Plan. This was initially a very frustrating meeting as I was given to believe that the program had been cancelled by the World Bank. Mr. Traore was located in an office with a computer. He presented me with a program which made good sense for the collection of environmental data but I could not get him to show me what had been collected.

Ultimately we communicated and he understood what I was looking for, namely basic information on hydrology, soil conditions and ecological information on a country wide scale. He introduced me to his boss, Mr.Prosper K. Sawadogo who, along with some other coworkers, who all indicated their wish to be able to help. I understood in retrospect, after reading the Burkina Faso National Environmental Action Plan, which was formulated in August 1991, the level of frustration which I sensed during the meeting. The plan is a document which calls for action and those were not evident to me by 1995.

As my communication with Mr. Traore improved and he understood what I was interested in, we made an arrangement to see the Institute Geographic again, where most of the information I wanted for the environmental planning for the mineral sector was available. An outline of this information and the project is given in Appendix 8.

July 14, 1995 - Morning

A meeting was requested by the mission leader with a consultant who could provide organisational and communication aspects of any project which might be organized. The questions below were prepared prior to the meeting with consultant Abdoulaye M. Barry from SIGNUR. There were used as a guideline for a discussion to establish if he would be suitable to work on the project.

1. What are the capabilities of the company?
   Company profile and Mr. Barry's resume attached in Appendix 9.

2. What are the competitors doing?
   I did not get an answer to this. He claimed there are no competitors.

3. What does he think Burkina Faso's problems are?
   I did not receive an appropriate answer to this. He had not formulated a clear political position.

4. What is his understanding of the gold rush?
   He had not thought about it.

5. What does he think will happen if they find a gold ore body (large enough to exploit and develop?
   His view was it would be useful if mining and agriculture could be combined.

6. What are his views of the University?
   He was not connected to anyone specifically at the University thus he was ambivalent.

7. What are his views of the Geographical Institute?
   He had never heard of it in detail, nor had he used it for any of his contracts.

8. What are his views of ONEA or the water management of Burkina Faso?
He agreed with my suggestion that this organization is controlling the country.

9. What does he think about the exploration activities?
He thought nothing of it one way or the other, but he thought it was a positive development.

10. What does he know about the World Bank project?
He claimed to know very little, but indicated that it had been going on for a long time.

11. Terms of reference - cost development and supervision, is this work you could carry out?
He shows a clear understanding of the plan I would like to see carried out, should a project materialize. This understanding is expressed in Appendix 9.

12. What other sources of contracts do you have, such as Billiton or Anglo American? What is your daily rate and what do you call a days work?
He indicated that he is assisting Billiton in logistics. No indication of the amount of work which could be expected from a day as a project coordinator could be derived.

July 14, 1995 - Afternoon

Arranged visit to the University with Nariam Ouangrawa who attended the ORSTOM meeting on July 13th 1995 about the project.

We visited the University with Mr. Barry and were introduced to Alain Nindaoua Savadogo , Maitre de Conference d'Hydrologie at the University of Ougadougou. After discussions with him about the potential project, he showed us his LANDSAT facilities which were very impressive. He did not know about the facilities available at the

Institute de Geographique due Burkina IGB. His laboratory can carry out groundtruthing of LANDSAT interpretation with all the instrumentation. Some was supplied by a company in Canada.

My conclusion from this afternoon was that cooperation between organisations in Ougadougou is non-existent and even the resources available within the same institution are not necessarily shared. This was particularly evident when we returned to the Institute the Geographique (IGB) to pick up the aerial photographs. Yes I had a delivery of a series of aerial photographs, comparing the same area several years apart. The flight lines were placed on a topographical map by Sawadogo Ousmane, who is a flight line operator with 830 h experience. He is at the Institute since 1980 and his resume is given in Appendix 9. If it had not been for his assistance, obtaining the aerials would have been more complicated. He marked the flight lines and located the places for which aerial photographs were available.

On the day before I had visited the upstairs of the same Institute, where computers are available which have the capability to produce maps for Burkina of different relevant environmental information. Clearly there is no coordination between upstairs and downstairs in the institute and among the institutions.

Appendix 1

LABORATOIRE CENTRAL O.N.E.A.

1 - LABORATOIRE CHIMIE GENERALE :

Equipements principaux	Paramètres mesurés
Auto-analyseur :	Nitrite, Nitrate, Ammoniaque, Phosphate.
Spectrophotomètre :	Fer, Manganèse, Nitrites/Nitrates, Ammoniaque, Phosphate, Silice.
Photomètre à flamme :	Sodium , Potassium.
Néphélémètre :	Turbidité, Sulfate.
Etuve 105°C :	Matières en suspension, Résidu sec.
Four 550°C :	Perte au Feu.
Distillateur :	Azote de Kjeldahl, Ammoniaque.
Conductivimètre :	Conductivité.
Titrigraphe :	Chlorures, Fluorures, Alcalinité (TA/TAC), pH.

2 - LABORATOIRE CHIMIE ORGANIQUE :

Equipements principaux	Paramètres mesurés
Chromatographe phase gazeuse :	Pesticides Organochlorés, Hydrocarbures, Chloroforme.
TOC Analyser :	Carbone Organique Total.
Equipement Général :	Centrifugeuse, Rota vapeur, etc ...

3 - LABORATOIRE MICROBIOLOGIE :

Equipements principaux	Paramètres mesurés
Incubateurs (21°C , 37°C , 44°C)	Germes Totaux, Coliformes Totaux, Coliformes Fécaux.
Rampe de Filtration	
Bains-Marie	
Microscopes	
Autoclaves	
Compteur de colonies	

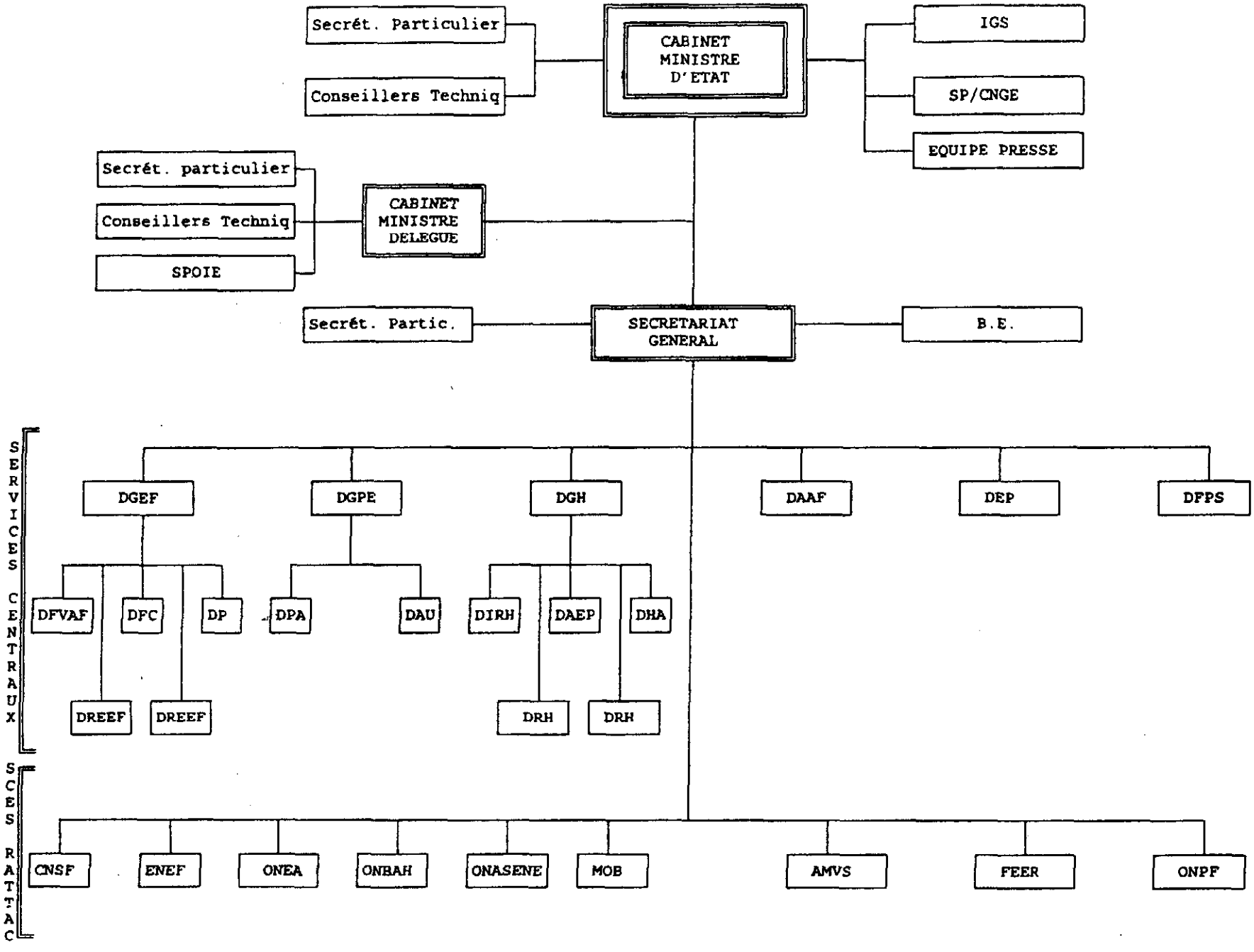
4 - EFFECTIF O.N.E.A.

1 Chimiste / Chef du labo
2 Techniciens chimie
2 Techniciens microbiologie
1 Assistant administratif 2 day / week
1 Chauffeur
1 Assistant du labo

5 - CONSEILLERS TECHNIQUES

VKI - L'Institut pour la Qualité des Eaux
Agern Allé 11
DK 2970 Hørsholm
Danemark

ORGANIGRAMME DU MINISTÈRE DE L'ENVIRONNEMENT ET DE L'EAU



Appendix 2

SIGLES

IGS	:	Inspection Générale des Services
SP/CNGE	:	Secrétariat Permanent du Conseil National pour la Gestion de l'Environnement
SPOIE	:	Secrétariat Permanent des Organismes Inter Etats
BE	:	Bureau d'Etudes
DGEF	:	Direction Générale des Eaux et Forêts
DFVAF	:	Direction de la Foresterie Villageoise et de l'Aménagement Forestier
DFC	:	Direction de la Faune et des Chasses
DP	:	Direction des Pêches
DREEF	:	Direction Régionale de l'Environnement et des Eaux et Forêts
DGPE	:	Direction Générale de la Préservation de l'Environnement
DPA	:	Direction de la Prévention des Pollutions et de l'Assainissement
DAU	:	Direction des Aménagements Urbains
DGH	:	Direction Générale de l'Hydraulique
DAEP	:	Direction de l'Approvisionnement en Eau Potable
DHA	:	Direction de l'Hydraulique Agricole
DIRH	:	Direction de l'Inventaire des Ressources Hydrauliques
DRH	:	Direction Régionale de l'Hydraulique
DAAF	:	Direction des Affaires Administratives et Financières
DEP	:	Direction des Etudes et de la Planification
DFPS	:	Direction de la formation Professionnelle et des Stages
ONBAH	:	Office National des Barrages et des Aménagements Hydro-agricoles
ONEA	:	Office National de l'Eau et de l'Assainissement
ONPF	:	Office NAtional des Puits et Forages
FEER	:	Fonds de l'Eau et de l'Equipement Rural
AMVS	:	Autorité de Mise en Valeur de la Vallée du Sourou
MOB	:	Maîtrise d'Ouvrage de Bagré
ONASENE	:	Office National des Services d'Entretien, de Nettoyage et d'Embellissment
ENEF	:	Ecole Nationale des Eaux et Forêts
CNSF	:	Centre National de Semences Forestières

Appendix 3

Table 1: Chemistry of samples collected July 7, 1995

No	Sample Description	FIELD			LAB				
		Temp. (C)	pH (units)	Cond. (umhos/cm)	Temp. (C)	pH (units)	Cond. (umhos/cm)	Em (mV)	Alkalinity (mg/L)
1	Fosse #4	25.0	7.76	125	24.6	7.48	174	157	47.2
2	Filon Ouest	29.0	8.27	420	24.3	6.56	69	250	24.4
3	Balago	30.0	8.85	900	24.4	7.98	310	198	165.6
4	Canal de Derivation	30.0	6.40	190	24.9	6.89	175	218	45.6
5	Basin #3	30.0	8.90	600	24.6	7.43	533	208	74.7

Table 2: Arsenic concentration
samples collected July 7, 1995

No	Sample Description	As mg/L
1	Fosse #4	<0.002
2	Filon Ouest	0.003
3	Balago	0.011
4	Canal de Derivation	0.009
5	Basin #3	0.049

Table 3: Comparison of water chemistry

No	Sample Description	Aug 1994	Jan 1995	Jul 1995
		pH		
3	Balago		8.26	7.98
5	Basin #3	6.30		7.43
		Conductivity		
3	Balago		350	310
		Alkalinity		
3	Balago		190	165.6

Fig. 1: Comparison of pH

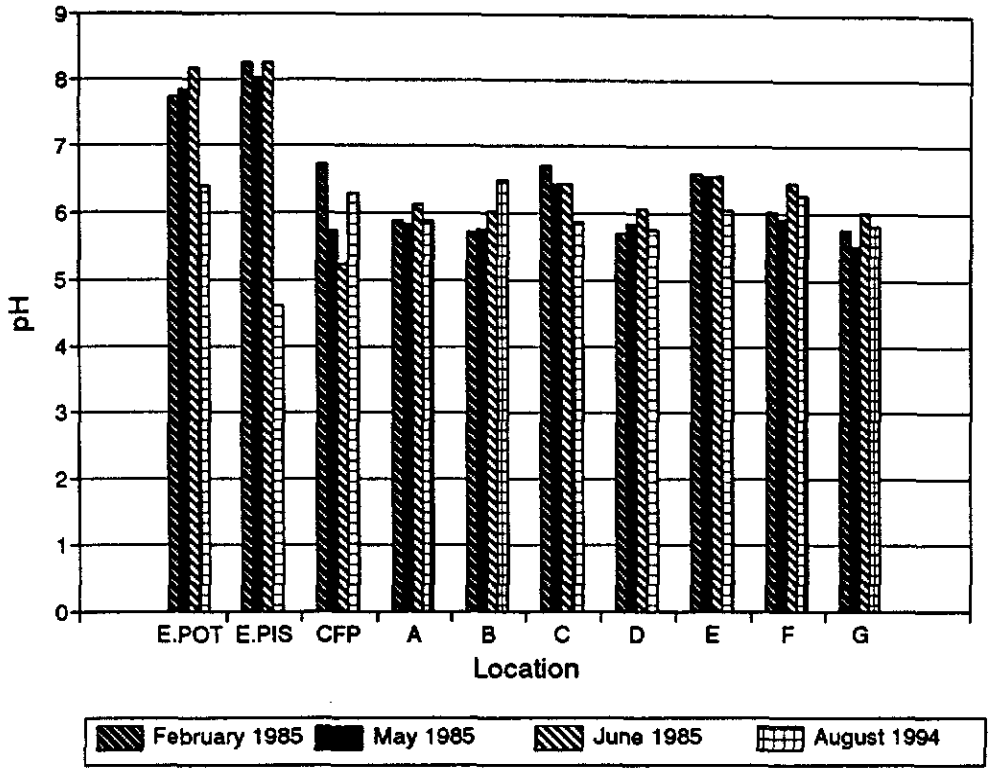


Fig. 2: Comparison of CN

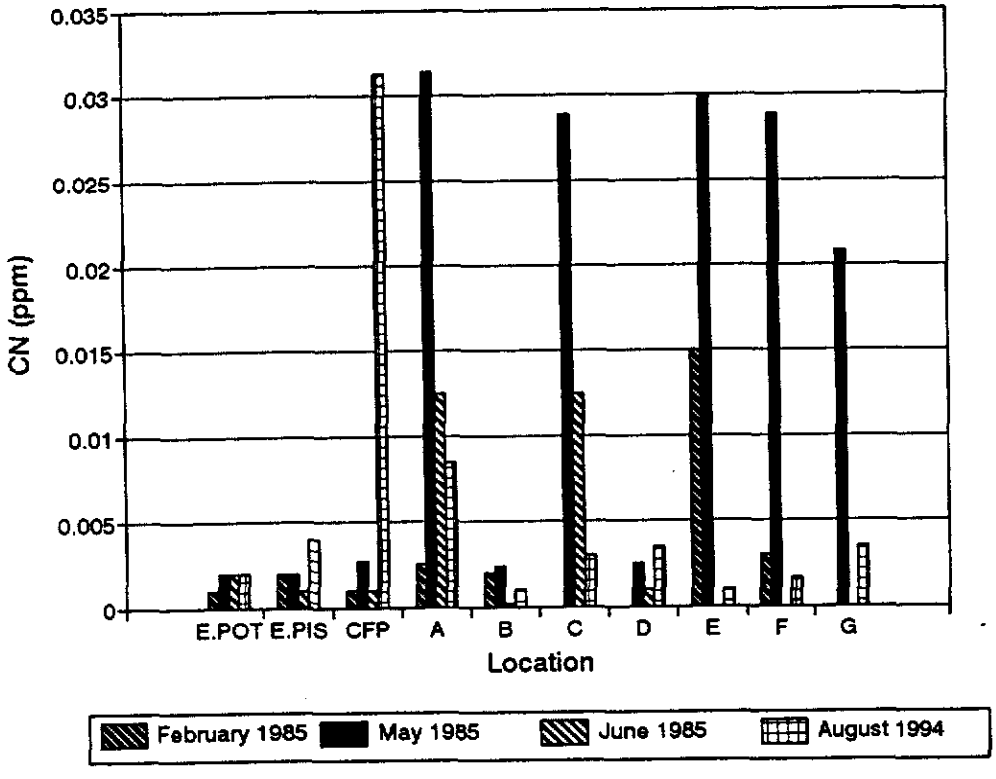


Fig. 3: Comparison of NO2

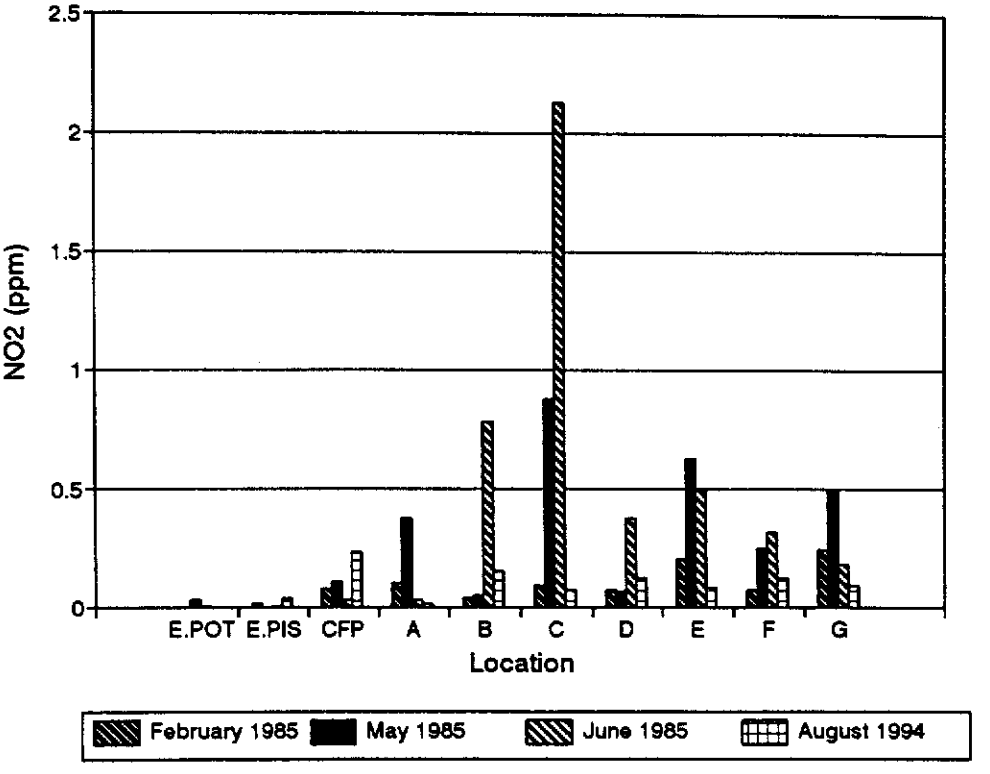


Fig. 4: Comparison of SiO2

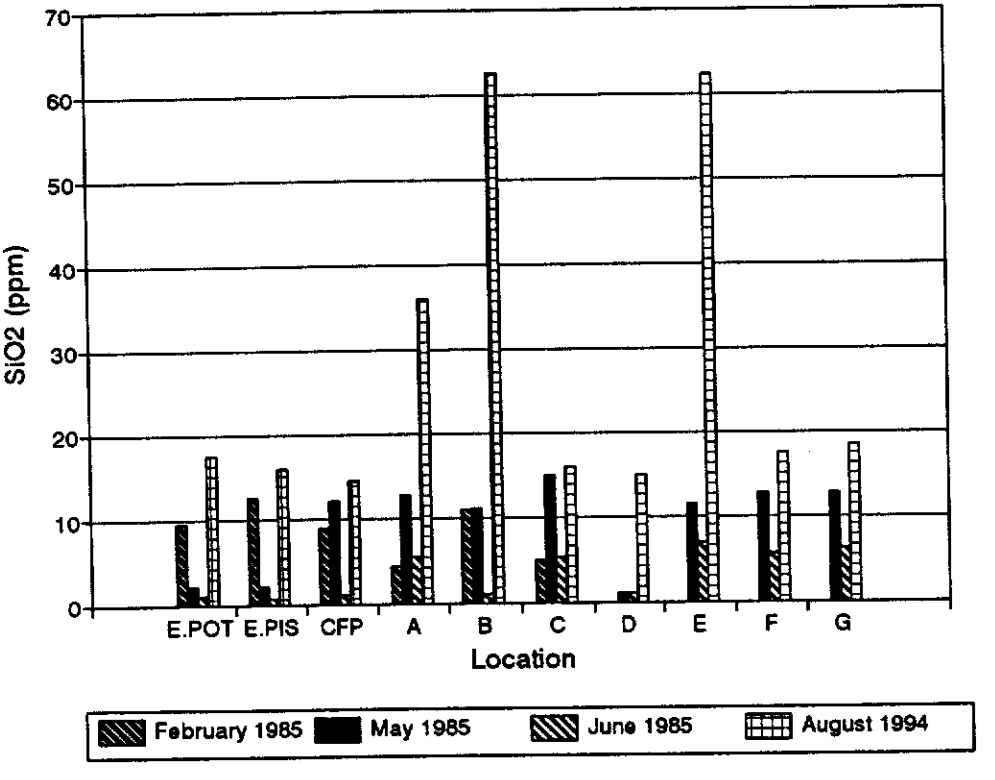
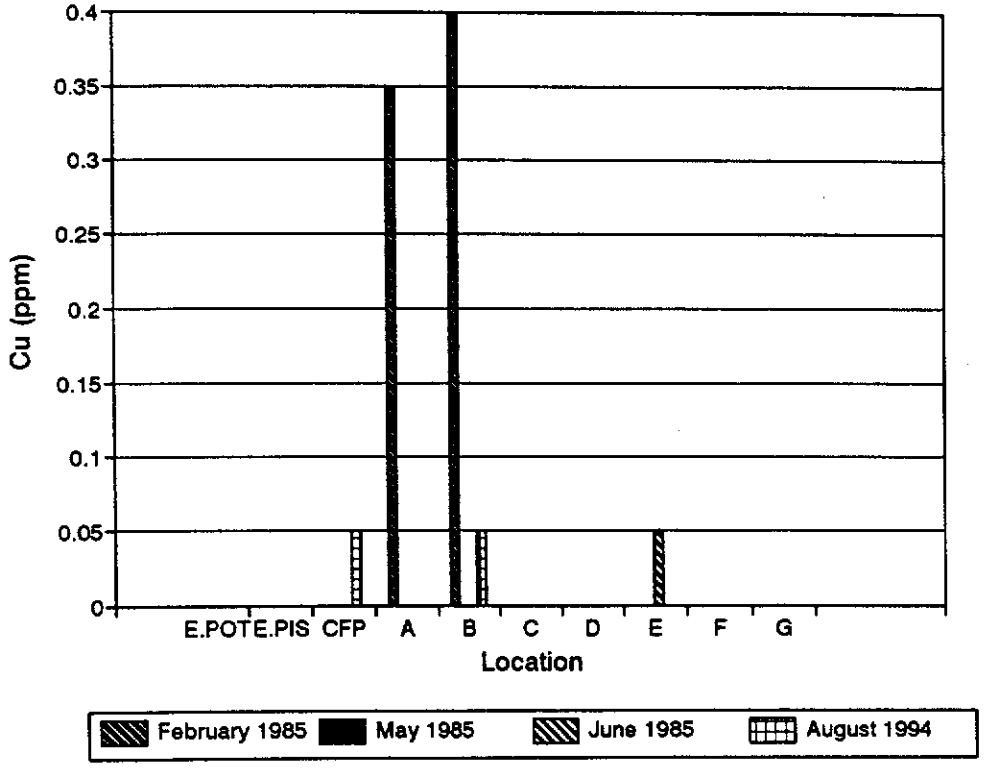


Fig. 5: Comparison of Cu



6.2 Alkaline Chlorination

6.2.1 Chemistry. The alkaline chlorination process for the destruction of cyanide is based on its oxidation by the hypochlorite ion at pH values in the range 10 to 11.

The hypochlorite may be provided by the use of either liquid chlorine or solid calcium hypochlorite. Liquid chlorine, if used, is fed as a gas and reacts first with the water of the transporting solution to generate hypochlorite ion, the actual oxidizing species. An equivalent amount of hydrochloric acid is also produced thus necessitating the simultaneous addition of lime to maintain the pH at 10.5 or above. This is necessary in order to avoid volatilization of the initial reaction product, cyanogen chloride. (Cyanogen chloride converts rapidly to cyanate ion provided that the pH is not allowed to drop below 10.5.) Metal complex cyanides, with the exception of ferrocyanide, behave similarly but much more slowly, the metals precipitating as hydroxides as the complexes are broken up. The ferrocyanide ion, on the other hand, is oxidized to ferricyanide, consuming hypochlorite but remaining in solution. If chlorine or hypochlorite additions are continued, cyanate is first hydrolyzed to ammonium and carbonate ions. The ammonia is then oxidized through a series of chloramines, with nitrogen as the final product. In practice the reaction is usually stopped at the cyanate stage. Oxidation of thiocyanate follows a similar sequence, the sulphur component being simultaneously oxidized to sulphate. This latter reaction consumes 80% more chlorine and 125% more lime than does that with cyanide. The equations for these reactions are shown in Figures 6.2.1 and 6.2.2. A number of other solution components consume chlorine and lime, albeit in lesser amounts. Where the settling pond receiving the treated waste has insufficient retention time for dissipation of excess oxidant (hypochlorite and chloramines), an additional dechlorination step using a sulphite salt may be necessary to eliminate residual toxicity.

A total of six alkaline chlorination circuits have been installed at Canadian ---- one of which is still operating (Table 6.2.1). At least

Formation of Hypochlorite from Chlorine

$Cl_2 + H_2O \rightarrow HOCl + HCl$ 1a

$HOCl + HCl + Ca(OH)_2 \rightarrow$
$1/2\ CaCl_2 + 1/2\ Ca(OCl)_2 + 2\ H_2O$ 1b

Oxidation of Cyanide: 1st Stage

$2NaCN + Ca(OCl)_2 + 2\ H_2O \rightarrow$
$2\ CNCl + Ca(OH)_2 + 2\ NaOH$ 2a instantaneous (independent of pH)

$2\ CNCl + 2\ Ca(OH)_2 \rightarrow$
$Ca(CNO)_2 + CaCl_2 + H_2O$ 2b pH 10-11:5-7 minutes
pH 8.5-9:10-30 minutes

Oxidation of Cyanide: 2nd Stage

$Ca(CNO)_2 + 4\ H_2O$ (presence of $Ca(OCl)_2$) $\rightarrow$
$(NH_4)_2\ CO_3 + CaCO_3$ 3a 1 to 1.5 hours

$2\ (NH_4)_2)\ CO_3 + 3\ Ca(OCl)_2 + 2\ Ca\ (OH)_2 \rightarrow$
$2N_2 + 3\ Ca\ Cl_2 + 2\ CaCO_3 + 10\ H_2O$ 3b rapid

Overall Reaction (3a + 3b)

$2\ Ca(CNO)_2 + 3\ Ca(OCl)_2 + 2\ Ca(OH)_2 \rightarrow$
$2\ N_2 + 3\ CaCl_2 + 4\ CaCO_3 + 2H_2O$

FIGURE 6.2.1 EQUATIONS OF ALKALINE CHLORINATION REACTIONS

Oxidation of Thiocyanate

$$Na\ CNS + 2\ Ca(OCl)_2 + Ca(OH)_2 \rightarrow Na\ CNO + Ca\ SO_4 + 2\ Ca\ Cl_2 + H_2O \quad (4)$$

Oxidation of Thiosulphate

$$Ca\ S_2O_3 + 2\ Ca(OCl)_2 + Ca(OH)_2 \rightarrow 2\ CaSO_4 + 2\ Ca\ Cl_2 + H_2O \quad (5)$$

Oxidation of Metal-Cyanide Complexes

Zinc

$$Na_2Zn(CN)_4 + 2\ Ca(OCl)_2 + Ca(OH)_2 \rightarrow 2\ Ca(CNO)_2 + Ca\ Cl_2 + 2\ Na\ Cl + Zn(OH)_2 \quad (6a)$$

Copper

$$2\ Na_2\ Cu(CN)_3 + 3\ Ca(OCl)_2 + Ca(OH)_2 \rightarrow 3\ Ca\ (CNO)_2 + 4\ Na\ Cl + Ca\ Cl_2 + Cu(OH)_2 \quad (6b)$$

Iron

$$4\ Na_4\ Fe(CN)_6 + Ca(OCl)_2 + 2\ H_2O \rightarrow 4\ Na_3\ Fe(CN)_6 + 4\ Na\ OH + CaCl_2 \quad (6c)$$

FIGURE 6.2.2 CHLORINATION REACTIONS OF OTHER GOLD MILL EFFLUENT CONSTITUENTS

TABLE 6.2.1 DESCRIPTION AND OPERATING HISTORY OF ALKALINE CHLORINATION AT GOLD MINES

Mine	Mill capacity, tons/day	Waste stream treated and method, (B or C)[1]	Operating History		Remarks
			Started	Terminated	
Mosquito Creek	100	Barren, B	April, 1980	1984	Mine ceased operation
Baker	100	Barren, C	Spring, 1981	Oct., 1982	Switched to SO_2-air, then mine ceased operation
Carolin	1250	Barren, C TPO[2], C	March, 1982	Oct., 1982	Switched to SO_2-air, (barren only) then mine ceased operation
Scottie	160	Barren, C	Oct., 1981	Sept., 1982	Switched to SO_2-air, then mine ceased operation
Detour Lake	2250	CIP tailings slurry, C	Sept., 1983	Summer, 1984	Testing alkaline chlorination and other processes on TPO
Giant Yellowknife	1250	TPO, C	Aug., 1981	still operating	Includes arsenic removal
Grey Eagle (California)	500	TPO, C	Oct., 1982	still operating	—

(1) B = batch operation; C = continuous operation.
(2) TPO = tailings pond overflow.

- Evaporator; to convert liquid chlorine to chlorine gas
- Chlorinator: a cabinet containing an aspirator-injector, operated by water or the solution to be treated, to draw in and dissolve the chlorine gas and distribute the resulting hypochlorite solution. It also contains the necessary flow meters, pressure gauges and control valves.

Using calcium hypochlorite:

- Volumetric dry feeder with feed rate control.

Lime Supply:

The mill recirculating lime slurry is normally used. Alternatively, a separate slurry system or a volumetric dry feeder can be employed.

Reaction Vessel:

Corrosion-resistant baffled stirred tank of sufficient volume to give 1 1/2 to 4 hours retention time.

Dechlorination Equipment (if required):

Volumetric dry reagent feeder for sodium sulphite or handling and metering equipment for SO_2 gas.

Lime and acid feeding equipment for pH control.

Reaction vessel: Corrosion resistant, baffled stirred tank to give 30 minute retention time.

6.2.3 Operational Control

Control Equipment:

Flow meter for solution to be treated.

pH measuring, recording and controlling equipment.

Redox measuring, recording and controlling equipment.

Residual chlorine analyzer.

Application:

In addition to rigorous maintenance of a minimum pH of 10.5 in the reactor tank, control depends on oxidation reduction ("redox") potential (or ORP) measurements. This potential is maintained at a value high enough to ensure complete conversion of cyanide to cyanate by manual or automatic adjustment of the chlorine addition or of the

flow of the solution to be treated. However this strategy is not always effective. An alternative control strategy now under investigation is to measure "total residual chlorine" (TRC) in the treated effluent. The presence of residual chlorine is an indication that the oxidation of cyanide to cyanate is complete. Periodic TRC and potentiometric titrations of the solution to be treated, using a standard sodium hypochlorite solution, are sometimes employed to establish the most effective control potentials, as in Figure 6.2.3 (Zaidi, Whittle 1982).

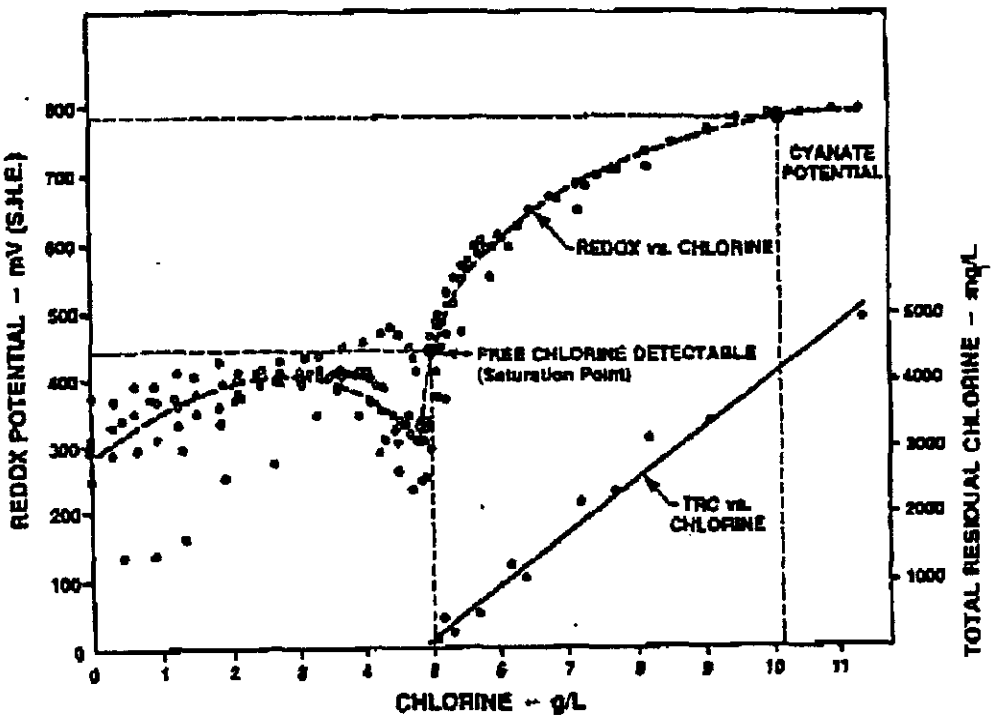


FIGURE 6.2.3 REDOX AND TRC RESPONSE CURVE DURING TITRATION OF GOLD MILL BARREN WITH STANDARD HYPOCHLORITE SOLUTION (Zaidi, Whittle 1982)

6.2.4 Operating Characteristics.

Treated Effluent Quality:

During the period October 1981 to March 1983, Environment Canada with the assistance of a consultant, completed a study of the performance of alkaline chlorination plants at 3 mills in British Columbia (Mosquito Creek, Baker and Carolin) and one in the Northwest Territories (Giant Yellowknife) (Brodie, 1983; Zaidi, Brodie 1983). Environment Canada also conducted a separate survey.

Figures 6.2.4 to 6.2.8 are the respective flow sheets. Table 6.2.2 lists the operating parameters of these plants, while Table 6.2.3 illustrates their efficiency in terms of cyanide and metals removal (the values are averages and hence may not be completely mutually consistent). Although there are wide variations in the compositions of both the treated and the untreated wastewaters, all systems were extremely effective in removing CN_W, with % removals ranging from 98.7 to 99.9%. Some plants were less effective in removing CN_T due to the presence of significant levels of iron in solution. This confirms the ineffectiveness of alkaline chlorination for the removal of iron cyanide. Copper and zinc, on the other hand, were effectively removed (94.7 to 99.6%). It should be pointed out that the studies which provided this information consisted of only 2 to 5 one-week campaigns. In addition, all but Giant Yellowknife were new operations and the alkaline chlorination systems had not been optimized. The data of Table 6.2.4, consisting of the averages of the analyses for the whole 1984 operating period at Giant Yellowknife probably provide a better indication of the reliability of alkaline chlorination. The excellent quality of the tailings pond decant, except for ammonia, is noteworthy.

Except in the case of Giant Yellowknife, CN_{WAD} was reduced to less than 1 mg/L in all plant effluents. At Giant Yellowknife, following retention in a polishing pond, CN_W dropped to 0.10 mg/L.

Iron cyanide levels of all the streams except the Carolin tailings pond overflow were reduced substantially but nevertheless in most cases remained unacceptably high, as one would expect, since alkaline chlorination is not effective in destroying iron cyanides. Where thiocyanate levels in the feed were high there was a corresponding increase in the cyanate level in the effluent. The levels of copper and zinc varied considerably and may have been influenced by the metal-complexing action of the ammonia produced as a result of hydrolysis of cyanate.

In addition, chlorine consumption in most cases was highly dependent on the concentration levels of other oxidizable constituents, varying from 5 kg Cl_2 to 12.5 kg per kg CN_T. Residual chlorine levels in the treated barren solutions range from fairly high to very high. In the case of the barren solution from the Baker mill, it was deliberately overdosed with chlorine, with the intention of destroying the residual cyanide contained in the untreated solid tailings slurry when the two streams came together in the tailings pond. At Giant Yellowknife, chlorine consumption in the cyanide destruction stage is increased due to the requirement to oxidize trivalent arsenic to pentavalent arsenic. Excess chlorine is also needed in the solution exiting from this stage to provide for the oxidation of ferrous iron which is added to precipitate ferric arsenate.

Appendix 4

Mining Journal, London, December 17, 1993

Burkina Faso Mining Aid

The European Commission is considering a grant of Ecu1 million ($US1.12 million) for emergency aid to support the mining sector in Burkina Faso. The grant will included technical assistance ($110,000), equipment ($500,000), and other control and evaluation inputs. The equipment orders will be placed as soon as possible. Technical assistance will be required upon delivery of equipment in Burkina Faso. The E.C. officer responsible for the project is Mr O. Fachada, European Commission, 200 rue de la Loi, B-1049 Brussels, Belgium. Tel: (+32 2) 296 2327.

MINING JNL OCT 15/93

Burkina Faso Project Approval

The African Development Fund has approved a technical assistance grant of $US1.2 million to help finance a feasibility study on gold projects within Burkina Faso. The study will consist of a detailed geological reconnaissance of gold deposits, evaluation and classification of reserves, metallurgical tests, and identification of optimum mining methods. The study will also include marketing and financial assessments and an environmental impact study. The feasibility contract will be let by tender to short-listed companies. Further information can be obtained from the Directeur General, Bureau des Mines et de la Géologie du Burkina Faso, P.O. Box 601, Ouagadougou 01, Burkina Faso. Tel: (+226) 300194. Fax: 300187.

BURKINA MANGANESE

The first batch of manganese ore from the Tambao mine in northern Burkina Faso left the country this week as part of a programme to assess various transport methods before some 50,000 t of ore are sent to potential customers for evaluation. Officials said that these trial runs, which will determine the international competitiveness of Tambao manganese, would allow them to identify the best means of transport and to issue firm short- and medium-term haulage contracts before commercial production begins at Tambao in 1994. The 800 t batch was railed to the Ivory Coast port of Abidjan and truck runs to Tema in Ghana will be evaluated later this year.

Located 400 km northeast of the capital, Ouagadougou, Tambao is being developed under a $15 million investment agreement between the Burkina Government, which holds 35% of the project, and Canada's Interstar Mining Group, with the remaining 65%. The deposit hosts an estimated 19 Mt of reserves averaging 50% manganese and, with potential production pegged at 140,000 t/y within two years, the Tambao project could boost the Burkina economy by more than $141 million/y. □

MINING JNL OCT 22/93

Mining Jnl Jan 27/95

New Discovery For Randgold

Randgold and Exploration Ltd has announced that its current exploration programme in West Africa had yielded a "promising" gold discovery in Burkina Faso. The South African company said in a statement that the discovery was within the Sanmatenga project in which Randgold, the operator, and Newmont Mining Corp. each own a 45% interest. A Burkina Faso company has a 10% subscription right on the project.

Results from the two targets investigated to date had confirmed gold mineralisation in elevated quantities and encouraging results had been obtained from a third target located near a broad shear zone. Sampling from the first trench excavated across part of the third target returned a broad zone of continuous mineralisation yielding an average grade of 1 g/t. The statement added that work was continuing.

Mining Jnl Dec 18/94

Geomaque In Burkina Faso

Geomaque Explorations is currently conducting a follow-up programme of sampling and trenching on previously identified gold anomalies and high-grade gold veins on its exploration concessions in Burkina Faso, West Africa. Assays on approximately 3,000 samples taken are expected early in the new year. Geomaque has also received the final documentation from the Ministry of Industry, Commerce and Mines, granting the company exclusive exploration rights to a 500 km² concession in the Diapaga area. The concession, together with Barsalogho concession acquired in 1993, brings Geomaque's land holdings in Burkina Faso to 2,200 km².

Mining Jnl Nov 18/94

Artisans Work Geomaque Ground

Local artisanal miners, mining by hand, have been exploiting a gold-bearing quartz vein in the northwest quadrant of Geomaque Exploration's 500 km² Diapaga permit in Burkina Faso. The gold occurs in bedrock in a vertical quartz vein which is up to 3 m in width and exposed along 80 m length. Three samples of discarded vein material returned values of 5.8 g/t Au, 25.2 g/t Au and 26.1 g/t Au, and a sample of tailings from the artisans' recovery operations graded 13.7 g/t Au.

A reconnaissance geochemical survey completed by Geomaque in mid-1994, included the artisans' workings, and a strong gold anomaly was traced for 3.5 km. The quartz vein system is being examined by a series of trenches, with a geochemical grid being expanded and a more detailed geochemical sampling programme due to be completed next month.

A quartz vein system in the northeast quadrant of the permit is also being mined by local artisans. A composite sample of discarded vein material averaged 41 g/t Au. This vein system will also be explored by trenching during the current programme.

acquiring a one-third stake in the project.

Mining Jnl Aug 12/94

EMF In Burkina Faso Gold Project

European Mining Finance Ltd (EMF), the London-based mining finance company has completed its acquisition of a 51% stake in STREM-CO SA (STREMCO), a company registered in Burkina Faso. STREMCO holds an 800 km² exploration permit which includes a large area of Archaean greenstone.

Several partly explored gold veins indicate resources of 500,000 t grading 10 g/t gold to a depth of 70 m, of which 210,000 t grading 10.25 g/t are in the probable reserve category for shallow open pit mining. The veins are open at depth and much of the area covered by the exploration permit remains untested. Production at a rate of 7,000 oz/y will commence in the second half of 1995, with initial cash costs of less than $200/oz.

Mineral Research Ltd at Kenowna, British Columbia.

Mining Jnl April 29/94

Mutual In Burkina Faso

Vancouver-based Mutual Resources has entered into an option arrangement for the Kiéré Nord-Dohoun gold concession in Burkina Faso. The 285 km² property in the west of the country is owned as to 70% by Comidok (a Burkina Faso company), 10% by Faso Etudes et Travaux and 20% by the government.

Under the terms of the agreement Mutual must spend $US750,000 on the property over two years. Thereafter, it may earn a 60% interest by paying $12 for each mineable ounce defined on the concession with a minimum of 150,000 oz, less all monies expended in exploring the property.

To date, Mutual has trenched and drilled the property and outlined a number of gold occurrences with potential economic intersections which warrant follow up.

Mng Jnl April 29/94

Aid For Poura Mine

The European Community is considering a Ecu600,000 ($US520,000) loan for an urgent aid package for the 60% state-owned Poura gold mine in Burkina Faso. The loan will be used to maintain underground production at Poura by strengthening procurement management and replacing mining equipment. The E.C. officer responsible for the project is Mr D. Walravens, Room 04/21, Evere Green Building, 12 Rue de Geneve, Brussels B1140, Belgium. Tel: (+32 2) 299 2824.

North and West Africa

Burkina Faso · Egypt · Ivory Coast · Liberia
Mauritania · The Gambia · Chad · Niger · Nigeria · Togo
Algeria · Senegal · Benin · Cameroon · Sierra Leone
Mali · Ghana · Libya · Sudan · Tunisia · Morocco · Guinea

Missing Annual Review by Mining Journal July 1994

Burkina Faso

By A. Notholt*

BURKINA FASO remains one of the least developed countries in the world, mainly by virtue of its landlocked location and poor infrastructure. Agriculture, the mainstay of the country's economic growth, is almost at subsistence level and there are only limited natural resources. Burkina Faso thus continues to rely very heavily on aid from overseas donors, notably from European Union countries, particularly France, as well as international funding agencies. Fortunately, such support has provided for sustained growth, expected in real GDP terms to be around 3-4% in 1993-94. Although considerable emphasis is placed by the government on developing the potential of the mining sector as a means of providing significant export earnings, mining is still very limited and at present is restricted to that of gold at several artisanal extraction sites and the quarrying of marble. Mine production of gold in 1992 was 1,500 kg (metal content), much less than the 3,500 kg reported for 1991, but this appears to represent only about 40% of total production because of extensive smuggling. Exports of gold account for most of the country's foreign revenue.

Gold and Zinc/Silver

The Poura underground gold mine, situated 160 km southwest of Ouagadougou, was operated by the Société de Recherches et d'Exploitation Minières du Burkina (Soremib), in which the government had a 60% stake, the remainder being held equally by the Islamic Development Bank and Coframines, the latter a subsidiary of the French Bureau de Recherches Géologiques et Minières (BRGM). Coframines has withdrawn from the project, however, and the government is seeking new partners to continue exploration and mining at Poura. Proved and probable reserves at Poura are estimated at 512,000 kg of gold in ore averaging 11 g/t, with additional possible resources of 562,500 kg assaying 9·4 g/t of gold.

The second major project, the development of a Zn-Ag mine at Perkoa, 100 km west of Ouagadougou, has been delayed mainly because of prevailing poor base metal prices but partly also because of uncertainties regarding adequate transport facilities. The Perkoa orebody, situated some 36 km northwest of Koudougou, about 30 km from the railway which links Ouagadougou and the port of Abidjan in Ivory Coast, is a massive sulphide body reported to contain 6 Mt of ore grading some 18% Zn and some silver. It was reported early in 1994 that the second phase of development was being put in hand, involving the sinking of a 300 m shaft for bulk sampling and pilot plant testing. The mine is expected to produce about 500,000 t/y of ore, to yield some 155,000 t/y of concentrates or about 85,000 t/y of zinc over a 12-year mine life. However, commercial operations are now unlikely to begin before 1995. The mine represents a joint venture between Boliden International Mining (65%), responsible for managing the project, and the state-owned Bureau de Mines et de la Géologie (35%). Capital costs for the project amount to $US77 million.

Manganese

Cie Minière de Tambao (Comitan) represents another joint-venture, between the Canadian concern Interstar Mining, Toronto, which has a 65% stake in the project, and the Burkina Faso Government (35%), for the development of the Tambao manganese deposits situated on its northern border with Mali, the project involving an investment of $US15 million. The Tambao deposits are estimated at nearly 19 Mt containing 50% Mn with additional resources of underlying carbonate ore averaging 48% Mn. Proved reserves amount to 9 Mt. Production is reported to be rising to 5,000-6,000 t/month, the first batch of 800 t of ore being carried in October 1993 by road to Kaye, a distance of about 140 km, and thence by rail to the Ivory Coast port of Abidjan to assess appropriate transport methods before some 50,000 t of ore are sent to potential customers for evaluation. Truck runs to Tema in Ghana were also being evaluated. Commercial production at Tambao is expected to start in 1994 and to amount to 70,000 t in the contract year May 1993 to June 1994. ■

* Mineral Resource Consultant, London, U.K.

Egypt

By A. Notholt

EGYPT's economy has for some years depended heavily on revenues from oil sales, remittances from Egyptian nationals working overseas, tourism, and revenues from the Suez Canal. Problems for the tourist industry due to terrorist activity by Islamic militant groups remain and these, together with the fall in oil prices, are reflected in some decline in economic growth, the real GDP being estimated at only about 1% in 1993, compared to 4·4% in 1992. The oil sector accounts for over 15% of GDP and more than 50% of export earnings. Production of crude was maintained at about 870,000 bbl/d in 1993, a level expected to be maintained over the next three years. During 1993, a significant natural gas discovery, by Amoco in its East Balteem concession in the Mediterranean, has raised hopes of the eventual development of a gas field comparable in size with that of Egypt's current main gas-producer, Abu Madi. Revenues from the Suez Canal, another major source of foreign exchange, continued at the high level of just over $US2 billion, although the Canal is reported to be operating well below its capacity.

Mineral Production

An interesting variety of minerals is produced in Egypt, but mining continues to be on a limited scale, with the notable exception of iron ore, phosphate rock, gypsum and salt.

Iron ore deposits currently worked in the Bahariya Oasis in the Western Desert, are linked by a 350 km railway with the Helwan iron/steel complex on the River Nile, capacity of which is being raised from about 1·1 Mt/y to 1·5 Mt/y by 1995, at a cost of some $250 million. Production is around 2·4 Mt/y. The Islamic Development Bank has agreed to lend $15 million to the Egyptian Iron & Steel Co. for equipment in the construction of Egypt's first special steels plant at Sadat City between Cairo and Alexandria. Construction of the complex, the cost of which has been estimated at $120-$150 million, is scheduled to begin in 1994. Initial production is expected in 1996 at a rate of 100,000 t/y, eventually rising to 150,000 t/y to meet Egypt's needs for special steel. The operator is to be the Arab Co. for Special Steel (Arcosteel), in which Metallurgical Industries Corp., the National Investment Bank, and Saudi Arabian groups are reported to be among those with a stake in the project. Nippon Kokan have been engaged as consultants.

EGYPTIAN MINERAL PRODUCTION
(t)

	1990	1991	1992
Aluminium	141,081	177,700	177,800
Asbestos	367	450	373
Barytes	6,197	5,943	7,841
Bentonite	4,904	4,500(e)	4,215
Feldspar	21,299	32,636	49,623
Fluorspar	1,249	1,790	1,290
Gypsum(a)	1,279,000	1,239.000	1,425,383
Iron ore	2.405,000	2,144,000	2,391,584
Kaolin(a)	149,000	186,000	203,473
Magnesite	9,426	n.a.	n.a.
Phosphate rock	886,911	900,000(e)	900,000(e)
Salt	1,013,230	891,000	1,036,391
Sulphur(b) (e)	10,000	10.000	10,000
Talc	6,340	9,091	8,908
Vermiculite	28	519	500(e)

n.a. = not available.
(a) Years ended 30 June of that stated.
(b) From petroleum refining and/or natural gas.
(e) Estimated.
Source: British Geological Survey, Keyworth.

Phosphate rock production has been hovering around the 900,000 t/y to 1 Mt/y level, based on operations at Sebaiya (West and East) on the

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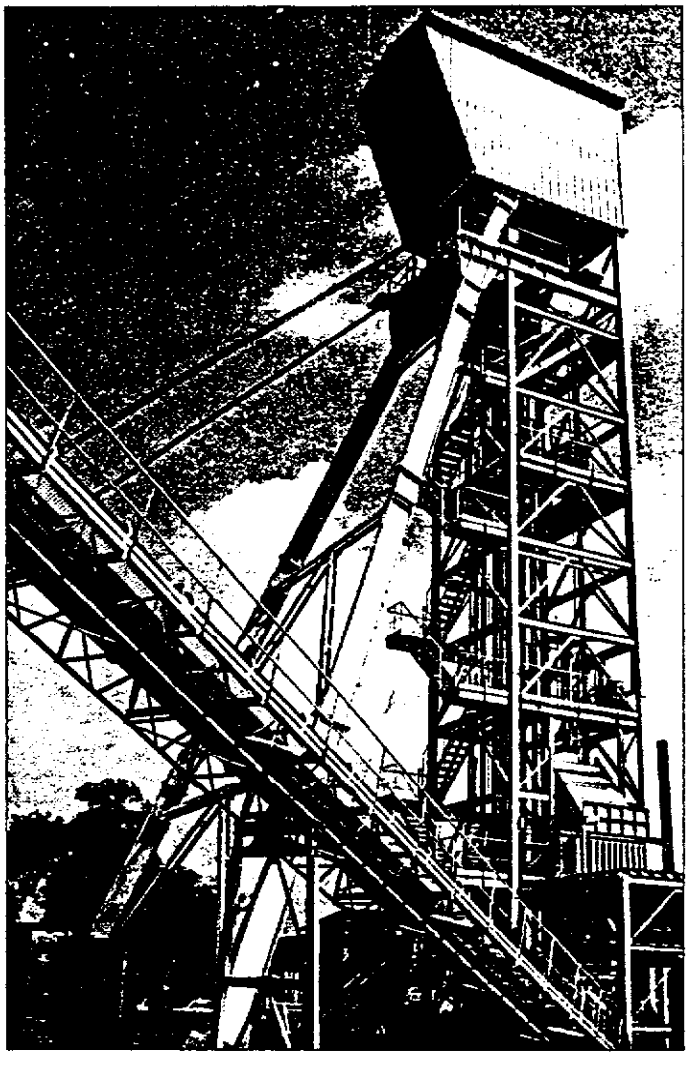
MINING

BURKINA FASO



The shaft at Poura gold mine is equipped to handle 1,000 t/d ore

CONTENTS

Burkina Faso, formerly known as Haute Volta, is one of a number of west African countries that achieved political independence in the early 1960s. Its national history can be traced, however, far earlier than that, to when a legendary 11th Century king of the Gambaga, who originated in the area of what is now northern Ghana, founded the Mossi kingdoms in the upper Volta region. Several kingdoms were created - the Zandoma and Ouagadougou kingdoms in the 12th Century, the Yatenga kingdom in the 14th Century, and others followed. Well administered, these Mossi kingdoms escaped the turmoil arising from the Moroccan invasion of the region in the 16th Century.

In the late 19th Century, the Mossi states became French protectorates and in 1904 the upper Volta region was attached to Senegal as the French colony of Haut-Sénegal-Volta. Later as the separate colony of Haute-Volta, the country became a self-governing state in 1958 and achieved full independence in 1960 under the leadership of President Maurice Yaméogo.

Burkina Faso is a landlocked Sahelian country, situated some 700 km from the Atlantic coast. Covering almost 274,000 km^2, its neighbours are Mali to the north and Niger to the east, while to the south it borders the Ivory Coast, Ghana, Togo and Benin. Its population of 8.5 million is predominantly rural, with agriculture being by far the largest part of the gross domestic product (GDP). Ouagadougou, the capital, has a population of 500,000; other towns include Bobo-Dioulasso, 350 km to the west of Ouagadougou, with 250,000 inhabitants, Koudougou (55,000), Ouahigouya (45,000), Banfora (40,000) and Kaya (30,000).

Topographically, much of Burkina Faso is a plateau at an elevation of between 250 and 350 m. The plateau slopes gently to the south, with hill ranges in the southeast and southwest of the country rising to nearly 600 m in places. Three river basins cut the plateau, the Mouhoun, Nakanbe and Nazinon rivers flowing southwards to merge in Ghana as the river Volta. Only rivers such as the Mouhoun and Comoe, which rise in the gritstone plateaux in the west of the country, flow all year; none are navigable.

The climate changes from savannah in the south to Sahelian in the north. The

Established 1835

wet season lasts from June until October, with maximum rainfall normally occurring in August. Annual rainfall is around 1,200 mm in the south of the country, decreasing to some 650 mm in the drier north. Temperatures during this period are between 20° and 32°C, rising to between 37° in the south and 41° in the north during the November-May dry season.

Central government has been controlled by the military for much of the post-colonial period. Between 1980, when the Constitution was suspended and the National Assembly was dissolved, and 1990, when a national referendum approved a new republican Constitution with an elected president and universal, multi-party democracy, the country was governed by military regimes, the last being headed by Capt. Blaise Compaoré. Civilian government returned in 1991 with Compaoré as president and an elected assembly. Local administration is through 30 provinces which, in turn, are divided into 250 departments, districts and villages.

This Supplement in support of the minerals potential of Burkina Faso has been prepared by *Mining Journal Research Services* through the sponsorship of the United Nations Development Programme and in close collaboration with the Minerals Resources Branch of the Science, Technology, Energy, Environment & Natural Resources Division of the UN Department of Development Support and Management Services.

INFRASTRUCTURE

Burkina Faso is one of the world's poorest countries, measured against any of the generally-accepted yardsticks for quality of life. For example, life expectancy at birth is less than 50 years; there are endemic diseases and a high birth rate, which results in infant mortality estimated by the UN at 67% up to the age of five years.

Agricultural products account for nearly 40% of the GDP. Principal crops are cotton, cereals, groundnuts, fruit and vegetables. Livestock rearing also is important. The contribution to GDP from the industrial sector, including mining, is around 30%, although within this component minerals is a relatively small share.

Burkina Faso has, nevertheless, substantial mineral potential, including gold and base metals in the Birimian greenstones of the northeast, manganese, marble and phosphates. The isolated location of many deposits has been eased to some extent by the opening in 1985 of the Sahel railway, which runs from Kaya in northeast Burkina Faso to the port of Abidjan in the Ivory Coast.

Agriculture and livestock raising are the principal sectors of Burkina Faso's economy

Major roads link Ouagadougou with Bamako in Mali, Niamey in Niger, and Abidjan, Accra and Lomé on the Gulf of Guinea. Most roads are not hard-surfaced, and some are impassable in the rainy season. There are two international airports, served by airlines such as Air France, Air Afrique and Air Burkina. An air charter company and an airfreight company also fly between Ouagadougou and France on a regular basis. The country has an effective telephone system, with automatic exchanges in most of the principal towns giving good-quality local and international services.

GEOLOGY

In general terms, the geology of Burkina Faso can be divided into three distinct sections. The central region across the country consists of Archaean migmatites and gneiss, emplaced between 3000 and 2600 Ma and affected by the Liberian orogeny at 2700-2600 Ma.

Later Precambrian rocks are found interspersed with the Archaean in the form of Birimian greenstone belts that consist of rocks of both volcanic and sedimentary origin. In the far north, and the west and east of the country, Precambrian sedimentary formations cover the earlier Birimian unconformably.

The Lower Proterozoic Birimian volcano-sedimentary rocks form a series of belts within the crystalline Archaean terrain. These measure from 20 to 50 km in width and from 100 to 400 km long and consist largely of lavas and associated breccias, volcano-sediments and rocks of chemical and detritic sedimentary origin. The Birimian lavas and sediments were affected by the Eburnian orogeny (2100-1950 Ma), during which time important granite intrusions, both syn-tectonic and post-tectonic, were emplaced.

Along the southwest, west and northwestern borders, the shield rocks are overlain unconformably by sediments of the southeastern edge of the Taoudeni basin, while in the far southeast, they are also overlain unconformably by sediments of the Volta basin. This sedimentary cover was formed between the Upper Precambrian and the Cambrian-Ordovician and is largely flat-lying except in the southeast corner where the Buem and Atacorien sediments were affected by the results of the Pan-African orogeny around 550 Ma. The sediments in the north and northwest consist of rocks of detritic origin, such as grits, while those in the southeast consist of grits with carbonate lenses, and argillite schists with limestone and stomatolitic horizons.

MINERAL POTENTIAL

To date, the mineral possibilities of Burkina Faso remains inadequately explored. Nevertheless, more than 200 mineral indications and occurrences have been recognised, with the list of minerals present including gold, zinc, manganese, lead, silver, molybdenum, bauxite, iron, chromite, antimony, nickel cobalt, niobium-tantalum, phosphates, graphite and diamonds.

The Birimian terrains cover some 60,000 km², or about 22% of the land area. These greenstone belts offer a major exploration target, showing similar potential to that found in equivalent geological environments in countries such as Australia, Canada, Ghana and

Venezuela. A list of some of the principal mineral deposits discovered to date is shown in an accompanying map. As will be seen, most are hosted in Birimian-age rocks.

GOLD

There are many gold occurrences in Burkina Faso, which have formed the basis for both hard-rock, alluvial and eluvial mining. The Poura deposits were certainly worked before the 19th Century and in recent years there have been gold rushes to the north and northeast of the country where artisanal workings reached depths of around 50 m.

The most important vein-type gold deposits are at Poura, Bagassi, Kari, Dossi and Koupéla-Bouda in the west and south of the country, and at Dioga, Gangaol, Bouroum, Guiro, Bayldiaga, Taparko, Solna, Arbinda and Essakane in the north. The Poura deposits are found in a Birimian inlier surrounded by pre-Birimian granites and migmatites. The three main veins are hosted in an intraformational complex of greenstones and tuffs.

The Taparko deposit in the Bouroum-Yalogo greenstone belt consists of gold-bearing quartz veins that outcrop intermittently over a distance of 4 km. Limited exploration over a strike length of 200 m indicated some 110,000 t to a depth of 20 m grading 14 g/t gold. Together with the Arbinda deposit, in the Djibo greenstone belt in the north of the country where preliminary drilling and underground exploration has indicated 197,000 t at 5.5 g/t gold, this indicates a good potential for economic gold deposits. Other gold deposit types are:

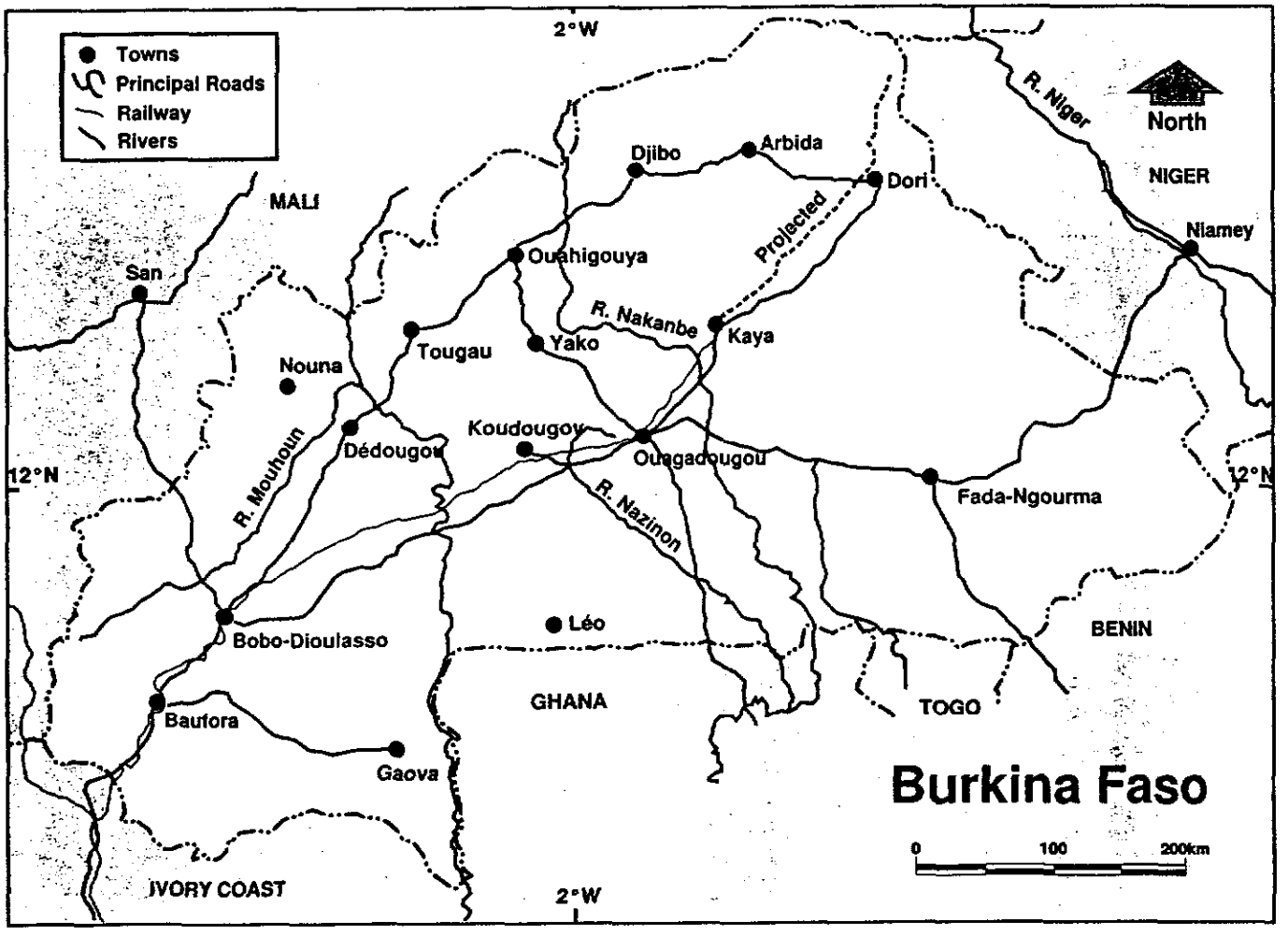
- disseminated in shear zones in volcano-sedimentary formations, as at Kwademen, Kelsio, Larafela and Lilige;
- associated with acid subvolcanic intrusions and copper, as at Diénéméra and Gongondy;
- alluvials, principally in the southwest where there are surface workings between Konkoira, Djikando and Sampolé; and
- eluvials, well-known in the Sahel part of the country and in the south around Ouahigouya and Kongoussi, where there is extensive small-scale surface working.

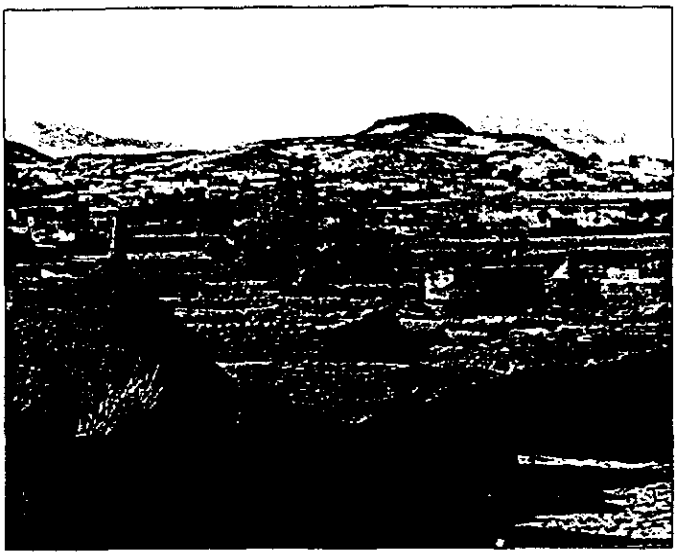
In the first three of these deposit types, the most common mineral assemblage is gold-pyrite-chalcopyrite-quartz, with associated arsenopyrite and manganese. In the Djibo-Arbinda area in the northwest, the assemblage includes tourmaline. There are many occurrences of vein systems that have given rise to eluvial accumulations of gold, and it is probable that deposits similar to those at Poura remain to be discovered.

FERROUS METALS

Lenticular deposits of titaniferous magnetite and vanadium, located in the north, occur in post-Birimian noritic gabbro massifs that outcrop over an area of some 2,400 km². The Tin Edia, Gouba, Kolel, Pwiga and Goumtoulala massifs contain lenticular bands of vanadiferous magnetite intercalated in gabbro sills; the bands range in thickness from a few centimetres to 10 m, and the entire deposit is considered comparable to those of the Bushveld complex in South Africa and the Taberg deposit in Sweden.

Manganese, together with gold, is one of the most widespread minerals in Burkina Faso. Principally found in Birimian formations, in some places it forms economic deposits. The most important of these is the Tambao deposit, which contains a geological resource estimated at 19 Mt of manganese oxide at a grade of 53% MnO_2, plus further manganese carbonates that grade around 48% MnO_2. Proven reserves are 9 Mt. Work undertaken to date has defined a resource only in the oxide portion of the orebody which, owing to its isolation, has yet to be brought into production.





A typical Sahelian village in the Dori district of the country

Another significant manganese occurrence is at Kiéré (500,000 t at 42% MnO_2), while others include those at Sokoura, Koursiéra, Gomponsom, Tin Boulou, Gaïgoy, Bouloy and Oursi.

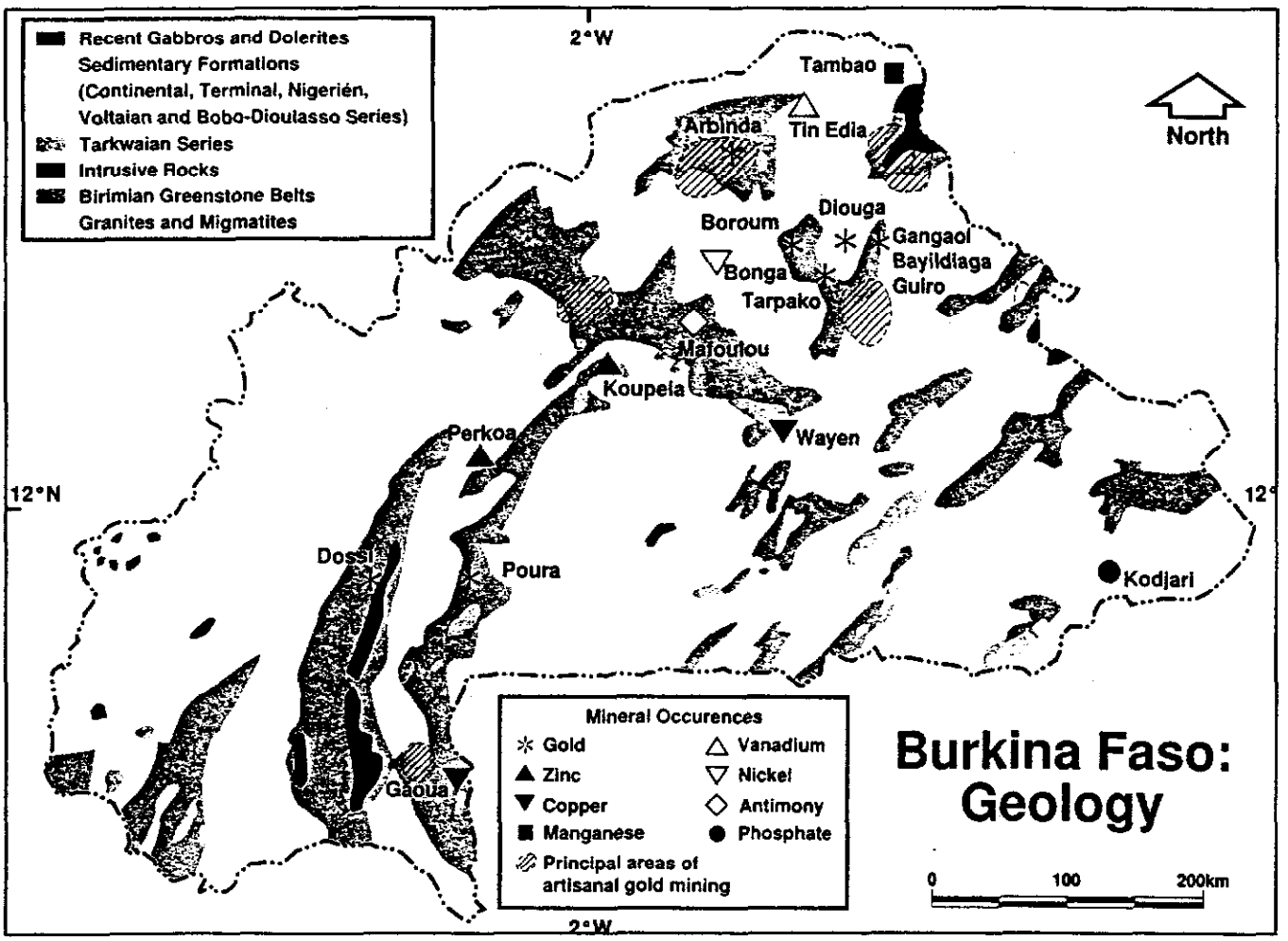
Nickel and chrome occurrences are known in basic and ultrabasic Birimian sequences, such as at Tin Saman, as small lenses of picotite in wehrlites at Koumé, and through a geochemical anomaly at Takatami. Nickeliferous laterites occurring at Bonga over an ultrabasic complex have been evaluated to contain 17 Mt grading 1.5% nickel and 0.5% cobalt, with raised iron and platinum values as well, while at Dablo, a mineralised body associated with pre-Birimian serpentinised peridotites and pyroxenites has been estimated to contain 15,000 t of nickel at a grade of 1.5% nickel.

BASE METALS

Lead-zinc mineralisation is known in pre-Birimian, Birimian and the later sedimentary cover formations, although it was not until the Perkoa deposit was found in 1982 as a direct result of a UNDP project that economic concentrations were identified. This deposit is hosted by the Boromo Birimian greenstone belt. Laterisation of the overburden resulted in little in the way of a gossan cap although the main orebody extends down from unaltered bedrock at a depth of some 30 m. The massive sulphides consist of sphalerite and pyrite, with less common pyrrhotite, accompanied by barite and quartz gangue. Mining reserve estimates are 5.6 Mt grading 18% zinc, with minor lead and 26 g/t silver.

The geological situation of the Perkoa deposit is similar to those found in the Archaean greenstone belts in Canada, where it has been established that sulphide deposits are never isolated. By analogy, it seems probable that further massive sulphide deposits remain to be found in the Boromo greenstone belt, and current exploration is centring on ground follow-up of aeromagnetic anomalies distributed over much of this area.

There are also indications of copper throughout the country, mostly associated with other metals such as nickel, chromium, cobalt, gold and molybdenum in varying combinations. Virtually all are Birimian age, with three



principal occurrence types: disseminated mineralisation in association with granite intrusions, in volcano-sedimentary settings, or in quartz veins.

Antimony is rare in West Africa, although at Mafoulou, the Birimian Kaya-Kongoussi belt contains a deposit grading between 44 and 65% antimony. Sporadic production has taken place in the past, with 80 t of massive stibnite being mined.

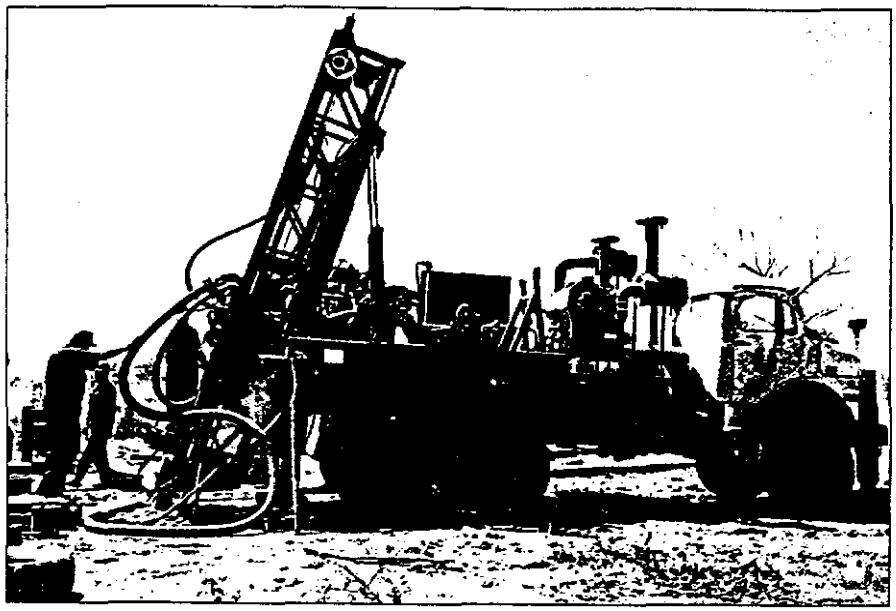
PHOSPHATES

The principal phosphate occurrences are the Arly, Kodjari and Aloub Djouma deposits, contained in Cambro-Ordovician sedimentary formations in the southeast. The latter two deposits contain resources of some 180 Mt at more than 20% P_2O_5. Testwork on the Kodjari phosphates has shown that crushing and screening can give a product grading 30-31% P_2O_5, suitable for fertilizer production.

OTHER MINERALS

Some 60 Mt of limestone suitable for cement manufacture exist at Tin Hrassan, with other resources in the area around Bobo-Dioulasso. Deposits of kaolin are also known, resulting from the alteration of Birimian schists and locally worked on a small-scale for ceramics.

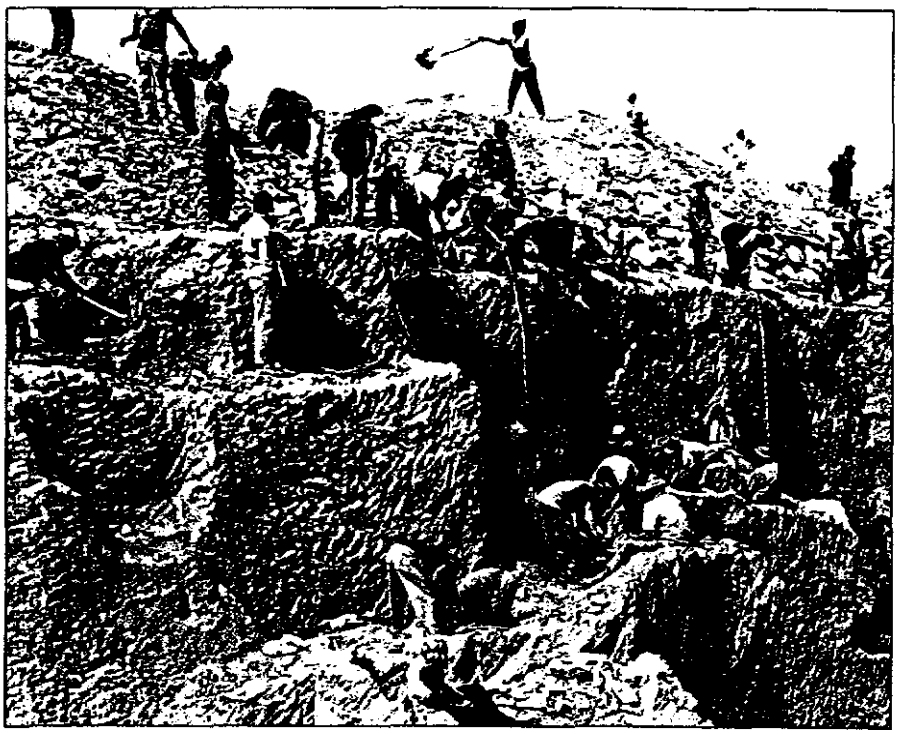
The main bauxite deposits are at Fara (3.8 Mt) and Dowempapassedo (0.7 Mt), both with grades of around 70% Al_2O_3 and 1% SiO_2. A number of carbonaceous schist occurrences are known in the Birimian formations, with the Datari deposit near Kaya estimated to contain around 22% graphite.



The current UNDP-funded exploration project, in which BUMIGEB has had a leading role, includes reverse circulation drilling

CURRENT MINING

In common with many other countries, the mining industry in Burkina Faso took on a new lease of life during the 1980s as artisanal workers pursued opportunities provided by higher international gold prices to establish a thriving small-scale gold mining sector. This in turn was followed by an interest from more entrepreneurial foreign mining companies, resulting in the opening of two major mines in addition to the small-scale operations.



Artisanal gold miners operating in a small opencast mine at Essakane

The Perkoa base metals project is located some 36 km northwest of Koudougou. Exploration over a number of years by the state Bureau of Mines and Geology (BUMIGEB), and assisted by both the World Bank and the UNDP, defined a reserve of 5.6 Mt at a grade of 18% zinc, and in 1990 a joint venture was set up to develop a mine between BUMIGEB, the Burkina Government and the Swedish company, Boliden International Mining AB.

Boliden, which manages the project, subsequently offered part of its 65% holding in the joint venture company, Perkoa Minéral S.A. to others. BUMIGEB holds the remaining 35% on behalf of the state. Prefeasibility studies suggested a mining rate of 500,000 t/y of ore, giving a production of 84,000 t/y of contained zinc over a 12-year mine life.

The deposit is hosted in Early Proterozoic Birimian greenstones and consists of a stratiform volcanogenic massive sulphide orebody within a transitional zone between volcanic and sedimentary sequences. Comprising two lenses that appear to be connected at depth, the ore zones sub-outcrop and reach a depth of almost 600 m below surface. Banded sphalerite-pyrite-barite ores contain up to 40% zinc with about 30 g/t silver and 5-25% barite.

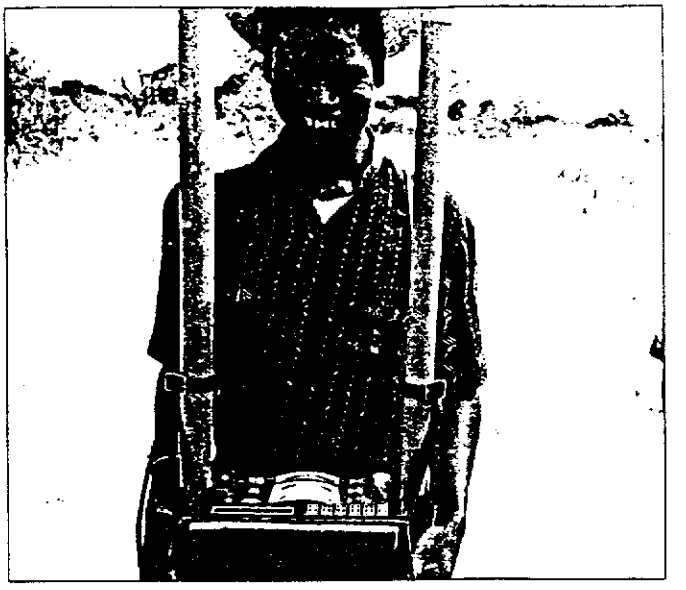
The mining method planned at Perkoa is cut-and-fill, with underground access gained by a 5 m-diameter shaft that is being sunk initially to a depth of 300 m for further exploration and sampling purposes.

The Poura gold mine, on the other hand, is long-established. Situated in an

old mining area mid-way between Ouagadougou and Bobo-Dioulas, between 1939 and 1949 there was commercial production of around 250 kg of gold from the tailings from old alluvial workings. Underground hard-rock mining by Société des Mines de Poura (SMP) between 1961 and 1966 produced 5.6 t of gold from 420,000 t of ore, while between 1984 and 1992 Société de Recherches et d'Exploitation Minières du Burkina (SOREMIB) produced 12.7 t of gold and 1.8 t of silver from 1.2 Mt of ore won from both underground and surface workings.

SORIMEB was held 40% by the French mining company Coframines, which withdrew from the project last year. The property reverted to the state, and the Government is now seeking new partners to continue exploration and production at the Poura mine.

The deposit consists of three quartz veins, the most important of which extend over 2,000 m with an average thickness of 2.5 m. The veins were emplaced in a fault system between country rocks of volcanic and sedimentary origins. The gold mineralisation is associated with sulphides, and occurs in alternating higher- and lower-grade patches along the veins. Proven and probable reserves at Poura have been estimated at 512,000 t grading 10.6 g/t gold, with possible resources of 562,500 t at 9.4 g/t. Drilling undertaken during 1992 at the far south end of the deposit returned highly silicified samples grading over 20 g/t in one case.Underground access is gained through a shaft and a decline. Sub-level stoping was used, with single-boom jumbos, LHDs and underground trucks used for production. The shaft is equipped with a 7.5 t skip. The treatment plant has a capacity of 200,000 t/y of ore, using gravity, flotation and CIP technology to achieve around 90% gold recovery. Doré bars produced at the mine are shipped to Europe for final refining into bullion.



Geophysical field work, with equipment provided through the United Nations Development Programme.

EXPLORATION PROSPECTS

The most important prospects for short-term development are the Perkoa and Poura projects, noted in the previous section. There are, additionally, numerous other mineral occurrences that, given adequate time and resources, may justify more detailed investigation.

The Government has a five-year plan for minerals development, extending from 1991 to 1995. Its objectives include an increase in exploration and the development of primary resources, so that the country may benefit from the use of these resources by both national and international companies. Priorities are:

- Production of manganese, zinc, and especially gold;
- Further studies on six main projects: Perkoa, Arbinda, Kwademen, Dossi, Tarparko and UNDP-funded work;
- Mapping and regional exploration;
- Revision to the mining investment code, and
- Establishment of a central gold recovery plant in the northeast.

The UNDP has supported exploration projects since the mid-1960s. Its earliest work involved a study on a copper occurrence at Gaoua, and this was followed by exploration in the Boromo and Houndé greenstone belts, an evaluation of the Tambao manganese deposit, assistance to artisanal gold miners, an airborne geophysical survey over the centre and southeast of the country and, most recently, assistance with the drafting of the new mining investment code.

Exploration aid has also been given by countries such as France, Germany, Canada, the Netherlands, Belgium and North Korea, while financial support for projects has come from the World Bank and the Islamic Bank.

The Tambao manganese deposit is now being evaluated by a Canadian company, InterStar Mining. The deposit, located 340 km northeast of Ouagadougou, was previously explored between 1960 and 1976, and consists of four manganese-bearing beds hosted between Precambrian volcano-sedimentary rocks and granites. It grades over 50% manganese, with low phosphorus and minimal sulphur. InterStar is undertaking a feasibility study which, if positive, will lead to a 65:35 joint venture with the Government to operate a 140,000 t/y mine.

Several gold properties are under investigation. The French company SIREXM and the Government have a 70:30 joint venture to explore and develop the Essakane and Guibare gold properties, both of which are artisanal mining sites. The joint venture, CEMOB, has installed a tailings retreatment plant at Essakane, and is planning to heap leach 120,000 t/y of ore grading 4.5 g/t gold.

Another company, COMIDOK, was formed in February 1993 to explore and develop gold deposits in the Kiéré district. Located in the Houndé greenstone belt, the prospect lies in an area composed of andesites, schists, tuffs and quartzites, with local manganiferous beds. Soil geochemistry has identified gold anomalies, while drilling has given intersections of disseminated gold grading from 4 to 15 g/t.

ROLE OF GOVERNMENT

Until 1992, the minerals sector was under the jurisdiction of the Secretary of State for mining, within the Ministry for Economic Development. Last year, management of the sector became the responsibility of a Minister for Energy and Mines, whose office is part of the Ministry of Industry, Commerce and Mines.

Day-to-day administration and policy-making for mining, energy and geology rests with the Direction Générale de l'Energie et des Mines, whose responsibilities include liaising with state-owned and private-sector companies, both local and from overseas, who are interested in Burkina Faso's mineral potential. The department consists of three directorates, the Direction des Mines (DM), the Direction de la Recherche Géologique (DRG) and the Direction de l'Energie (DE).

Besides BUMIGEB, described in more detail below, the state participates directly in the minerals sector though local mining companies such as Soc. de Recherche et d'Exploitation Minière du Burkina (SOREMIB), which operated the Poura gold mine, Soc. des Mines de Guiro (SMG) and Soc. Minière Coréo-Burkinabé (SOMICOB), established for small-scale gold production, and La Filière Or, aimed at artisanal-level gold production.

The organisation responsible for gold purchasing throughout the country is the Comptoir Burkinabé des Métaux Précieux (CBMP). Based in Ouagadougou, this office buys and sells gold, silver, platinum group metals and diamonds.

In 1991, the Government formed a Commission of Privatisation with the task of selling state-owned industries to the private sector. Privatisation of the state-owned mines is scheduled to begin in 1994 and extend over a two-year period.

BUMIGEB

The Bureau des Mines et de la Géologie du Burkina (BUMIGEB), a state owned commercial organisation, has the responsibility for undertaking exploration, research and studies into all the country's mineral resources. It also acts for the Direction Général in the inspection of mines, quarries and certain types of equipment. BUMIGEB consists of five directorates, the Direction des Affaires Adminstratives, the Direction de la Recherche Géologique, the Direction des Mines et des Hydrocarbures, the Direction des Sondages et Forages, and the Direction Résiduale de Bobo, which acts as a regional office based in Bobo-Dioulasso.

Formed in 1978, BUMIGEB today has a staff of over 300, its own drill rigs, modern geophysical and topographic surveying equipment, and two laboratories (at Ouagadougou and Bobo-Dioulasso) that can undertake sample analyses.

Amongst the tasks assigned to BUMIGEB are the gathering of geological data, collation of a national geological map, publication and distribution of geological information, and the conservation of samples and their associated documents. The organisation also has responsibility for collecting production data and publishing statistics.

It also performs economic studies on those projects under its control, and is the lead organisation through which the state participates in joint ventures in the minerals sector. Other duties include the collection of fees for issuing permits and licences, conducting inspections, and providing other services.

BUMIGEB has been involved in several major projects. For example, projects funded by the UNDP in which BUMIGEB had a leading role include regional geochemical surveying throughout the southwest, centre and north of the country, and exploration over the Boromo and Houndé Birimian greenstone belts, resulting in the location of the Perkoa zinc-lead-silver deposits, nickel at Bonga, gold at Kwademen, sulphides at Zogyon, gold-bearing sulphides in the Tako district, and numerous other occurrences.

With funding from the Islamic Bank and UNDP, between 1987 and 1991 BUMIGEB in the context of a UNDP project also conducted airborne geophysical surveying over parts of the Boromo greenstone belt. The work included magnetics and electro-magnetics.

Aid from Germany provided BUMIGEB with all-terrain vehicles and geophysical equipment during airborne geophysical surveying which resulted in finding diamond indications in the Barsalogho district, and diamonds, nickel, copper, platinum and palladium at Dablo.

A project funded by France led to BUMIGEB working in conjunction with the French exploration organisation BRGM, on the evaluation of gold deposits at Bouroum and Diouga-Gangaol, where a resource of some 900 kg of gold was identified, while the Islamic Development Bank funded work at the Taparko gold prospect, which has resources of some 500,000 t grading 13 g/t gold. Other gold properties evaluated include Arbinda (137,000 t grading 5.9 g/t), Essakane-Korezena, Bilanga-Piela and in the west, near where BHP-Utah sought rights to explore for gold.

Evaluations of mining projects that have been funded by international donors have included the Kodjari phosphate deposits, where the initial intent was to produce natural phosphate rock for use as fertilizer, the Guiro-Bayildiaga gold property, which resulted in formation of Soc. des Mines du Sahel, the Bonga lateritic nickel deposits (17 Mt at 1% Ni), copper-gold mineralisation in the Gaoua district, and identification of dolomitic limestone deposits to the west of Bobo-Dioulasso.

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FISCAL ASPECTS

Burkina Faso's new Mining Code, adopted by the National Assembly in May 1993, aims to encourage exploration and mining for social and economic development. It gives overseas investors

The gold recovery plant at the Poura mine has a capacity of 600 t/d

Oxidised material from the Poura mine, the sulphides having been altered to limonite and goethite

equal rights to those of the country, as well as guaranteeing the right to repatriate investment capital and revenues subject to normal taxation requirements. Burkina Faso is a member of the Central Bank of West African States, and uses the CFA franc, which is tied to the French franc at FF1 = CFAF 50, and is freely convertible.

Customs concessions are granted on equipment used on a temporary basis for exploration, and fuel and lubricants used during exploration programmes are wholly exempt from duty, while there are also exemptions from payment of certain other taxes.

During project development, most equipment required to bring a mine into production may be imported duty-free, as are fuels for use at the mine. The Mining Code offers holders of mining permits fiscal incentives that include holidays of up to seven years from some taxes, and reductions on other taxes. Mineral products can be exported tax-free, although minerals sold within the country are taxed at the same rate as similar imported products. Accelerated amortisation of investments is also allowed under the terms of the national Tax Code.

Companies operating in Burkina Faso are required to employ local people as a priority, to respect the environment and to file regular financial accounts and technical reports. Where necessary, expatriate skilled workers may be employed.

Companies that have found a viable mineral deposit which they wish to bring into production must form a joint venture company with the state. The proportion of the project held by the state is open to negotiation.

In July 1993, fees for a prospecting permit are $370 (CFAF 100,000), while granting an exploration permit costs $550 with increased charges on renewal or transfer. A mining permit incurs an initial charge of $7,500 while the granting of a concession is $15,000. There are in addition annual land holding taxes, based on the area held and ranging from CFAF 125/km^2 for an exploration permit to CFAF 50,000/km^2 for a mining permit.

Royalties are calculated on the fob value of the product, and range from 3% for gold and other precious metals to 4% for base metals and 7% for diamonds and precious stones.

LOCAL SUPPORT

As the state organisation directly involved in the administration of the minerals sector, BUMIGEB can offer interested companies great assistance during their initial enquiries. BUMIGEB holds the national geological archive, which is open for inspection. It has experienced staff with extensive local knowledge to assist overseas companies in their prospecting operations, and also can offer geophysical surveying, drilling and analytical services on a contract basis.

For over 20 years, BUMIGEB and its predecessors have worked closely with the UNDP and its agencies, which have implemented a number of successful exploration and evaluation projects. The UNDP maintains an office in Ouagadougou, from which guidance can also be sought.

Ouagadougou offers international-standard hotels, as does Bobo-Dioulasso. Accommodation elsewhere is limited, although houses may be rented through local agencies. Further information on accommodation, health care and related matters may be obtained from the UNDP or from the overseas embassies of Burkina Faso.

Legal and financial advice may be obtained from the local professional sector, and both BUMIGEB and the UNDP may also be able to offer initial generalised assistance in these areas. It must be borne in mind that on these issues, expert local counsel is essential.

For further information on the mineral resource potential of Burkina Faso, please contact

Directeur Général BUMIGEB
P.O.Box 601
Ouagadougou 01
Burkina Faso

Tel: (226) 30 01 94
Fax: (226) 30 01 87

Directeur Général de L'Energie et des Mines
Ministère Délégué Chargé des Mines et l'Energie
P.O. Box 514,
Ouagadougou 01

Tel: (226) 31 24 18
Fax: (226) 31 24 18

Printed by Mayhew McCrimmon, Southend, England.

Table 3 Soil Chemistry for Samples collected along the **east** side of the B-zone Pond.

Analyte	Units	Sample Number BZHK5-s 2000.09.17	BZHK6-s 2000.09.17	BZHK7-s 2000.09.17	BZHK8-s 2000.09.17	BZHK9-s 2000.09.17
Ag	µg/g	0.5	0.5	0.5	0.5	0.5
Al	µg/g	11300	24600	7600	8600	4700
As	µg/g	**480**	**520**	**10**	**1.8**	**2.1**
Ba	µg/g	26	39	33	40	25
Be	µg/g	0.9	1.4	0.6	0.7	0.5
B	µg/g	1	18	3	5	1
Ca	µg/g	860	670	2500	1100	1700
Cd	µg/g	0.5	0.5	0.5	0.5	0.5
Co	µg/g	3.3	4.4	2.4	3.3	2
Cr	µg/g	25	36	31	77	25
Cu	µg/g	3.8	4	4.5	5.3	5.1
Fe	µg/g	2500	3200	8500	10400	7400
K	µg/g	2700	5900	1700	2900	1200
Mg	µg/g	2600	5600	4800	3500	1700
Mn	µg/g	37	40	110	150	91
Mo	µg/g	9.8	8.9	0.5	0.5	0.5
Na	µg/g	70	120	210	220	220
Ni	µg/g	**530**	**490**	**20**	**9.4**	**6.4**
Pb	µg/g	9	10	4	4	3
P	µg/g	440	330	300	210	320
Sr	µg/g	200	200	24	8.8	16
Ti	µg/g	7.3	12	390	470	420
V	µg/g	29	48	17	17	14
Zn	µg/g	7.9	12	14	20	12
Zr	µg/g	2.6	3.9	8.9	6.8	7.9

ORGANIGRAMME DE L'ORSTOM AU BURKINA FASO

(01/05/95)

Représentation au Burkina Faso : Grandin G.

Direction du Centre de Ouagadougou : Grandin G.

Programmes scientifiques

1) Géologie de l'or (TOA)
2) Infiltration et érosion (DEC)
3) Hydrologie régionale - FRIEND AOC (DEC)
4) Gestion des ressources en eau (DEC)
5) Ecologie agroforestière (MAA)
6) Structures des sols cultivés (MAA)
7) Télédétection et dynamique des savanes (MAA)
8) Mortalité infantile en milieu rural (DES)
9) Sciences sociales et SIDA (DES)
10) Impact sanitaire du barrage de Bagré (DES)
11) Développement agricole et ONG(s) (SUD)
12) Religions et changements sociaux (SUD)

Administration et Services techniques

a) Comptabilité, Gestion du personnel
b) Secrétariat
c) Garage et Menuiserie, Entretien Maintenance et Garde
d) Centre de Documentation
e) Atelier informatique
f) Atelier de cartographie

Direction du Centre de Bobo-Dioulasso : Devineau J.L.

Programmes scientifiques

13) Interrelations système écologique -système de culture (MAA)
14) Anthropologie juridique et développement (MAA)
15) Accès aux soins des jeunes enfants à Bobo (DES)
16) Demande sociale et stratégies d'éducation (SUD)

Administration

α) Comptabilité, Gestion du personnel

Appui aux Détachés

17) OCP
18) INERA

Responsables de programmes

1) Grandin G. 2) Planchon O. 3) Gautier M. 4) Dezetter A. 5) Ouédraogo S. 6) De Blic Ph. 7) Lavenu F. 8) Ouédraogo R. 9) Taverne B. 10) Parent G. 11) Fauré Y. 12) Otayek R. 13) Devineau J.L. ; Fournier A. ; Serpantié G. ; Dugast S. 14) Nianogo I. 15) Petitjean M. 16) Gérard E. 17) Hougard J.M. 18) Marly M.

Responsables de services

a) Delacour E. b) Brotel M.C. c) Ouattara D.. d) Tankoano M.M. e) Zongo S. f) Oulla P. α) Fournier A.

Lieu d'implantation	Corps ORSTOM et accueil	Allocataires +CSN	ORSTOM recrutement local	Cherch. Associés +CFI	TOTAL
Ouagadougou	14	6 + 1	39	3 + 1	64
Bobo-Dioulasso	5	2 + 0	11	2 + 0	20

Appendix 6

ATTENDEES AT ORSTOM MEETING IN BURKINA FASO

JULY 13, 1995

NAME	ORGANIZATION
Koussoube, Youssoaf	Universite Ouaga, Geologie, Geophysique, Hydrogeologie
Ouangrawa, Nariam	Universite Ouaga, Geologie
Tapsoba Claude Obin	Institut Geographique du Burkina
Ouedrhogo Amadou	Institut Geographique du Burkina
Traore, Louis	Secretariat Permanent du Plau d'Action National pour l'environment
Dezetter, Alain	ORSTOM, Hydrologie
Wenmenga, Urbain	Universite Ouaga, Geologie
Grandin, Georges	ORSTOM, Geologie
Ouedraogo, O. Francois	PATSN, Geologie
Evareste, D.A. Dapola	Universte Ouaga

WBAttend.let

Liste d'attendus

Réunion du 13/07 avec Mme Margarete Kalin

Nom	organisme -	
KOUSSOUBE Youssouf	Université Ouaga	Géologie - Géophysique - Hydrogéologie
OUANGRAWA Mariam	Université Ouaga	Géologie
TAPSOBA CLAUDE OBIN	INSTITUT GEOGRAPHIQUE DU BURKINA	
OUEDRAOGO AMADOU	"	"
TRAORE LOUIS	Secrétariat Permanent du Plan d'Action National pour l'environnement.	
DEZETTER Alain	ORSTOM - Hydrologie	
WENMENGA. urbain	université - Ouaga	Géologie
GIRARDIN Georges	ORSTOM	Géologie
OUEDRAOGO D. François	PATSN	géologue
DA Dapola Evariste C	FLASHS/géographie - Université de Ouaga -	

Appendix 7

ROUND TABLE ON ARTISANAL MINING CHARTS THE ROAD FORWARD

For a Start, Give Them Legal Mining Title

Keith R. Suttill, International Editor

Processing gold ore with mercury in Tanzania.

An international round table to discuss what to do about the growing number of artisanal, or informal, miners worldwide was convened in Washington by the World Bank in May. A predominantly invited group of some 80 delegates from 25 countries attended. It included representatives from the full spectrum of interested parties: multinational agencies, governments, non-governmental organizations (NGO), international mining companies, and the artisanal mining community itself.

This was the first international meeting to discuss purely the problems of the informal mining sector. Previous international conferences have considered artisanal mining within the broader scope of a small mines sector. Artisanal mining was defined for the purposes of discussion as the most primitive type of mining, which is characterized by individuals or groups of individuals exploiting deposits, usually illegally, with the simplest of equipment.

At the end of three days of discussions, the most important conclusion was that no solutions were possible unless artisanal miners were given full legal and transferable mining titles to their claims. However, the legalization of artisanal miners, although an essential precondition for reform of the sector, can only be considered a start. The problems are so wide ranging that a flexible and integrated approach tackling regulatory, social, environmental, and other issues will be necessary.

The point about legal title was put most forcefully by John Holloway, a consultant from Zimbabwe who has wide experience of artisanal mining throughout Africa. None of the other problems of lack of technology and financial support, he said, could be tackled effectively until this prime need was met. Subjecting artisanal miners to special regulations and/or treating them as an unwelcome and marginal activity to industrial mining operations, as so many countries do, only aggravates the problem.

The Scale

The World Bank is interested in informal mining because part of its mandate is to alleviate poverty and artisanal miners, although they may be rich in comparison to many of their compatriots, are poor. John Holloway described them as "islands of prosperity in a sea of poverty." Indeed, the mere existence of informal mining is largely due to poverty and the lack of alternative employment, although the "get rich quick" mentality is also a factor where gold and precious stones are concerned.

In the words of Mining and Industry Division chief, Peter van der Veen, the subject to be discussed was "How artisanal mining could be carried out safely and in an environmentally acceptable manner, and what were the technical, financial, and regulatory measures required to achieve this"; i.e. how to help at least some of the hundreds of thousands involved make the jump from a subsistence activity to form the nucleus of a genuine economically viable small-scale mining industry.

The scale of the informal mining sector is enormous and in many countries growing due to rapid population growth and the lack of alternative means of earning a living. Richard Noetstaller of Leoben University, Austria, estimated that perhaps 6M people are directly involved in artisanal mining worldwide. Half of these are in China, predominantly in small village-run coal mines. Brazil, India, Indonesia and Zaire have about 500K informal miners each and the rest are spread throughout the developing world.

Although artisanal mining is most associated with gold, diamonds and gemstones, large quantities of coal, tin, tantalum, wolfram, and construction materials are also mined by the informal sector. It also includes all types of mining: alluvial, open pit, and hard rock.

The value of production is prodigious. Artisanal miners account for 20% of the gold, 40% of the diamonds, and nearly all the gemstones mined in Africa. Not long ago they accounted for 70% of Brazilian gold production (now less than 50% but still worth about $1,000M/yr). In Zambia, the informal sector has been estimated to be worth $250M/yr or a quarter of ZCCM's copper and cobalt sales. Similar figures apply in other countries.

Governments almost universally wish that artisanal miners would disappear. They show little interest in the sector because

Rudimentary haulage system in Tanzania.

informal miners have little political clout and provide no tax revenues. Furthermore, they usually operate far from government control and their activities are typically inefficient, illegal, unsafe, environmentally damaging, and an actual and potential source of conflict with the major mining companies most are trying so hard to attract. The environmental and potential conflict factors are of prime concern.

In practice, many international mining companies have managed to strike up good working relationships with the artisanal miners on their properties. James Askew of Golden Shamrock Mines described how they permitted informal miners to continue operations on unworked parts of their concession at Iduapriem in Ghana. He also said they are excellent workers for exploration programs but most were too individualistic to adapt well to the disciplines of normal operations. Philip Morriss of Placer Dome also described how his company had achieved similar working relationships at their property in Venezuela.

The Potential

Although artisanal mining is predominantly a poverty-driven activity it could equally be opportunity-driven. If artisanal miners were to be brought into the mainstream of the industrial activity, there is considerable potential for alleviating their own poverty and increasing national wealth. Artisanal miners have proved themselves to be excellent prospectors. There are also many mineral deposits which because of their size will never to be of interest to a major mining company but which could be mined profitably on a small scale. But in most countries there is nothing in scale between the smallworker on his usually illegally held patch and the mine treating hundreds or thousands of tons per day.

The problem is, as Richard Noetstaller described it, that both the informal miners and the governments are caught in negative circles. The miners are using inadequate technology, so recoveries are poor. They therefore have low savings and so are unable to invest in superior technology to improve their recoveries and incomes. Governments on the other hand have inadequate resources to control informal mining. They are therefore unable to collect taxes and so have insufficient income to exert control. To break the dilemma both negative circles must be broken.

The round table discussed the problem under four headings: Environmental, Health, and Safety Issues; Organizational, Social, and Women's Issues; Technical and Financial Issues; and Regulatory and Legal Issues. Each section began with a series of short formal presentations followed by active discussions. On the last day delegates broke up into four workshops to discuss the same issues and come to conclusions.

It became clearer and clearer as the discussions progressed that the four groupings had many aspects in common. These interrelationships emphasized the need for an integral approach to the problems of the informal mining sector.

Environmental, Health, and Safety Issues

This panel discussed how governments can set appropriate regulatory regimes for environmental protection; what has been learned from the activities of NGOs in environmental management; what can be done to improve environmental, health, and safety conditions; and what role, if any, can governments and NGOs play.

Environmental destructiveness is the single most visible aspect of artisanal mining. Although the total area affected is small (e.g. less than 1% of the Amazon basin in Brazil has been affected by garimpo mining), the local impact is high. The problems include acid mine drainage, deforestation, soil erosion, and river silting, and for gold mining, pollution of river systems with mercury. Mercury is also a health hazard to the miners through the common practice of burning amalgam in the open air. Other health hazards are occupational diseases, lack of worker protection, and the lack of support in underground workings.

The panel concluded that ideally all mining, including artisanal mining, should be subject to the same environmental health and safety laws but recognized the special circumstances of the informal sector. To bring them into the system, regulations and technical standards need to be realistic and achievable. Enforcement will often be difficult so incentives to comply will also be needed. It was considered that the ministries of mines and environment, and local governments, need to become actively involved in the sector. Assistance should be provided both directly and through NGOs and private companies where applicable.

All were agreed that education and the communication of information were the keys in making all interested parties, miners, governments, and the local communities aware of the situation and encouraging them to improve it. This can be done through newsletters, comics, seminars, videos, and radio and TV campaigns.

Organizational, Social, and Women's Issues

This panel analyzed what past initiatives on informal mining have worked and why; what can be done to promote orderly development of the activity; and what role can governments, NGOs and donor agencies play. Women's issues were included because in many countries informal mining employs a large percentage of women, especially in downstream activities, yet they remain subject to a number of constraints on their full participation.

Essentially, bottom-up initiatives based on participation and cooperation between miners and non-governmental agencies have worked much better than top-down initiatives based on model solutions. For example, attempts to form cooperatives have usually failed. Most "cooperatives" are legal conveniences where each miner works for himself rather than true revenue sharing arrangements. Nevertheless, appropriate organizational structures are necessary to improve accountability and effectively introduce modern

A Tanzanian mining camp.

Mine workings along the system of shears in Tanzania.

technology. Artisanal miners need to be encouraged to become entrepreneurs and look upon mining as a business.

Technical and Financial Issues

The Technical and Financial Issues panel was asked to consider whether artisanal mining was a viable long-term activity and if so, what could be done to support its development. The sector is restricted by legal impediments such as the absence of property rights and restrictions on the sale or transfer of mineral rights and physical factors such as the presence of water at depth and inadequate ventilation.

The introduction of modern mining and processing techniques and equipment is the key to increasing productivity and mineral recovery, and hence revenues. It is one point at which the negative circle can be broken. Delegates felt that the establishment of model mines and mining centers for demonstration and training purposes had a role to play. Financial constraints could be overcome by encouraging entrepreneurs to branch out into small scale mining and encouraging miners to invest their own savings and those of family and friends. It was also considered that options for finance without collateral should also be explored, including the formation of solidarity groups and third party guarantees.

Legal and Regulatory Issues

This is the section on which all the other issues depend and the point at which the government's negative circle can be broken. Legalization of artisanal miners was agreed to be the essential first step in transforming them into sustainable small mines. The discoverer of a deposit must automatically be granted mining title and mechanisms need to be established so that he can easily transfer it. In most countries at present, artisanal miners are in the unenviable position of having to exploit their discoveries themselves without the benefit of finance or modern equipment, otherwise they lose them. If they were able to transfer or negotiate their titles, some such discoveries could be converted into efficiently run small mines. Legal status also improves the creditworthiness of artisanal miners and their willingness to invest.

To encourage registration, licensing of informal miners should be done on a regional rather than a national basis, as is the case in Ghana. District buying stations paying world prices will also help eliminate illegal marketing.

Conclusion

These were the main issues discussed and there were several pertinent examples of success recounted. Ghana for example, has invested $1.4M in regularizing its informal mining sector through district licensing offices and district buying centers over the past six years. Over the same period, $140M of revenues that would otherwise have escaped the government have been collected.

In Bolivia, where artisanal miners can obtain legal title but otherwise receive minimal help, Castillo Condori, president of the Kantuta Cooperative which has 26 members, described how they had obtained, and successfully used, a $200K loan to mechanize their underground operation. One informal worker who has made the jump to small scale miner.

In southern Ecuador, the Cenda Foundation has adopted an innovative and successful approach to the artisanal miners in the area by offering technical assistance that is backed by a community-wide effort that aims to inform and instruct through all the means of communication available. This program was described in detail by Fabian Rodriguez, director of the Cenda Foundation. In Ecuador, the government has granted the informal miners title to their claims and encourages them to come to agreements with established mining companies that are operating in the area. Under the new mining code, the titles will be made fully transferable.

These are success stories and it is notable that all are founded to different degrees on a flexible legal framework designed to regularize the activities of the informal sector. This is the key but the other aspects of access to finance and technical expertise, and general education must be addressed at the same time. Partnerships must be formed between all those involved in the sector, governments, NGOs, international donor agencies, international mining companies, and the artisanal mining community itself if long term solutions are to be found.

Whatever is done, the problems of environmental degradation, ruination of mineral resources, and poor health and safety will not disappear. However, if governments take the basic steps to regularize their informal mining sectors they should at least prevent the situation from worsening, and in favorable circumstances artisanal miners could begin to make a positive contribution to national wealth. That was the main conclusion of this First International Round Table on Artisanal Mining. ■

Plate 1: An Artisan Mine Site

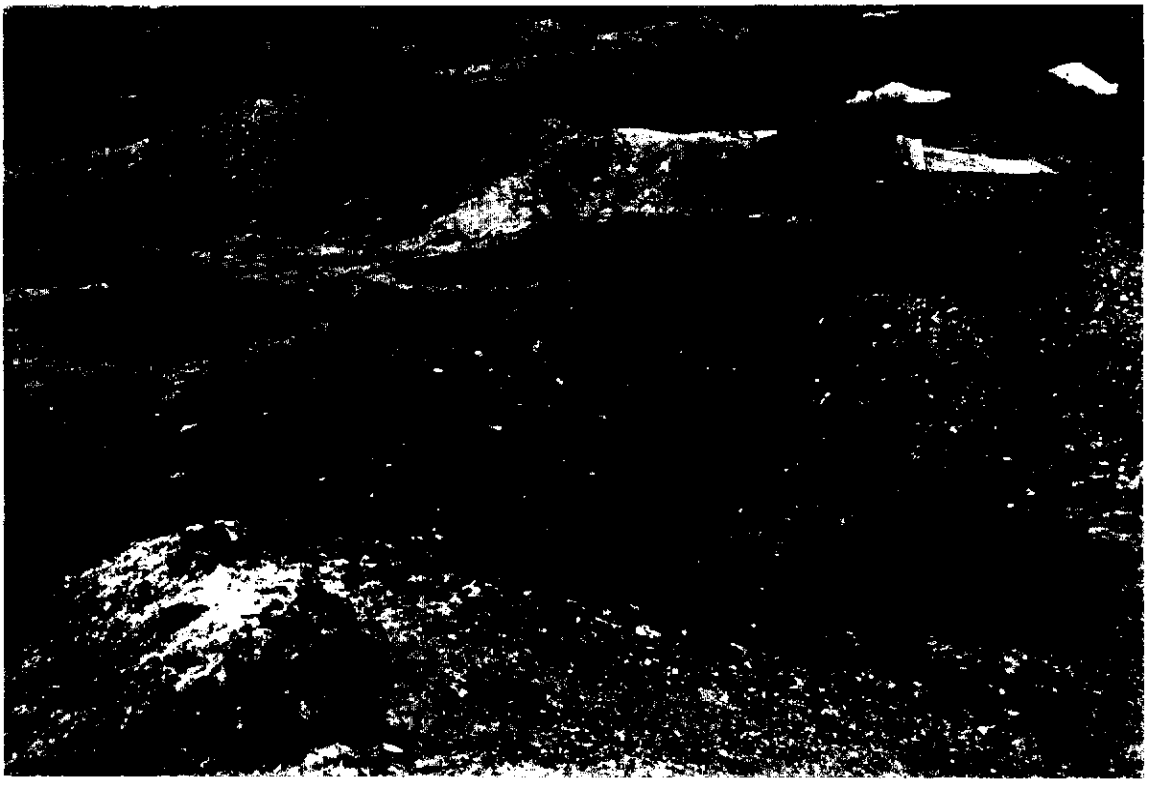


Plate 2: Natural Colonization at an Artisan Mine Site

Appendix 8

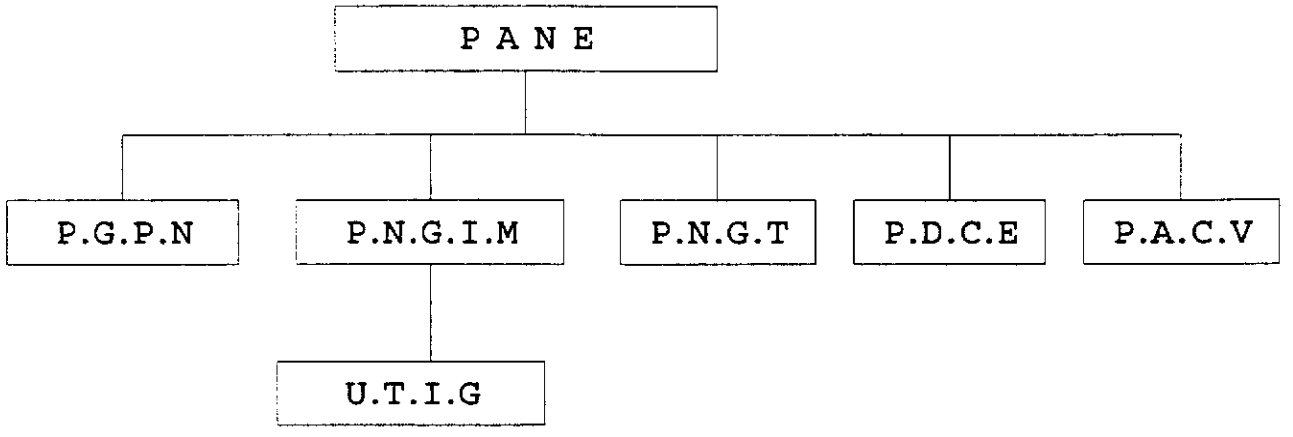
-o- L E S M I S S I O N S D E L ' U T I G -o-

E T S E S

R E A L I S A T I O N S

Créée en **Mai 1992**, l'**U**nité de **T**raitement de l'**I**nformation **G**éographique (**U.T.I.G**), est un outil technique du Programme National de Gestion de l'Information sur le Milieu (P.N.G.I.M.), qui est un des cinq (05) programmes Cadres du Plan d'Action National sur l'Environnement (P.A.N.E).

Croquis



I/- **M I S S I O N S**

L'objectif premier du P.N.G.I.M est d'améliorer la pertinence, la qualité et la disponibilité des informations sur l'environnement. Pour mener à bien cet objectif, il a été décidé de mettre en place une formule institutionnelle de trois éléments de base :

1)- Le réseau de partenaires
2)- La cellule de coordination
3)- l'Unité de Traitement de l'Information Géographique (U.T.I.G)

1)- **Le Réseau de partenaires** seront responsables de la collecte des données de base du contrôle de leur qualité, et de la maintenance de bases de données, chacun selon ses attributions réglementaires.

2)- **La Cellule de coordination**, structure légère aura les objectifs suivants :

- Coordonner et contribuer à renforcer les capacités existantes en matière de collecte, de traitement et de diffusion de l'information sur le milieu ;
- Mettre en place un système efficace de circulation de l'information disponible à tout moment ;
- Assurer le bon fonctionnement du "feed-back" entre les prestataires, demandeurs et fournisseurs ;
- Appuyer les programmes Cadres du PANE et les actions de suivi des programmes et projets de développement.

3)- **L'Unité de Traitement de l'Information Géographique (U.T.I.G)**

Les missions de l'U.T.I.G sont à long et moyen terme.

Dans le long terme :

- être un instrument au service de la cellule de coordination, notamment pour :
  . l'établissement d'un répertoire de jeux de données disponibles aux autres partenaires ;
  . garantir la compatibilité des supports cartographiques de l'information, assurer un transfert de technologies (Choix et installation du matériel Informatique, formation....etc) ;
  . assister et conseiller les autres acteurs dans l'élaboration des programmes techniques ;
  . réaliser des prestations de services, les acteurs du P.N.G.I.M.

Dans le moyen terme :

exécuter le contrat qui le lie au Programme National de Gestion des Terroirs, par :

1)- **la mise en place et le développement** :

. Des capacités nationales de traitement d'informations sur le milieu pour la réalisation d'études sur l'importance de la dégradation des ressources naturelles et sur l'évolution de l'occupation des terres et productions rurales ;

. Des capacités d'analyses spatiales, nécessaires, afin d'identifier les causes et de déterminer les tendances de ces phénomènes ;

2)- La fourniture au P.N.G.T d'information à l'échelle Nationale qui lui permettront de mieux cibler et évaluer l'impact de ses interventions,

3)- La mise en marche de certaines composantes du P.N.G.I.M définies plus haut.

Le contact U.T.I.G/P.N.G.T porte sur les tâches suivantes :

- réaliser une étude systématique des changements dans l'occupation des terres sur l'ensemble du BURKINA FASO à partir de l'imagerie satéllitaire.
- Collecter des informations complémentaires de divers départements, afin d'apprécier l'évolution des ressources et des productions rurales,
- Intégrer les informations sur les changements dans l'occupation des terres et les informations complémentaires, afin d'évaluer les tendances évolutives et leur gravité pour chaque province.

Pour exécuter ce contrat, le P.N.G.T a alloué un budget de 779.000 U$. pour :

- assurer le fonctionnement de l'U.T.I.G,
- l'acquisition du matériel informatique et des logiciels,
- assurer la formation du personnel de l'U.T.I.G.

II/- R E A L I S A T I O N S

Après la mise en place de l'**U**nité de **T**raitement de l'**I**nformation **G**éographique (**U.T.I.G**), l'**U.G.O/P.N.G.T** a mis à la disposition de l'UTIG en Janvier 1993 :

- 2 PC 486,
- 3 logiciels ARC/INFO,
- 1 table à numériser,
- 1 table traçante.

Ce qui a permis à l'U.T.I.G de produire la carte numérique, administrative du BURKINA FASO au 1/1.000.000è, avec trois (03) dérivées (Provinces, Départements, Régions Economiques). Cette carte a été reprise et à la date du 31 Décembre, les couvertures composant cette carte numérique, sont disponibles au prix du support.

Le Parc informatique a été augmenté et à ce jour, l'U.T.I.G dispose de 6 PC, 3 logiciels ARC/INFO, 2 tables à numériser A0, 1 table à numériser A3, 1 table traçante A0.

La production disponible actuellement est la suivante :

- 3 feuilles au 1/500.000è (Planimétrique, Hydro, Altimétrie)
- 5 feuilles au 1/200.000è (" , " , ")
- des cartes thématiques (réseau routier, morphologique.....etc)

En juillet 1995, débutera le traitement de l'imagerie satéllitaire afin de produire les cartes d'occupation du sol. A cet effet, l'U.T.I.G disposera de :

- trois (03) stations,
- deux (02) Arc/Info UNIX,
- deux (02) ERDAS,
- quatre (04) Arc/Info PC,
- trois (03) Arciew Unix,
- trois Arcview PC 2.0
- un (01) Scanner A1,
- un (01) réseau ethernet + le fasopac (internet),
- une (01) imprimante A0 à jet d'encre,
- de couvertures MSS LANDSAT de tout le territoire (17 scènes),
- de couvertures TM LANDSAT de tout le territoire (17 scènes) stockés sur disques optiques.

Le personnel de l'U.T.I.G est une équipe pluridisciplinaire de dix (10) agents ayant les formations et les fonctions suivantes :

- Responsable U.T.I.G : Informaticien, Photogrammètre, SIG

- Chef d'équipe N°1 : Télédétection, Géographe, SIG
- Chef d'équipe N°2 : Télédétection, Topographe, SIG
- Chef d'équipe N°3 : SIG, Topographe
- Technicien N°1 : SIG, Photogramètre
- Technicien N°2 : SIG, Photogramètre
- Technicien N°3 : SIG, Cartographe
- Technicien N°4 : SIG, Cartographe
- Technicien N°5 : SIG, Géomètre
- Technicien N°6 : SIG, Photogramètre

L'UTIG fournira au PNGT les produits suivants à la fin du contrat

- 50 exemplaires d'un jeu de 5 cartes d'occupation des terres de 1973-1975 et 1992-1994, imprimées en polychromie à l'échelle du 1/500 000è.

-Les tableaux détaillant pour chaque province, les changements dans l'occupation des terres par classe d'occupation pour la période de 1973-1975 à 1992-1994.

- Les cartes sur l'ensemble du pays ou des tableaux par province pour les thèmes suivants :

- Population
- Bétail
- Productions et rendements agricoles par année
- Productions des pâturages
- Eaux souterraines et eaux de surface
- pastorale

- Une analyse pour chaque province dans l'occupation des terres à la lumière des informations, complémentaires disponibles.

Dans le cadre de la production de la carte d'occupation des terres l'UTIG va associer des collaborateurs techniques nationaux et étrangers,en signant des contrats de collaboration.

Afin une commission de supervision nationale, vérifiera l'avancement des travaux qui se réunira 6 mois après le démarrage de l'interprétation des images satellitaires 1991-1992.

En outre cette commission à la lumière des informations disponibles déterminer les analyses spécifiques à réaliser.

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LE DIRECTEUR DE L'UTIG

Soumaïla DIALLO

SECRETARIAT PERMANENT DU
PLAN D'ACTION NATIONAL
POUR L'ENVIRONNEMENT

BURKINA FASO

La Patrie ou la Mort, Nous Vaincrons!

PROJET DE DEVELOPPEMENT DES CAPACITES DE GESTION DE L'ENVIRONNEMENT

12 avril 1995

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DESCRIPTION ET BUDGETS DES ACTIVITES DU PROJET:

INTRODUCTION

La prise en compte de la variable "environnement" dans la définition et l'application des politiques et stratégies de développement durable est un des faits majeurs des réflexions et initiatives des dernières années sur le devenir des sociétés. Dans ce contexte, le Burkina Faso s'est doté d'un cadre global d'orientation des actions liées à la gestion des ressources de l'environnement. Cet outil d'orientation qu'est le Plan d'Action d'Action National pour l'Environnement (PANE/Agenda 21 National) met l'accent sur la pérennisation et la valorisation des acquis et jette les bases d'une gestion rationnelle de l'environnement tout en prenant en compte, les dimensions sociales, économiques, institutionnelles, politiques et écologiques du développement. Il a pour objectifs de contribuer à:

- maîtriser les pressions sur le milieu naturel
- favoriser la régénération des ressources naturelles et protéger la diversité biologique
- améliorer le cadre de vie
- amorcer le processus du développement durable

Le présent projet vise à développer et à consolider les capacités nationales en matière de gestion de l'environnement. Il comporte cinq (5) volets.

Le volet 1 vise l'harmonisation des politiques nationales de gestion de l'environnement à travers la précision des attributions des différentes structures concernées et la création d'un mécanisme opérationnel de coordination des activités. Ce volet prévoit également l'établissement de rapports périodiques sur l'état de l'environnement.

Le volet 2 vise l'amélioration de la production et de l'utilisation de l'information sur le milieu dans la gestion de l'environnement. Ceci se fera par une circulation efficiente de l'information à travers un réseau de partenaires producteurs/utilisateurs d'information.

Le troisième volet concerne les conventions. Il s'agit ici de mettre en oeuvre des programmes nationaux sur les conventions internationales sur l'environnement signées et ratifiées par le Burkina Faso.

La quatrième composante vise la formation en vue d'accroître les compétences nationales nécessaires pour une gestion saine de l'environnement.

Enfin, il est prévu un cinquième volet pour appuyer le Secrétariat Permanent du Plan d'Action National pour l'Environnement, structure d'animation quotidienne du PANE dans ses tâches de coordination et de suivi.

Le projet est totalement financé par la Banque Mondiale à travers le PPF P. 784-O-BUR, le PNGT et le Fonds de Développement Institutionnel (IDF).

COMPOSANTE 1: ANALYSE ET SUIVI DES POLITIQUES NATIONALES DE GESTION DE L'ENVIRONNEMENT

Objectifs globaux

Cette composante du projet a pour objectifs à long terme, la consolidation des actions en faveur du développement durable et ce par la mise en place d'un mécanisme opérationnel de programmation, de coordination et de suivi des activités liées à la gestion de l'environnement:

- créer un mécanisme opérationnel de programmation, de coordination, de suivi et d'évaluation des activités liées à la gestion de l'environnement dans le cadre de la mise en oeuvre du PANE/Agenda 21 national.
- veiller à une cohérence et à une harmonisation des politiques nationales en matière de gestion de l'environnement
- établir un rapport périodique sur l'état de l'environnement

Objectif immédiat 1: Créer et gérer une banque de données

Le premier domaine d'activités concerne le suivi de la mise en oeuvre du PANE/Agenda 21 national. Pour ce faire, la création d'une banque de données sur les projets contribuant à la mise en oeuvre du PANE est indispensable. Les informations contenues dans cette banque de données comprendront entre autres:

- nom et adresse de contact pour chaque projet
- source de financement et montant
- modalités de financement
- dates de début et de fin du projet
- nature du projet (ancien, renouvelé, nouveau)
- degré d'élaboration du projet, selon la classification du MEFP (idée de projet, dossier de factibilité, dossier d'exécution, etc.)
- situation de financement du projet
- aire géographique d'intervention
- domaines d'activité du projet

Résultat 1.1: Banque de données effectivement créée, périodiquement actualisée et accessible à tous les utilisateurs

Cette banque de données facilitera le suivi régulier de la mise en oeuvre du PANE, en fonction de la situation des différents projets et programmes qui en font partie. Elle permettra d'identifier les insuffisances matérielles, humaines, techniques, et financières qui peuvent limiter l'atteinte de ses objectifs. Elle permettra également de fournir à la

demande des utilisateurs publics, des services d'identification de projets selon des critères spécifiés. Eventuellement, il est prévu de lier cette banque de données aux informations spatiales du PNGIM, ce qui permettra des analyses très intéressantes liant les projets environnementaux aux problèmes qu'ils cherchent à résoudre. La banque de données sera accessible à ceux qui s'y intéressent par la mise à leur disposition de disquettes et d'imprimés, afin qu'elle soit exploitée autant que possible.

Activité 1.1.1: Création et gestion de la banque de données

Le SP/PANE coordonnera la mise en place de la banque de données sur les projets. Cependant, le travail sera sous-traité avec un bureau d'études privé expérimenté en informatique et gestion des banques de données. Ce travail se fera en plusieurs étapes:

Etape 1: Identifier des projets environnementaux

Il faut d'abord identifier les projets "environnementaux" à inclure dans la banque. Pour ce faire, il faut d'abord définir les critères de sélection des projets. Ces critères seront définis par le SP/PANE de concert avec le CICT et les utilisateurs potentiels de la banque de données.

Ensuite il faut rechercher les listes existantes (de préférence informatisées) sur les projets à partir desquelles on peut extraire une liste de projets sous le PANE. Le MEFP dispose déjà d'une base référentielle à exploiter, le PNGT également. Au niveau des DEP, il existe un minimum de données à prendre en compte. Ce travail sera confié à un bureau d'études.

Etape 2: Définir la structure de la fiche de projet à informatiser dans la banque de données. Cette étape est la plus importante du processus. Les informations à inclure dans la fiche déterminent les questions auxquelles on peut répondre en utilisant la banque de données.

Etape 3: Créer la structure informatique de la banque de données. Il s'agit à partir du SGBD retenu, de concevoir la structure et l'organisation de la gestion des données suivant les informations portées sur la fiche de projet définie plus haut. Ce travail technique sera confié à un bureau d'études qui analysera et écrira les différents programmes permettant les saisies, les corrections, les mises à jour des données et les requêtes diverses.

Objectif immédiat 2: Veiller à une cohérence et à une harmonisation des politiques nationales de gestion de l'environnement

Le deuxième domaine d'activités de cette composante est le suivi et l'analyse des stratégies de gestion de l'environnement et de l'avancement des projets et activités

contenus dans la banque de données. Cette activité prendra en compte:

- la relation entre les nouvelles stratégies de décentralisation et la gestion de l'environnement (y compris l'approche gestion des terroirs), notamment en ce qui concerne la fiscalité locale et le financement des activités techniques
- les relations entre stratégies différentes de gestion de l'environnement, telles que la gestion des terroirs, l'approche *training and visits*, la foresterie villageoise, le pastoralisme, etc.

Résultat 2.1: Les politiques et stratégies de gestion de l'environnement mises en place sont cohérentes et opérationnelles

Activité 2.1.1: Analyse des approches sectorielles

Une analyse approfondie sur les questions pertinentes sera faite et diffusée aux structures intéressées ou directement impliquées. Selon les besoins, il sera envisagé des réunions ou des ateliers pour discuter des différences d'approches ou conflits de compétences afin de trouver des solutions consensuelles.

Les nouveaux projets et programmes doivent être suivis de près pour s'assurer de leur cohérence et adéquation avec les politiques nationales. Le SP/PANE doit s'informer sur les projets en préparation et au cas où il y a incompatibilité avec les stratégies nationales, il doit contacter ceux qui préparent le projet pour en discuter. Pour ce faire, il faut développer un mécanisme permettant d'assurer la connaissance des nouveaux projets. Ceci peut probablement se faire à travers le MEFP, qui détient normalement des informations sur les différents projets. Le même besoin d'identifier les nouveaux projets va se poser dans la création de la banque de données sur les projets et au BEIE dans l'identification des activités assujetties aux EIE. A cet effet, le SP/PANE le SP/PANE et le BEIE de la DIPAC doivent chercher un mécanisme approprié de collaboration.

Résultat 2.2: Rôles de toutes les structures de mise en oeuvre du PANE clarifiés et acceptés par toutes les partenaires

Activité 2.2.1: Analyse des aspects institutionnels de gestion de l'environnement

Entreprendre une étude en vue de mieux clarifier les attributions des uns et des autres, évitant toutes sortes de conflits de compétences pouvant entraver la mise en oeuvre de la stratégie environnementale.

Activité 2.2.2: Organisation de réunions et d'atelier

Sur la base de l'étude (activité 2.2.1.), des réunions de concertation et un atelier national seront organisés avec l'ensemble des partenaires de gestion de gestion de l'environnement pour valider de manière consensuelle, les attributions des uns et des autres.

Objectif immédiat 3: Etablir un rapport sur l'état de l'environnement

Résultat 3.1: Le rapport sur l'état de l'environnement est disponible

Activité 3.1.1:

Il s'agit ici d'élaborer un rapport faisant le point sur la situation de l'environnement au Burkina Faso. Ce rapport sera fait sur la base des rapports d'activités des projets à caractère environnemental mais également sur la base d'études spécifiques. Ces rapports d'activités seront fournis par les différents départements ministériels, les ONGs et autres structures intervenant dans le domaine de l'environnement.

COMPOSANTE 2: PROGRAMME NATIONAL DE GESTION DE L'INFORMATION SUR LE MILIEU (PNGIM)

OBJECTIF GLOBAL

A long terme, le Programme National de Gestion de l'Information sur le Milieu vise l'amélioration de l'utilisation de l'information dans la gestion de l'environnement au Burkina Faso.

OBJECTIFS IMMEDIATS

objectif immédiat 1: Aider les fournisseurs d'informations environnementales à produire des données pertinentes et utilisables.

Résultat 1.1: Cadre de référence et d'orientation des producteurs d'informations et de données en rapport avec le suivi de l'environnement créé.

Activité 1.1.1:

Identification des différents producteurs, de leurs difficultés liées à la production des données et recensement de leurs besoins.

Activité 1.1.2:

Mise en place d'un cadre général pour tous les partenaires/producteurs d'informations. Il s'agit de voir les besoins communs en terme de formation, d'équipement et de logiciels afin d'une part d'harmoniser et de synchroniser les progrès des partenaires et d'autre part afin de gérer les problèmes de compatibilité des données.
Il a donc été identifié un premier réseau de 11 partenaires travaillant dans la production de l'information environnementale: INERA, DOET, BUNASOLS, DSAP, INSD,CNSF, METEO, IRBET, DGE/MET, DAT, DIRH.

Activité 1.1.3:

Mise en place de renforcements spécifiques pour la production de produits particuliers.

Les appuis spécifiques permettront à certains partenaires de générer ou compléter l'information nécessaire à la mise en oeuvre du Système d'Information Environnemental

(SIE). Pour les cas présents, il s'agit de renforcement pour:

- l'IGB pour la mise en place de points géodésiques pour la cartographie
- la METEO pour assurer la continuité de la collecte des données primaires .

Résultat 1.2: Responsabilisation accrue de chaque producteur d'informations.

Activité 1.2.1: Spécialisation des fournisseurs

Il s'agira de sensibiliser les producteurs afin que chaque producteur reconnaisse et reste dans ses zones d'activités et d'intervention.

Activité 1.2.2: Orienter les différents bailleurs sur les besoins les plus urgents des producteurs.

Objectif immédiat 2: Mise en place d'un système efficace de circulation de l'information disponible à tout moment.

Résultat 2.1: Mise en place et animation d'un réseau de partenaires producteurs/utilisateurs d'information sur le milieu.

Activité 2.1.1: Harmonisation de la nomenclature pour la classification des données environnementales dans les systèmes d'information à référence spatiale

Il s'agira de travailler de concert avec toutes les institutions concernées par la question, végétation/occupation des sols et d'arriver à une harmonisation des nomenclatures afin de résoudre en partie les problèmes de compatibilité des données et de superposition des cartes. Les institutions suivantes sont concernées par cette activité : UTIG/IGB, BUNASOLS DOET, CNSF, DSAP, INSD, DIRH, IDR, INERA/IRBET, DAT, BUMIGEB/PROJET MINIER, METEO, DEPART/GEOGRAPHIE (U.O).

Une consultation (nationale et internationale) aidera à la mise en place de cette nomenclature.

Activité 2.1.2 : Harmonisation de la toponymie

Il s'agira dans cette activité d'arriver à un consensus (au niveau national) sur les noms des villes et villages du Burkina Faso. L'objectif est de parvenir à une appellation unique pour le même village ou la même ville. Cet objectif atteint permettra un croisement des

données de différentes institutions. Institutions concernées: FEWS, UNICEF, UTIG/IGB, INSD, PROJET APPUI A LA DEP/EAU.

A cet effet, des documents seront préparés par les différentes parties et feront l'objet d'adoption lors d'ateliers.

Activité 2.1.3 : Intégration des données

Il s'agit de la réalisation d'un prototype d'intégration et d'échange des informations à références spatiales à l'échelle du 1/1.000.000 auquel participerait l'ensemble des institutions nationales détentrices d'informations. Cet objectif atteint permettra d'expérimenter les concepts, les normes et les processus d'intégration des données à références spatiales de diverses sources et de faire des analyses beaucoup plus pertinentes pour les prises de décision.

Activité 2.1.4: Formation en DBASE et ARC INFO

Une première formation serait une introduction à ces logiciels et viserait principalement les instituions appelées à contribuer à la production des informations pour le suivi écologique à l'échelle nationale. Au total 18 à 20 institutions participeront à cette première phase de formation qui durera 10 jours.

Une deuxième série mais d'un niveau supérieur intéresserait les agents de l'IGB appelés à programmer.

Activité 2.1.5: Diffusion de référentiels numériques de base

Cette activité concerne la diffusion auprès des tous les partenaires, de tout référentiel produit et validé aussi par l'IGB que par d'autres institutions spécialisées en la matière. L'objectif est d'arriver à ce que tout le monde utilise le même référentiel numérique afin de résoudre en partie les problèmes de juxtaposition et d'échanges des données.

Activité 2.1.6 :Réalisation d'ateliers de définition de SIG

Les résultats escomptés de ces ateliers sont les suivants:

- Information des partenaires sur :
  * les inventaires et les potentialités des SIG au Burkina
  * le programme de suivi écologique du PNGT
  * L'UTIG (programme et réalisations)
  * les stratégies d'échanges et de partenariat
  * le PNGIM et la coordination de l'information sur le milieu

  Ce résultat atteint permettra de jeter les bases d'une stratégie nationale

pour approcher les difficultés posées et renforcer davantage le processus de collaboration inter-service au bénéfice des acteurs de développement.

- Elaboration de documents de référence pour la mise en place d'une stratégie/approche concertée et harmonisée en vue de faciliter la coordination des activités.

- Jeter les bases de la mise en place d'un comité national pour la promotion des SIG et de la Télédétection au Burkina.

Résultat 2.3: Favoriser la collaboration et la complémentarité entre les services et les structures dépositaires de l'information.

Activité 2.3.1: Identifier les utilisateurs des données environnementales et leurs besoins

Cette activité devra faciliter la mise en cohérence des utilisateurs et l'établissement d'une matrice produits-fournisseurs/besoins-clients, ceci dans le but de réorienter aux besoins les actions des uns et des autres dans la production de l'information nécessaire et demandée.

Activité 2.3.2: Développer l'esprit d'intérêt potentiel de l'information pour les autres, l'esprit d'ouverture et de partage.

Activité 2.3.3: Gestion de catalogues de données (à la disposition des utilisateurs) mais pas les données elles mêmes.

Il s'agit de recenser les données statistiques utiles pour la gestion de l'environnement. Ceci permettra l'établissement d'un catalogue d'information que l'on mettra à la disposition de tous les utilisateurs. Ainsi on pourra voir dans le catalogue, qui produit telles données avec les dates et formats des données, l'existence des banques de données sectorielles et dans quel domaine.

Le PNGIM devra oeuvrer à la mise en place d'un tel document et maintenir un niveau de collaboration entre les différents fournisseurs pour les questions de mise à jour de ce catalogue.

Objectif immédiat 3:

Appuyer les programmes cadres du PANE et les actions de suivi des programmes et projets de développement.

Résultat 3.1 : Les programmes cadres du PANE et les actions de suivi des programmes et projets environnementaux sont appuyés

Activité 3.1.1: Aider à la mise en place d'une banque de données sur les projets et programmes du PANE

Activité 3.1.2: Contribuer à la réalisation d'un rapport sur l'environnement en fournissant les données quantitatives sous forme cartographique ou statistique de ce rapport

Activité 3.1.3: Analyser et effectuer une synthèse de l'information sur le milieu en vue des instruments de prise de décision.

Activité 3.1.4 : Aider à l'édition et à la publication de bulletins d'information sur le PANE et l'ensemble des activités de gestion de l'environnement.

Activité 3.1.5: Etablir une liste d'indicateurs représentatifs et suivre leur évolution.

COMPOSANTE 3 : SUIVI DES CONVENTIONS

Objectif global

L'objectif général vise la mise en oeuvre effective des conventions en matière d'environnement ratifiées par le Burkina Faso, le suivi et l'évaluation des différents programmes d'actions liés à ces conventions.

Objectif 1: Sensibilisation des populations sur les conventions

Résultat 1.1: Les décideurs, les populations et les partenaires sont sensibilisés

Activité 1.1.1: Organisation d'exposés-débats

Organisation d'exposés-débats à travers des réunions et la presse sur le contenu des différentes conventions.

Résultat 1.2: La documentation sur les différentes conventions sont disponibles et compréhensibles par le large public

Activité 1.2.1: Assurer une large diffusion des textes des conventions sous forme simplifiée, facile à comprendre et dans les principales langues locales

Résultat 1.3.: Un consensus sur les objectifs, le contenu des programmes d'action est obtenu avec l'ensemble des partenaires

Activité 1.3.1: Organiser des ateliers et séminaires sur les progammes d'action

Objectif 2: élaboration des programmes d'action nationaux sur les différentes conventions

Résultat 2.1: Programmes nationaux élaborés

Activité 2.1.1: Collecte des données de base

Ce travail sera confié soit à un bureau d'études, soit à un consultant, mais sous la supervision du SP/PANE à travers la cellule chargée du suivi des conventions.

Activité 2.1.2: élaboration des programmes dont les grandes lignes ont déjà été définies, soit par les fora, soit par les journées de sensibilisation. Cette tâche sera accomplie par un comité de rédaction.

Activité 2.1.3: Organiser des ateliers pour approuver les avants-projets de programmes.

Objectif 3: Assurer le suivi et l'évaluation des activités liées à la mise en oeuvre des conventions

Résultat 3.1: Mécanismes appropriés de suivi et d'évaluation des activités des différentes conventions disponibles et appliqués

Activité 3.1.1: Elaborer des mécanismes appropriés de suivi et d'évaluation

Activité 3.1.2: Elaborer des rapports périodiques sur l'état de mise en oeuvre des conventions

Objectif 4: Suivre la mise en oeuvre des conventions au plan international

Résultat 4.1: S'enquérir de l'expérience des autres pays en vue d'améliorer les mécanismes nationaux de mise en oeuvre et de suivi des conventions.

Activité 4.1.1: Rédaction et présentation des rapports nationaux aux réunions internationales conformément aux dispositions de suivi des conventions

COMPOSANTE 3: DEVELOPPEMENT DES COMPETENCES EN ENVIRONNEMENT

Objectif global

L'objectif de cette composante est de disposer des ressources humaines en qualité et en quantité suffisantes, à même d'assurer une gestion saine de l'environnement.

Objectif immédiat 1: Assurer une formation sur l'économie de l'environnement

Résultat 1.1: 10 à 15 cadres nationaux ont été formés en économie environnementale au cours des deux années

Activité 1.1.1: Organisation d'un atelier de formation de deux semaines sur l'économie environnementale, ciblée aux non-économistes, y compris cadres techniques et enseignants. L'appui d'un consultant ayant de solides connaissances en économie de l'environnement est indispensable.

Objectif immédiat 2: Introduire le concept environnement et développement durable à l'attention des communicateurs

Il s'agit de faire connaître aux communicateurs le concept de l'environnement et du développement durable; de susciter l'intérêt des journalistes à produire des articles, émissions, documents, documentaires, et outils de sensibilisation sur l'environnement; et de fournir aux communicateurs les compétences requises pour être des vrais acteurs de sensibilisation et d'information en matière d'environnement.

Résultat 2.1: 10 à 20 communicateurs ont reçu des notions de base sur le concept environnement et développement durable

Activité 2.1.1: Organisation d'un atelier de formation dans le domaine indiqué avec l'appui de personnes ressources

Objectif immédiat 3: Contribuer à la formation des étudiants en matière d'environnement

Résultat 3.1: 5 à 10 étudiants ont bénéficié de l'appui du SP/PANE pour améliorer leur connaissance dans des domaines spécifiques

Activité 3.1.1:

Il s'agit des formations de courte durée pour les futurs cadres en fin de cycle de formation à l'université dans les domaines liés à la gestion de l'environnement, tels les études d'impact, l'économie environnementale, le droit environnemental, le SIG, le développement rural intégré, ou autres sujets à la demande. Le projet propose apporter un appui pour une formation sous forme de stage ne dépassant pas 8 mois.

COMPOSANTE 5: APPUI AU SP/PANE

Il s'agit de doter le Secrétariat Permanent du PANE de moyens financiers et matériels pour lui permettre de fonctionner convenablement et de jouer son rôle de coordinateur. Ce fonds servira à organiser des réunions et ateliers thématiques de concertation, à produire et à ventiler divers documents, à engager du personnel contractuel (comptable, gardien et chauffeur), etc.

Appendix 9

Environmental Information System for mining

Mission

Devise a map production service within a national institution such as IGN in Burkina Faso, pertaining to environmental factors of interest like hydrology, rainfall, vegetation, wind.
The data inventories, presumably already available mainly at the University of Ouagadougou School of Sciences should be tapped into for pictoral interpretation purposes. The existing equipment at IGN seems adequate to satisfactorily perform the above requirement, once the right information is properly fed into it. The initial focus will relate to mining concerns right at the operations onset.

Tasks

A thorough project briefing and understanding will be carried out at both the University and IGN.
In each institution, a specific individual in charge of the project will be selected and be made aware of all involved parties expectations.
The project managers' roles will be defined and an assignment program will be established for the both of them, each one having his (her) own chronogram.
A daily follow up of data sorting out and gathering for processing, will be necessary to ensure

that we will be getting what has been initialy scheduled for.

A close monitoring of information beeing gradually processed after been supplied to the computer unit, will equally be needed.

Regular checks of the progress schedule for timely deliveries will be run in order to immediately correct discrepancies that may occur.

A regular contact will be maintained between the field operations in Ouagadougou and Boojum in Canada, for sound liaison dynamics.

An overall view will be kept on the project with the final goal being: obtaining the on time printed out map that has been ordered and is meeting the clients expectations.

Derived Actions

This project will be used to increase the awareness and the capacity of public institutions as profitable services providers

Links and interactions between several public and para statal organizations will be encouraged, while a productive synergy could be derived from ~~the~~ the water and electricity companies, the meteorological department, the remote Sensing Center

An opportunity for training to enhance skills and competences will be fostered as an asset in human resources development.

Mining companies participation will be highlighted as a contribution to bring out environmental concerns at large, which might be a strong bridge to lay for outreach prospects between the government and the private sector.

Needed Resources : Time, manpower, finances

Assumptions :
- All data are available, ready to be organized and processed into maps
- the equipements are in perfect order of working conditions
- the terms of references are agreed upon by everyone involved in the project
- the project zone is limited to the city of Ouagadougou

The estimated time is twelve (12) days at a daily fee rate of USD six hundred (600) plus expenses - the assignment will be entirely carried out by one coordinator.

14/07/95

Marguerite -

Here is the promised document.

Thanks for your interests -

Have a safe trip back home -

Abdoulaye

S. I. G. N. U. R

QU'EST-CE QUE C'EST ?

S.I.G.N.U.R., c'est le Système Intégré de Gestion et de Négoces pour l'Utilisation des Ressources.

OU LE TROUVER ?

Au 206, Avenue Tibo-Bernard OUEDRAOGO à Koulouba, secteur 4 en zone résidentielle de Ouagadougou.

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BURKINA FASO (Afrique Occidentale)
Téléphone : 30.71.49
Télex : 5409 - BF
Télécopie : (226) 33.44.08

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Le Système Intégré de Gestion et de Négoces pour l'Utilisation des Ressources est mis en place par une entreprise Burkinabè qui a pour champs d'action :

- le développement international : études et analyses de programmes socio-économiques, ainsi que leurs réalisations en milieu rural et urbain ;
- la promotion des investissements : mise en oeuvre et suivi d'opérations commerciales, industrielles et artisanales, soutenues par un service de représentation et d'ingénieurs conseils ;
- les relations publiques : contacts entre opérateurs économiques nationaux et internationaux, organisation de séjours, d'études et de prospection, animation de groupe de recherche et de réflexion.

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BURKINA FASO (West Africa)
Tél : 30 71 49 – Télex : 5409 BF
Fax : (226) 33 44 08

NOTE D'INFORMATION

S.I.G.N.U.R. est une entreprise individuelle burkinabè immatriculée au Registre du Commerce de Ouagadougou sous le nom d'Abdoulaye BARRY. Créée en 1986, elle a pour vocation de développer et de valoriser les ressources locales, tout en favorisant les échanges intra et internationaux des biens et services qu'elle fournit.

S.I.G.N.U.R. agit principalement dans les domaines de l'agriculture/élevage, de l'industrie, de l'artisanat et du commerce. Son champ d'action s'étend sur l'Afrique à partir du Burkina Faso. L'exportation de fruits et légumes, l'approche organisationnelle pour le déstockage du bétail sahélien, les conseils en investissement avec appui en relations publiques, les études de projets et l'analyse-évaluation de programmes de développement rural ont constitué la majeure partie de ses activités au cours de ses sept ans d'existence.

Constitué de Burkinabès et d'expatriés, les cadres de S.I.G.N.U.R. viennent d'horizons et de formations aussi divers que solides. Notre approche pluridisciplinaire et intégrée est possible grâce à la somme d'expérience que les uns et les autres ont acquis auparavant à travers le système des Nations Unis, la gestion de programmes d'assistance internationale, le secteur privé, et les formations de niveau supérieur respectives.

Sur le terrain, S.I.G.N.U.R. bénéficie de la confiance de ses partenaires. Des fonds aussi publics que privés lui ont déjà été alloués pour le montage et l'exécution de projets passés ou en cours. Des accords privilégiés de représentation et de travail existent entre la société et d'autres compagnies et institutions africaines, européennes et américaines. Tout est mis en oeuvre pour continuellement satisfaire notre clientèle qui se consolide davantage et progressivement.

Nous sommes pour la coopération et le partenariat Nord-Sud qui, comme cela se constate chaque jour, passe nécessairement par le développement des rapports-échanges Sud-Sud... "La gestion de l'efficacité" nous l'impose à **S.I.G.N.U.R.** !

Décembre 1993

LISTE D'EXEMPLE DE REFERENTIELS

1. Exportation et commercialisation au sein de la CEE des haricots verts, de la mangue et de la papaye du Burkina.

2. Tests de marché de confitures exotiques de la CDEAO en Europe.

3. Etude de mise en place d'une centrale urbaine d'achat, de traitement et de distribution des produits agricoles et d'élevage.

4. Importation de semences de pomme de terre des Pays-Bas avec essais variétaux au Sahel.

5. Etude de factibilité pour la restructuration de la Société Industrielle du Polyster (SIP) à Ouagadougou.

6. Exploitation d'unité semi-industrielle de production de beurre à partir d'amande de karité du Burkina.

7. Assistance pendant trois ans, à la gestion du contrat d'exécution du groupement Voith-Thyssen dans le montage des turbines et de la Vantellerie au sein du projet de barrage hydro-électrique et agricole de la Kompienga.

8. Conception et élaboration de la banque de projets de l'Agence d'Exécution des Travaux d'Intérêt Publics à Haute Intensité de main d'Oeuvre au Burkina, sur financement Banque Mondiale dans le cadre des mesures d'accompagnement du programme d'Ajustement structurel.

9. Assistance à la détermination des actions à entreprendre et des opérations à réaliser pour le compte du projet "Forêt et Sécurité Alimentaire en zone Sahélienne" de la FAO.

10. Représentation du groupe EIFFEL-CMS Ingénieurs dans le cadre du financement et de la réalisation du barrage hydro-électrique et hydro-agricole de Bagré, pour le lot hydro-mécanique.

11. Gestion de la partie nationale de l'expertise sollicitée pour le contrat cadre PASA/SATEC-SIES sur financement FED au Burkina pour des études telles que :

    - Etude d'Identification pour un Programme d'Appui du FED au sous-secteur céréalier.

    - Rapport de synthèse pour la mise en oeuvre d'un Programme d'Appui FED au Secteur de l'Elevage au Burkina Faso.

    - Etude pour un Programme d'Appui à la Filière Maïs

    - Etude de la Création d'une Filière Lait

    - Programme d'Appui Technique et Financier aux Institutions Financières Décentralisées.

- Etude de Faisabilité d'un Programme d'Appui au Stockage Villageois dans les zones alimentaires déficitaires du Burkina Faso.

- Etude d'un Programme de Recherche Développement dans le secteur Elevage burkinabè.

- Etude de Faisabilité pour l'Elaboration dans le cadre du Programme d'Ajustement Sectoriel Agricole d'un plan National d'Intervention en Situation de Crise Alimentaire et l'Appui à l'Institution Nationale chargée de sa mise en oeuvre

- Etude et Concertation avec les Organisations Paysannes sur les Besoins d'Appui au Monde Rural

12. Analyse des goulots d'étranglement à la consommation des crédits sur requête de la Banque Mondiale.

13. Assistance à la formation pour la gestion privée des unités de forages à l'échelle villageoise.

14. Formation des formateurs en gestion des programmes de développement rural.

15. Interventions auprès d'instituts internationaux de recherches et développement.

16. Programme privé de développement des bases de l'export entre régions africaines d'une part et entre l'Afrique et les autres continents d'autres parts.

17. Approche analytique de la promotion du cheptel sahélien sur les marchés du Moyen Orient : exemple de la possibilité de substitution du mouton bali-bali au bétail australien dans les pays arabes du Golfe.

18. Etude de faisabilité d'une minoterie de maïs dans le Sourou.

Abdoulaye M. Barry

01 B.P. 525
Ouagadougou 01, Burkina Faso
West Africa
Tel: 30-71-49
Fax: (226) 33 44 08

EDUCATION

1980-1981	Purdue University, West Lafayette, Indiana, USA. Graduate course work in Agricultural Economics and Botany.
1978-1980	Purdue University, West Lafayette, Indiana, USA. B.S. in International Agronomy. Course work in Cooperative Development, International Trade and Marketing of Agricultural Products.
1976-1977	Université de Ouagadougou, Burkina Faso, West Africa. Course work in Arts and Humanities.
1971-1972	Legon University, Accra, Ghana, West Africa. Course work in Languages and Economics.

WORK EXPERIENCE

1986-Present	Set up and management of own business. Head of a core staff of 4 people, involved in investments promotion ventures, international development projects and public relations outreach programs. The company, Système Intégré de Gestion et de Négoces pour l'Utilisation des Ressources (SIGNUR), is incorporated in Ouagadougou, Burkina Faso with activities mainly in West Africa and partners in Europe and the USA.
1985-1986	Director of Partnership for Productivity (PFP)/Ethiopian Program. PFP was a U.S. private voluntary organization involved in drought relief and agricultural rehabilitation efforts in Ethiopia with emphasis on seed projects designed for the Wello and Tigray provinces. Performed the duties of PFP field representative in Addis Ababa.
1984-1985	Free lance Consultant: - design of an integrated rural development macro project in northern Burkina Faso, sponsored by World Vision International.

- Design and implementation of a seed bank program in the Sahel for the Federation of Evangelical Churches and Missions of Burkina Faso (FEME). Technical Advisor to the Executive Secretary of the FEME Development Projects Office, while managing the seed bank project.

- Member of the Permanent Secretariat of Non Governmental Organisations (SPONG) survey team on the drought efforts in Burkina Faso.

- Participant in the international organizations (USAID, EEC, UNICEF, World Food Program, French and German bilateral aid, Save the Children, The Red Cross, Catholic Relief Services, Caritas) regular information exchanges on drought monitoring and coordination of strategies for relief and development at the national level.

- Development of marketing research for Minnesota fiber fuels export venture, under the auspices of the Duluth Port Authority. Renewable sources of energy programs in the West Indies with Haiti and Jamaica as primary target countries.

- Technical assistance to Partnership for Productivity and America's Development Foundation in the preparation of a project proposal regarding the organization of local seed banks in drought affected regions of Ethiopia, Sudan, Mali and Burkina Faso.

1982-1984 Projects Director, Dori Impact Area (SCF/FDC Burkina Faso). In charge of a grass roots integrated development program undertaken in the Sahel by the Burkina Faso Field Office of Save the Children/Fondation de Développement Communautaire-USA.

Responsibilities involved directing, coordinating and supervising five key operational sectors (agriculture/environment, education, health/nutrition, productivity and sponsorship) throughout the Dori district in northern Burkina Faso. Primary tasks encompassed village level activities, overall administrative, personnel and financial management, liaison with other private volunteer organizations, donors and government agencies.

Programming duties consisted of projects identification, implementation, monitoring and evaluation, which required extensive field trips and constant presence on the project sites.

Concurrently with the Projects Director's duties, filled out the Agriculture/Environment sector coordinator's position with direct involvement in cereal banks construction, grain marketing strategies, village gardens and reforestation activities, dissemination of semi-arid land technology, communal farms and cereal production. Supervised a staff of twenty people from a central office in Dori and across a fifty kilometer radius operational impact area.

Executive Secretary of "SAHEL 84", a consortium of six non governmental organizations active in the Seno Province. "SAHEL 84" was created to face that year's famine and drought situation in the Province; it served as a coordinating and implementation body in the relief efforts with programs for seed rehabilitation, livestock rescue and water retention. My tasks for "SAHEL 84" were performed on a voluntary basis, in addition to my SCF/FDC functions above.

1981-1982 Assistant Projects Development Officer, USAID/Burkina Faso. Primary responsibility was to serve as Assistant to the Capital Projects Design Officer. Chief duties included:

- Analytical review of proposals for project activities coming from AID/Washington, the Burkina Faso Government and other agencies in Burkina Faso.

- Assisted in the preparation of design documents (projects identification papers, discussions with government officials and consultants on projects design, travelling alone or with design teams to the field, project paper write-up, verification of required budget and tabular data etc.).

- Assisted in the overall operations of the Program Office functions relating to project design and evaluation, such as preparing and clearing of project implementation orders, maintaining design records and files, preparing French language correspondence, scheduling meetings and logistics, participating in the analysis of the Country Development Strategy Statement and the Annual Budget Submission.

1978-1981 Student employment, Purdue University, USA.: farm helper, laboratory assistant (small grains), interpreter-translator, tutor, etc.

1976-1977 Program specialist, USAID Seed Multiplication Project. Coordination between the government of Burkina Faso, USAID and private firms for the implementation of the first seed program in the country (seed laboratory construction, equipment installation, seed production and distribution). In charge of logistics.

Transferred to the International Institute of Tropical Agriculture (IITA/Ibadan, Nigeria) to help establish a five month intensive training program for four Sahelian countries (Mali, Senegal, Chad and Burkina Faso) in seed multiplication and crop production.

1975-1976 Free Lance Consultant. Market development for import and export transactions between inland and coastal countries of West Africa. Participant in various trade fairs on the African continent. Feasibility studies for small local projects and enterprises.

1974-1975 Sales Manager, SCOA Motor Company (La Société Commerciale de l'Ouest Africain). SCOA was the national dealer for Volkswagen, Mitsubishi, Ford and Berliet automobiles in Burkina Faso, with its headquarters in Paris. Was responsible for import, customs clearance and marketing strategy of new cars and trucks. As Department Head, supervised six employees.

1972-1974 Assistant Traffic Manager, Lang Afrique in Abidjan, Ivory Coast. (Overseas branch of Lang Engineering Corporation, Coral Gables, Florida). Responsible for the air freight division of a sixty million dollar sugar complex (cane plantation and refinery) funded through a US loan to the Ivory Coast. Involved in the sea freight handling division also. Carried out public relations duties concurrently with other functions.

-o- CURRICULUM VITAE -o-

NOM ET PRENOMS : SAWADOGO Ousmane

DATE ET LIEU DE NAISSANCE : 1956 à Konéan Province du Sanmatenga (BURKINA FASO)

NUMERO MATRICULE : 23.416

SITUATION MATRIMONIALE : Marié, Deux (2) enfants

FONCTION : Navigateur de Prise de Vues depuis le 1er/11/1980

Heures de vol pour travaux photos aériennes : 830 heures

EXPERIENCES PROFESSIONNELLES

Depuis 1980 à l'Institut Géographique du BURKINA (I.G.B) comme Navigateur de Prise de Vues aériennes et participé aux projets importants suivants :

- Couverture générale du BURKINA FASO à l'échelle 1/50.000è ;
- Couverture photographique du BURKINA à l'échelle 1/50.000è pour le projet : BID/BURKINA (Bassin des fleuves) ;
- Couverture photographique en MAURITANIE (périmètre de M'BOUT pour le compte de SETAM CONSULT (FRANCE) ;
- Couverture photographique BURKINA-TOGO-BENIN pour le compte de l'OMS/ONCHO à l'échelle 1/50.000è ;
- Couverture photographique au TOGO pour le compte de TECHNOSYNESIS (LOME) ;
- Couverture photographique urbaine pour le compte de la DGUTC (Direction Générale de l'Urbanisme, de la Topographie et du Cadastre) -OUAGADOUGOU ; à l'échelle 1/10.000è
- Couverture photographique au BURKINA pour le compte du P.N.G.T. (Programme National pour la Gestion des Terroirs) au 1/20.000è et 1/50.000è ;
- Couverture photographique pour le compte du projet PNUD/BKF/93/003 au 1/20.000è ;
- Couverture photographique pour le compte du projet de cartographie du Sud-Ouest du BURKINA aux échelles 1/50.000è ; 1/20.000è et 1/10.000è.

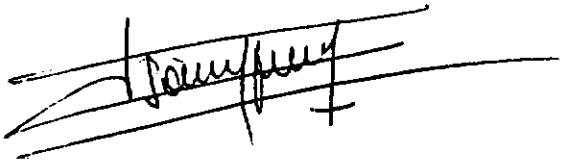
COUVERTURE PHOTOGRAPHIQUE AU NIGER

- Ville de NIAMEY 1/3.000 - 1/4.000 - 1/50.000,
- Région de Gaya (Roneraies) au 1/20.000,
- Ville de Tilabery - Birni N'Koni - Tessaoua - Mirriah - Diffa au 1/20.000è,
- Arrondissement de SAY au 1/20.000 pour le compte ENERGIE II,
- Département de TAHOUA au 1/50.000 pour le compte G.T.Z,
- Ville de TAHOUA au 1/8.000 pour le compte G.T.Z,
- Projet TARKA au 1/20.000 pour le compte INGENIGER,
- Projet Keita au 1/20.000 pour compte ENGENIGER.

DIVERS PROJETS POUR LES BUTS SUIVANTS :

- Couvert végétal,
- Aménagements hydro-agricoles,
- Ligne de force (H.T)
- Tracé de route
- Etude minière et points d'eau, etc...

OUAGADOUGOU, le 23 Janvier 1995



SAWADOGO Ousmane

Appendix 10

ENVIRONMENTAL PROCEDURES OF INTERNATIONAL ORGANIZATIONS: A PRELIMINARY EVALUATION

Madhu Malik
Purdue University

Abstract. This paper undertakes an analysis and evaluation of official environmental review procedures published by three international organizations—the United Nations Environment Programme (UNEP), the World Bank, and the United Nations Development Programme (UNDP). I assess the extent to which these procedures provide explicit and adequate guidance to policymakers in fostering greater awareness and consideration of environmental factors in developmental planning and decisionmaking. I analyze and evaluate the content of these procedures using criteria pertaining to various analytic functions involved in environmental review. The analysis and evaluation indicates that the environmental review procedures used by these organizations are minimally adequate in integrating environmental concerns into the planning, approval, and implementation of proposed developmental activity. These procedures also contain a surprising amount of detailed and specific information and guidance which should enhance their usefulness to their users.

INTRODUCTION

Although the nexus between environment and development is well recognized, as evidenced by the growing popularity of the concept of sustainable development, the task of integrating environmental considerations into developmental planning and decisionmaking has not been easy, particularly for international organizations. In their efforts to promote development and other policies that are environmentally sound and sustainable in the long term, many international organizations are faced with conflicting and contradictory demands and expectations. Many of the existing organizations and policies in the area of environment and development were established on the basis of narrow mandates and concerns, and they tend to be independent and fragmented. Environmental and developmental responsibilities are not concentrated in a few institutions but are separated and spread around several institutions. For instance, the United Nations Environment Programme (UNEP) was created primarily for coordinating the environmental activities of the United Nations system, while the United Nations Development Programme (UNDP) has been, and continues to be, engaged primarily in developmental activities and programs.

Furthermore, organizations that are primarily financial, developmental, or agricultural are now expected to be aware of and integrate environmental considerations into planning and decisionmaking. Although neither exclusively environmental nor developmental, international organizations such as the Food and Agriculture Organization (FAO), the World Health Organization (WHO), and the World Meteorological Organization (WMO), for example, have environmental and developmental responsibilities in addition to their primary concerns (Nikitina and Soroos, 1995). Also, existing institutions and policies on environment and development have tended to focus largely upon after-the-fact repair of damage, because many of them are directed at the symptoms of harmful growth and development, rather than the sources (WCED, 1987: 9).

Thus, there is a serious need for greater coordination and cooperation among international organizations concerned with environmental protection and sustainable development, particularly in sharing resources and knowledge and avoiding duplication and waste. There is an even greater need for these organizations to undergo institutional reforms such that their policies and mechanisms are better able to prevent damage to the environment before it occurs and they are able to design programs and policies that undertake developmental activity that is sustainable in the future as well as environmentally sound. In other words, it is imperative that international organizations "learn to think" ecologically (Taylor, 1984).

International organizations—developmental, environmental, and financial—have begun to adopt procedures that anticipate and prevent environmental damage from development and other projects and policies. In order to accomplish this, they have begun to consider the ecological dimension of policies and actions during the planning, approval, and implementation stages. In many cases, such changes have required policymakers within international organizations to assess the potential impacts of new technologies before they are widely used in order to ensure that their production, use, and disposal do not harm or degrade environmental resources (Le Prestre, 1995). In other words, international organizations have begun to reorient their policies and decisionmaking processes by integrating economic and ecological considerations in decisionmaking, by placing greater focus on the sources of environmental problems as well as their effects, and by integrating production with resource conservation. Thus,

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international organizations are undertaking institutional changes as part of the process of organizational "learning" (Bartlett et al., 1995).

Some international organizations have published procedures and guidelines for integrating environmental considerations into developmental decisionmaking through a variety of processes ranging from environmental impact assessment (EIA) to environmental assessment (EA) to environmental management (EM). These procedures and guidelines vary tremendously in terms of content, substance, and length, with some being sophisticated and detailed, while others are general and brief. Since the procedures published by international organizations are utilized and implemented by policymakers within various countries with differing economic and political systems, different levels of development, and different historical experiences, they are of necessity general and, in some cases, ambiguous.

There is, as of yet, no standard framework by which to evaluate the ability of these environmental review procedures of international organizations to integrate environmental considerations adequately into development planning and decisionmaking. There is, however, a need to evaluate such procedures, particularly as more and more international organizations are developing and integrating them into their day-do-day activities and operations.

It is important to clarify here that the focus of this research is limited to an evaluation of the policy design; in other words, this research focuses on the environmental review procedures and not on the environmental review processes that these procedures prescribe. Ultimately, however, it is the way policymakers and project managers use these procedures in conducting environmental review processes, such as EIA, that will determine the extent to which international organizations are able to integrate environmental considerations effectively into planning and decisionmaking. Thus, it is incumbent upon international organizations to design and create procedures that provide meaningful and useful guidance to their users such that they have the potential to integrate environment and development effectively in decisionmaking.

Thus, I assess here whether the environmental review procedures used by international organizations provide explicit and adequate guidance to policymakers in fostering greater awareness and consideration of environmental factors in developmental planning and decisionmaking. Such an assessment is useful for improving policy design by identifying possible amendments and improvements to these procedures in the future. The analysis and evaluation focuses primarily on the environmental review procedures published and used by three international organizations: UNEP, the World Bank, and UNDP.

METHOD OF ANALYSIS

Over the last two decades, the practice of environmental review has extended to international governmental and nongovernmental organizations and has resulted in the publication of a variety of guidelines and procedures for ensuring the consideration of environmental concerns in developmental planning and decisionmaking (Table 1).

Although the environmental procedures contained in these documents vary in length, in the extent of detailed guidance provided to policymakers, and in their specificity, the fundamental objectives of all these procedures are essentially the same: to create greater awareness of the environmental effects of development activity and to foster greater consideration of these effects throughout planning and decisionmaking. I assess here, by analysis and evaluation of the environmental procedures created and published by international organizations, the extent to which policymakers and project managers using these guidelines have the potential to realize any of these objectives.

At this early stage of the research, it is more useful to analyze environmental procedures that are general in scope and that can be applied to programs and projects of different scale and type, rather than procedures that are more specific to certain types of developmental activity and projects. Thus, the analysis here is limited to those international organizations that have developed general guidelines for integrating environmental awareness and considerations into all types of development activity. Environmental procedures of several international organizations met this requirement (Table 1); of these, I have selected for analysis and evaluation the environmental procedures of UNEP, the World Bank, and UNDP for the following reasons.

First, they represent international organizations engaged in environmental, financial, and developmental activity, respectively, and they also represent collectively, through their partnership in the Global Environmental Facility, international organizations concerned with forging a nexus between environment and development. Second, each organization uses a different type of environmental review process—EIA, EA, and EM, respectively—and, therefore, they provide a spectrum and variety of environmental processes for analysis and evaluation.

The analysis is further limited to these three organizations' procedures for integrating environmental concerns into development decisionmaking only, including any procedures that might be supplementary or reinforcing. For this study, the analysis of environmental procedures was restricted to the following: (1)UNEP's *Environmental Impact Assessment: Basic Procedures for Developing Countries* (1988) in its entirety; (2)Chapter 1 of the World Bank's *Environmental*

Assessment Sourcebook (1991), which summarizes the bank's EA requirements and identifies the environmental review process; and (3)Part II of UNDP's *Handbook and Guidelines for Environmental Management and Sustainable Development*, which consists of the operational guidelines for environmental management (1992).

CHARACTERIZATION OF INTERNATIONAL ORGANIZATIONS

In recent years, international organizations have made considerable progress in strengthening and clarifying the relationship between environment and development by raising public awareness (D'Anieri, 1995; Downie, 1995), through

Table 1. Techniques of Environmental Protection in Environmental Decisionmaking

1. Antarctic Treaty, Protocol on Environmental Protection (see 9.A), Art. 8 and Annex I—Environmental Impact Assessment Procedures (21 June 1991).
2. EEC Council Directive: Assessment of the Effects of Certain Public and Private Projects on the Environment (27 June 1985).
3. Espoo (Finland) Convention on Environmental Impact Assessment in a Transboundary Context, ECE (25 February 1991).
4. FAO: Comparative Legal Study on Environmental Impact Assessment and Agricultural Development (1982).
5. FAO's Procedures for Environmental Impact Assessment.
6. FINNIDA's Guidelines for Environmental Impact Assessment.
7. The Netherlands' Environmental Impact Assessment in Development Cooperation.
8. NORAD's Environmental Impact Assessment of Development Aid Projects.
9. OECD Council Recommendation: Analysis of the Environmental Consequences of Significant Public and Private Projects (14 November 1974).
10. OECD Council Recommendation: Assessment of Potential Environmental Effects of Chemicals (14 November 1974).
11. OECD Council Recommendation: Assessment of Projects with Significant Impact on the Environment (8 May 1979).
12. OECD Council Recommendation: Environmental Assessment of Development Assistance Projects and Programmes (20 June 1985).
13. OECD's Development Assistance Committee Guidelines on Environment and Aid.
14. UNDP's Handbook and Guidelines for Environmental Management and Sustainable Development (February 1992).
15. UNEP Governing Council Decision: Goals and Principles of Environmental Impact Assessment (17 June 1987).
16. UNEP's Environmental Impact Assessment: Basic Procedures for Developing Countries (1988).
17. UNIDO Environmental Appraisal Guidelines for Category A Projects.
18. UNIDO Environmental Appraisal Guidelines for Category B Projects.
19. U.S. Agency for International Development (USAID): Environmental Procedures (30 June 1976).
20. Wellington Convention on the Regulation of Antarctic Mineral Resources Activities (Arts. 4, 37[7][d]-[e], 39[2][c], 54[3][b]) (2 June 1988).
21. World Bank: Operational Directive "Environmental Assessment" (November 1989).

Source: Weiss et al., 1991: 120-21; UNDP, 1992: 46-48.

monitoring and research, by enhancing scientific and technical knowledge and understanding of the issues (Nikitina and Soroos, 1995), and by developing environmental laws that have encouraged innovative and new control technologies (WCED, 1987). Many international organizations have also made moderate to serious efforts to enhance their own institutional capacity and reorganize their organizational structures to better integrate environmental concerns into developmental planning and decisionmaking. Three such international organizations are UNEP, the World Bank, and UNDP. Each of these organizations has developed guidelines and procedures for integrating environment and development in policy formulation, program planning, and project implementation.

The United Nations Environment Programme (UNEP)

During the past 20 years, members of UNEP's Governing Council have urged UNEP to help clarify the linkages between development and the environment. The council believed that such clarification would help integrate issues of environmental and resource management concern into the framework of economic decisionmaking and thus provide a basis for long-term and sustainable development (Ahmad et al., 1989). The Brundtland Commission, too, identified several ways in which UNEP could be better adapted to addressing issues of sustainable development: reinforcing and extending its catalytic and coordinating role and strengthening its role as the principal source on environmental data, assessment, and reporting, as well as in developing, testing, and applying practical methodologies for environmental assessment at project and national levels (WCED, 1987: 320). Agenda 21 on sustainable development asks UNEP specifically, in paragraph 38.22(c), to concentrate on the following:

> further development and promotion of the widest possible use of environmental impact assessments, including activities carried out under the auspices of United Nations specialized agencies, and in connection with every significant economic development project or activity. (UNEP, 1992: 3)

In response to these mandates, UNEP is increasingly geared toward enhancing its scientific and technological capacity to better meet the changing demands and requirements for sustainable development in the developing world. Accordingly, UNEP has undertaken initiatives in developing principles and guidelines for EIA at the national, regional, and international levels. In June 1987, UNEP adopted a set of goals and principles on EIA (UNEP, 1987). These goals and principles on EIA were of necessity of the most basic and essential nature, since they were to be applied in countries with varying experience, traditions, legal systems, level of economic development, and availability of trained personnel. They were also of a recommendation nature and were designed to form the basis of national legislation and for bilateral and regional agreements. Together, the goals and principles were intended to identify the precepts essential to effective EIA. Then UNEP went on to formulate these goals and principles into a set of EIA guidelines and procedures for developing countries as they undertook major development projects (UNEP, 1988).

The World Bank

It was not until the late 1980s, with mounting pressure from the G7 Summit, industrialized countries, and nongovernmental organizations (NGOs), that the World Bank acknowledged the need to integrate environmental concerns into its development planning and implementation. Once it did recognize the growing threat of environmental degradation, however, it embarked on a serious campaign of adaptation and learning. The bank began a major program of reorienting its institutional and managerial capabilities toward greater environmental concerns. It reordered its policy priorities and lending operations and revised its management practices and organization structures (Le Prestre, 1989, 1995).

In keeping with this reorientation, the bank undertook several institutional reforms and developments. First, it created an Environment Department in its Policy, Research, and External Affairs complex to carry out the policy priorities and lending operations with the new attention to environmentally sustainable development. The bank also installed four Environment Divisions in the Technical Department of each regional complex to carry out "day-to-day responsibility for ensuring the environmental quality of Bank operations" (Hirono, 1993; Le Prestre, 1995). Other developments undertaken by the bank to integrate environmental concerns into its day-to-day operations include the following: (1)creation of the Consultant Trust Fund for the Environment (CTFE) in 1989, (2)publishing country-specific environmental issue papers and regional analysis papers focusing on specific environmental problems, (3)assisting in the formulation of formal National Environmental Policy Plans (Hirono, 1993), and (4)sponsoring national and international training workshops on environmental assessment (Goodland, 1991: 812).

The key component of the bank's process of learning was its program on environmental assessment, which was to occur both at the project and policy levels. Project managers were required to integrate environmental considerations early into all lending decisions, and environmental issues were to be addressed within the framework of national policies as well (Le Prestre, 1995). The bank's Environment Department published in 1991 an *Environmental Assessment Sourcebook* designed to assist all those people involved in environmental assessment, whether in the bank or outside, by offering practical guidance for designing sustainable development projects (World Bank, 1991). It serves as a reference manual for all those involved in environmental assessment and contains information on the environmental assessment process as required by the World Bank's Operational Directive on EA (OD 4.00 Annex A, October 1989).

In sum, then, the Environment Department of the bank has begun to make progress toward integrating environmental concerns into developmental planning and decisionmaking, primarily due to rigorous analysis of the environmental aspects of policy formulation and research and in the preparation of environmental assessment guidelines. To the extent that it has been able to achieve these objectives, the bank has demonstrated a capacity to "learn." Nonetheless, many people and many NGOs are not very impressed by the organizational changes, institutional restructuring, and environmental guidance undertaken by the bank. The jury is still out on whether such changes constitute meaningful "learning" by the bank and whether they will improve the environmental performance of the bank in the long term.

The United Nations Development Programme (UNDP)

Although UNDP primarily has a mandate for promoting economic development in developing countries, it has maintained a high level of environmental awareness in its developmental activities. Over the years, UNDP has supported and funded activities that promote sustainable development. This organization is uniquely qualified to identify and operate projects oriented toward environmentally sustainable development. It is increasingly reoriented toward assisting developing countries to enhance their own human resources and institutional capacity to promote sustainable development. Through its Environmental Strategy and Action Plan, UNDP has enhanced the institutional and managerial ability of developing countries to formulate and implement policies that promote sustainable development by assisting them with the transfer of environmental technology (Hirono, 1993).

Although UNDP has undertaken significant projects and activities in promoting sustainable development under its own initiative, it has also worked closely with other international organizations, particularly in financing environmentally sound and sustainable development projects. The Global Environmental Facility, set up in 1990 under the auspices of the World Bank, UNEP, and UNDP, serves "to provide grants to developing countries to help them finance projects designed to reduce global warming, protect international waters, preserve biological diversity and prevent depletion of the earth's ozone layer" (Hirono, 1993).

A more recent mechanism by UNDP to integrate environmental concerns into developmental planning includes the UNDP Guidelines for Environmental Management and Sustainable Development, which were issued in 1990. "The handbook and guidelines will enable UNDP staff and government officials to incorporate the principles of environmental management and sustainable development into their daily activities, particularly in their efforts to promote a sustainable, equitable and participatory development process" (UNDP, 1992). These environmental guidelines emphasize the need to find alternative solutions to project implementation, thereby going beyond problem identification and environmental assessment.

ANALYSIS

Although there has been no prior evaluation of environmental review procedures used by international organizations, evaluations of environmental procedures used by U.S. federal agencies are not uncommon (Warner and Preston, 1973; Smith, 1974; Keys and Bartlett, 1983; Malik and Bartlett, 1993). Therefore, I adopted and derived a list of criteria for evaluating the environmental procedures of international organizations from these previous studies and evaluations of EIA methodologies (Warner and Preston, 1973; Smith, 1974), with some additions of my own. All of the criteria pertain to various analytic functions associated with the consideration of environmental concerns in planning and decisionmaking: identification, measurement, interpretation, communication, resource requirements, and flexibility (Table 2). I formulated the criteria as questions and sought answers to each of the questions for the environmental procedures published by UNEP, the World Bank, and UNDP, respectively.

Characterization of Procedures

The primary purpose of this evaluation is to determine whether the environmental procedures of UNEP, the World Bank, and UNDP are minimally adequate in integrating environmental considerations into development decisionmaking. This does not, however, preclude the need for a higher standard in determining whether these environmental procedures are adequate. Each criterion was rated on a 1-0 scale. Criteria that were clearly met in the organization's environmental procedures, however minimally, were coded as yes (yes = 1); those that were not met by an agency's procedures received a rating of 0 (no = 0). For instance, environmental procedures for all three organizations prescribe processes that address a full range of impacts of the proposed development project, including environmental, health, social, economic, and cultural. Hence, all agencies receive a rating of 1 for the criterion of comprehensiveness.

The results of the content evaluation of the three organizations' environmental procedures, using 27 criteria for evaluating their ability to integrate environment and development adequately in decisionmaking, are summarized in Table 3. The columns present the data for each organization whose procedures were examined, and the column totals provide the total rating of each organization, indicating the number of criteria, up to a possible maximum of 27, met by its environmental procedures. Each set of environmental procedures was examined at least two times as a check on reliability.

An examination of the column totals for each of the three organizations indicates that they all met at least two thirds of the 27 criteria, with UNEP and the World Bank meeting 23 each and UNDP meeting 20. These figures indicate that in most respects the environmental procedures of all three organizations seem to be minimally adequate for integrating environmental awareness and considerations into developmental planning and decisionmaking—most of the criteria

Table 2. Criteria for Evaluating Environmental Processes

Criteria	Questions
A. For Impact Identification	
1. Comprehensiveness	Does the process address a full range of impacts?
2. Specificity	Are specific environmental parameters identified?
3. Isolate project impacts	Does the process suggest ways of identifying project impacts?
4. Timing*	Does the process suggest examining impacts in the early stages of planning?
5. Data sources	Does the process require identification of data sources?
B. For Impact Measurement	
6. Explicit indicators	Does the process suggest specific measurable indicators for impact quantification?
7. Magnitude	Does the process require determination of impact magnitude?
C. For Impact Interpretation	
8. Significance	Does the process require an assessment of significance on a local, regional, and national scale?
9. Explicit criteria	Does the process require that the criteria and assumptions in significance determination be stated?
10. Uncertainty	Does the process address uncertainty or the degree of confidence in impact projections?
11. Risk	Does the process focus on impacts of low probability of occurrence but high potential damage?
12. Mitigation*	Does the process identify a range of measures to mitigate adverse impacts?
13. Cost*	Does the process identify the costs of mitigating adverse impacts?
14. Alternatives comparison	Does the process provide a way of comparing alternatives?
15. Selection*	Does the process suggest ways of selecting between alternatives and identifying a plan of action?
16. Public involvement	Does the process provide a way for public input in the interpretation of impact significance?
D. For Impact Communication	
17. Affected parties	Does the process link impacts to affected human groups?
18. Setting description	Does the process require a description of the environmental setting?
19. Summary format	Does the process contain a suggested summary format?
20. Key issues	Does the process suggest a way of highlighting key impacts or issues?
E. Resource Requirements	
21. Data requirements	Does the process use current data, or are special studies required?
22. Manpower requirements	Are special skills required?
23. Time requirements	How much time is needed to implement the process?
24. Costs	What are the costs of using the process?
25. Technologies	Are special technologies required?
F. Flexibility	
26. Scale flexibility	Does the process apply to projects of different size or scale?
27. Range	Does the process apply to projects of different types?

* These criteria were added by the author; the rest of the criteria are derived and adapted from Warner and Preston, 1973.

Table 3. Indicators of Adequacy

Criteria	UNEP	World Bank	UNDP
A. For Impact Identification			
1. Comprehensiveness	1	1	1
2. Specificity	1	1	1
3. Isolate project impacts	1	1	0
4. Timing	1	1	1
5. Data sources	0	1	0
B. For Impact Measurement			
6. Explicit indicators	1	0	0
7. Magnitude	1	1	0
C. For Impact Interpretation			
8. Significance	1	1	1
9. Explicit criteria	1	1	1
10. Uncertainty	1	1	1
11. Risk	0	0	0
12. Mitigation	1	1	1
13. Cost	1	1	0
14. Alternatives comparison	1	1	1
15. Selection	1	0	1
16. Public involvement	1	1	1
D. For Impact Communication			
17. Affected parties	1	1	1
18. Setting description	1	1	1
19. Summary format	1	1	1
20. Key issues	1	1	1
E. Resource Requirements			
21. Data requirements	1	1	1
22. Manpower requirements	1	1	1
23. Time requirements	1	1	1
24. Costs	1	1	1
25. Technologies	0	0	0
F. Flexibility			
26. Scale flexibility	0	1	1
27. Range	1	1	1
Totals	23	23	20

are met, if in some cases only barely. The number of criteria met by each organization's procedures, however, only provides a crude measure of adequacy. This measure is not an interval or even ordinal measure of adequacy, nor are these the only appropriate criteria, nor are all of equal importance. Summary figures do, nonetheless, hint at overall strengths and weaknesses of these organizations' environmental procedures.

The environmental procedures of both UNEP and the World Bank rated well in impact identification and impact measurement, missing one criteria each, while UNDP's procedures did not perform as well and failed to meet four criteria. In order to improve their performance, both UNEP's and UNDP's procedures need to require identification of data sources when identifying the potential impacts of proposed developmental projects and activities. Both the World Bank's and UNDP's procedures need to develop specific measurable indicators for quantifying the impacts, both positive and negative, of proposed developmental projects. In addition, UNDP's procedures need to provide for ways of identifying potential impacts of proposed projects; only then will its environmental review process be able adequately to measure and quantify impacts and determine their magnitude.

The environmental procedures of all three organizations rated highly with respect to the functions associated with impact interpretation. All three procedures seem to be adequate in determining whether environmental impacts are significant and in identifying the criteria and assumptions used in such a determination. While all three procedures address the problem of uncertainty in impact identification and measurement, none of them focus on the issue of risk, that is, on impacts of low probability of occurrence but high potential damage.

All three sets of procedures identify a range of measures for mitigating potential adverse environmental impacts of proposed developmental activity; they all identify ways of comparing among various alternatives for mitigation; and they all provide a variety of ways of getting the public involved in the environmental review process. The procedures of UNDP need to identify the costs of the various alternatives for mitigating adverse impacts in order to ensure a complete comparison of alternatives. In addition, the World Bank's procedures need to clarify the process by which project managers and the concerned policymakers select among alternatives and design an appropriate plan of action.

All three sets of environmental procedures met all the criteria pertaining to impact communication and all but one pertaining to resource requirements. Although the document or format used by each type of environmental process to communicate impacts of proposed developmental projects differs in length, emphasis, and specificity, all three processes, nonetheless, linked impacts to affected human groups, required a description of the environmental setting, provided a

summary format, and highlighted key impacts and issues. With the exception of requiring special technologies for the environmental review process, which none of the organizations required, all three procedures provide for or address the need for data, skilled manpower, a realistic timetable and schedule, and financial resources in order to conduct the EIA, EA, and EM processes efficiently and adequately.

Finally, although UNEP's EIA procedures apply only to major development projects, such as building a hydroelectric dam or developing a harbor, the World Bank's EA procedures and UNDP's EM procedures are applicable for development projects of different scale and size. The procedures of all three organizations apply to development projects of different types, ranging from forestry and fishery to industrial and agricultural.

DISCUSSION AND CONCLUSIONS

Do the environmental procedures of all three international organizations—UNEP, the World Bank, and UNDP—provide adequate guidance for integrating environmental awareness and considerations into developmental planning and decisionmaking? The preceding analysis indicates that the various environmental review procedures used by these organizations are minimally adequate in integrating environmental concerns into the planning, approval, and implementation of proposed developmental activity. Despite the fact that environmental procedures published by international organizations are of necessity general and, in some places, ambiguous, the environmental procedures of these three international organizations contain a surprising amount of detailed and specific information and guidance, which enhances their adequacy and usefulness to their users.

Despite a certain level of generality and flexibility, these procedures have the potential to provide meaningful and useful guidance in the complexities of the developmental planning and policy process and enable policymakers to integrate environmental concerns thoroughly and systematically into all phases of developmental policy, programs, and projects. These procedures prescribe a comprehensive approach that considers a multitude of effects of proposed developmental or other activity on the human environment so that they present, as close as possible, a complete picture of the costs and benefits of a proposed action. All three procedures also provide for public participation at various stages of their respective environmental review processes.

More significantly, environmental review procedures established by international organizations also serve as important vehicles for facilitating international environmental cooperation among the various actors involved, whether they be national governments or government officials. On the one hand, international organizations can use their environmental review procedures as a means for forging consensus among the various actors involved on the goals of sustainable development, on the criteria for deciding among project options, and for establishing a common process of decisionmaking. International organizations, however, can go beyond this role by using their environmental review procedures to encourage or, in cases of stricter legal requirements, force actors to define developmental and other goals that are more environmentally conscious and to integrate environmental concerns into planning and decisionmaking, thereby influencing, and even changing, their interests and behavior.

Issuing and publishing environmental procedures, however, is not enough to ensure their effective implementation. Future progress of these environmental processes at the international level is contingent upon determining the circumstances and conditions under which they are most likely to be effective in integrating environment and development in decisionmaking. One condition for likely success of these procedures is if they are formulated and implemented in a formal-explicit manner, that is, if there is a legal requirement for their application, if an environmental impact statement (EIS) is required, and where appropriate authorities are held accountable for considering results of these processes in decisionmaking (Caldwell, 1989: 11). Other factors affecting the efficiency of these environmental review procedures include the following: their acceptance within and outside the organization, the growth of scientific knowledge, and the capacity of borrowers to conduct them (Le Prestre, 1995).

Furthermore, environmental procedures cannot be effective if they only contain a single report, such as the EIS, at the end of the planning process which analyzes the environmental impacts of the proposed action for the decisionmaker; such reports are often used to justify and rationalize plans already chosen. In addition, using these environmental procedures at the project level alone is not enough to ensure effective and adequate integration of environmental concerns in developmental planning and decisionmaking. For instance, EIA at the project level tends to yield fragmented, not comprehensive, analysis that focuses on the environmental consequences of individual projects. Application of EIA at the overall policy planning and program levels instead would ensure that policy choices are the result of having considered all the alternatives and their environmental consequences, thereby rendering the EIA process more effective in promoting environmentally sound development.

Although international organizations can provide guidance on integrating environmental concerns into developmental planning, the real responsibility for achieving environmentally sound and sustainable development lies in the hands of policymakers, at the national and international levels, who use these procedures. Most governments, particularly those of developing countries, face difficulty in integrating environmental concerns into development at the planning and policy levels. Decisionmakers in these countries must weigh critically the needs of the present generation to overcome

poverty, on the one hand, and the resource base and needs of future generations, on the other hand (UNEP, 1989a).

Adding to these problems are the cost and duration of conducting environmental review processes. Although the cost of EAs or EIAs is estimated at less than 1 percent of the costs of any major development project (UNEP, 1988: 15), it may still be too much to bear by some developing countries. Furthermore, although sustainable and environmentally sound development is cheaper and more cost effective in the long term, in the short term it may be considerably more expensive than existing methods. Many developing countries also face a lack of adequate resources, such as up-to-date data, skilled manpower, and adequate amount of time, that hinder their ability to integrate environmental concerns into developmental planning and decisionmaking.

The lengthy duration of environmental review processes, generally taking between six to eighteen months to conduct, further hinders speedy progress on projects. In attempts to protect their national sovereignty over developmental policy and projects, many developing countries are also unwilling to accept such resources through development assistance for fear of conditionality (UNEP, 1989b). Unless and until these problems are addressed, it will be difficult to ensure that environmental review processes will be adequate and effective in integrating environmental concerns in developmental planning and decisionmaking.

These problems faced by developing countries further illustrate the necessity of placing environmental review processes, such as EIA, EA, and EM, into a larger context. As technical and policy tools, these environmental review processes are conducted under varying political realities and under a range of institutional and legal requirements and constraints. In many instances, the environmental review process itself has become more significant than the product, thereby rendering these processes more political than environmental instruments (Le Prestre, 1995). They serve more to build consensus among the diverse actors involved than to integrate environmental concerns into the decisionmaking process.

> EAs are tools for decisionmaking and consensus building, not blueprints for protection. Their primary function is to help reduce political and economic liabilities and build local constituencies. Their technical merits are secondary to this function. (Le Prestre, 1995)

Furthermore, in some countries, environmental review processes of international organizations are used as the foundations for legal and institutional requirements in decisionmaking, whereas in other countries such requirements are absent. It is, thus, necessary to be aware of the larger political, institutional, and legal contexts within which environmental review processes are conducted such that we have realistic expectations of these processes and we can avoid attributing undue credit and blame to them.

In conclusion, international organizations continue to make substantial effort to incorporate environmental concerns in their regular operations. A great deal of work is being done to clarify the linkages between development and the environment and to integrate environmental and resource management concerns more effectively in the economic decisionmaking process. Despite the growing usefulness and significance of environmental review procedures, we should recognize that these procedures, and the processes that they prescribe, are only part of the answer to coping with the degradation of the global environment and unsound development practices. Initiation of environmentally sound policies and practices has to come from within the relevant national bureaucracies and international organizations through the process of organizational learning. Furthermore, the real test of these procedures lies in their actual implementation and in their ability to predict, minimize, and mitigate adverse environmental impacts of proposed and implemented developmental projects and activity.

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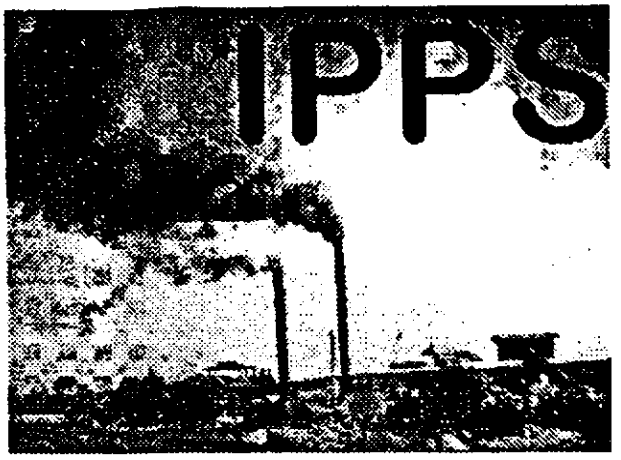

THE INDUSTRIAL POLLUTION PROJECTION SYSTEM

by

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December, 1994

Welcome to the World Bank's first, full text, full data, research report on the World Wide Web.

The IPPS data sets will facilitate the projection of industrial pollution loads given information about the structure of industry in a region. This web page includes the following:

access to the full text of the IPPS working paper. From here you can reach the IPPS Table of Contents, Executive Summary , and the full-text of the IPPS study.
access to downloadable versions of the IPPS paper in zipped postscript (166K) and acrobat pdf (300K) formats. You will need a viewer for either of these formats. The World Bank can not supply these viewers, but a post script viewer is available from Ghostscript and the Adobe Acrobat viewer is available from Adobe .
access to the IPPS dataset in flat ASCII format and Lotus .wk1 format. is available via the Intensities Datasets page .

The research reported in this paper was undertaken in collaboration with the Center for Economic Studies, U.S. Bureau of the Census. Our thanks to theUS Environmental Protection Agency for providing the industrial pollution data and to Angela Williams for invaluable assistance with preparation of final text and tables.

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Executive Summary

The World Bank's technical assistance work with new environmental protection institutions (EPI's) stresses cost-effective regulation, with implementation of market-based pollution control instruments wherever this is feasible. At present, however, few EPI's can do the requisite benefit-cost analysis because they lack data on industrial emissions and abatement costs. For the foreseeable future, appropriate estimation methods will therefore have to be employed as complements to direct measures of environmental parameters at the firm level. We are developing the Industrial Pollution Projection System (IPPS) as a comprehensive response to this need. Estimation of IPPS parameters is also giving us a much clearer and more detailed view of the sources of industrial pollution. In this paper, we report on our findings to date.

IPPS has been developed to exploit the fact that industrial pollution is heavily affected by the scale of industrial activity, its sectoral composition, and the process technologies which are employed in production. Although most developing countries have little or no industrial pollution data, many of them have relatively detailed industry survey information on employment, value added or output. IPPS is designed to convert this information to the best feasible profile of the associated pollutant output for countries, regions, urban areas, or proposed new projects. It operates through sector estimates of pollution intensity, or pollution per unit of activity.

We are developing IPPS in two phases. We have estimated the first prototype from a massive U.S. data base, developed by PRDEI in collaboration with the Center for Economic Studies of the U.S. Census Bureau and the U.S. Environmental Protection Agency. This data base was created by merging Manufacturing Census file data with US EPA data on air, water and solid waste emissions. It contains complete environmental, economic and geographic information for approximately 200,000 factories in all regions of the United States. The first prototype of IPPS spans approximately 1,500 product categories, all operating technologies, and hundreds of pollutants. It can separately project air, water, and solid waste emissions, and incorporates a range of risk factors for human toxic and ecotoxic effects. It can also project emissions of some greenhouse gases and several compounds which are hazardous to the ozone layer. Since it has been developed from a database of unprecedented size and depth, it is undoubtedly the most comprehensive system of its kind in the world.

We recognize, however, that this is only the beginning. Although much more detailed empirical research is needed on the sources of variation in industrial pollution, it is already clear that great differences are attributable to cross-country and cross-regional variations in relative prices, economic and sectoral policies, and strictness of regulation. The second phase of IPPS development will, therefore, have to be even more ambitious than the first. We are now undertaking an econometric research project which will use plant-level data from many countries to quantify the major sources of international and interregional variation in industrial pollution. This project should help identify the policies which have reduced industrial pollution most cost-effectively under different conditions. By quantifying the effect of country- and region-specific policy and economic variables, it should also provide the basis for adjusting IPPS to conditions in a wide variety of national and regional economies.

We have learned a number of valuable things from first-phase development and application of IPPS:

Industrial pollution problems vary substantially across countries, and across regions within countries. We have therefore estimated intensities for a large number of air, water and toxic pollutants. To illustrate, at the broadest level of pollutant aggregation, IPPS intensity estimates are available for the sum of all toxic pollutants released to all media (air, water, land). At the narrowest level, separate intensities have been estimated for air, water and land release of over 100 toxic pollutants.

Complementary economic data for developing countries can be somewhat randomly available by variable and level of aggregation. We have therefore found it useful to estimate IPPS parameters at the 2-, 3-, and 4-digit levels of aggregation in the International Standard Industrial Classification (ISIC). At each ISIC level, we have estimated pollution intensities, or emissions per unit of activity, using all three economic variables which are commonly available: Value of output, value added and employment. For cases where extremely detailed data are available, we have also estimated sectoral parameters at the U.S. 4- and 5-digit SIC levels. In the latter case, the estimates include some information for over 1,000 industry sectors.

For individual pollutants, we find generally high correlations across intensities based on output value, value

added and employment. At a purely 'mechanical' level, we therefore find little to distinguish the three sets of intensity measures as bases for pollution projection. However, basic economic reasoning does suggest that employment-based intensities may be preferable for pollution projection in developing countries. The logic is as follows: (1) Effective environmental regulation is thought to be quite income-elastic, although careful empirical work on cross-country data has yet to be done; (2) Sectoral pollution is thought to be quite responsive to effective environmental regulation in many cases; (3) Most cross- country econometric studies of sectoral labor demand find relatively high wage elasticities; (4) From (1)-(3), we can conclude that both sectoral pollution and sectoral labor demand will rise substantially as we move from richer (high- wage, high-regulation) to poorer (low-wage, low-regulation) economies. Since pollution and employment vary in the same direction, the variation in pollution intensity with respect to employment (P/E) may well be less than variation in pollution per unit of output. Very preliminary tests on U.S. and Indonesian sectoral data for water pollution provide support for this hypothesis, showing much higher variation for value-based intensities than for employment- based estimates.

We have uncovered what looks like an "iron law" of pollution intensity for all pollutants and levels of aggregation: Sectoral intensities are always exponentially distributed, with a few highly intensive sectors and many which have very low intensities. High-intensity sectors differ markedly across pollutants (see below), but the exponential pattern persists. The implication for applied work is clear: Pollution projections should always be done with the most disaggregated data available. The resulting gains in accuracy are often quite striking.

Although the phrase "pollution intensive" is commonly applied to industry sectors, it can be quite misleading. We find a very diverse pattern of sectoral intensity correlations across pollutants. Intensity correlations are sometimes high within similar classes (e.g., nitrogen dioxide and sulphur dioxide among air pollutants; biological oxygen demand and suspended solids among water pollutants). Across classes, however, intensity correlations are sometimes quite low.

IPPS parameters can be estimated differently, depending on the types of complementary data which are available. For the present purposes, we have used our U.S. factory sample to compute three basic types of indices. The first, or Upper Bound, estimates are computed from the subsample of factories which we have succeeded in matching between the EPA and Census data bases. Since no common ID codes are available, this has been a difficult process and inevitably entailed the loss of information from many plants. EPA files are kept only on firms which are significant pollutors, so we know that our matched sample provides an upward-biased estimate of general sectoral pollution intensity. Developing-country factories tend to be more pollution-intensive, however, so these estimates provide at least a partial correction.

We have produced complementary Lower Bound estimates for U.S. plants by summing all EPA-recorded pollution by sector and dividing by all Census-recorded output or employment. This makes maximum use of the EPA sample (the Census data cover the whole population of firms), but implicitly counts pollution from all non-EPA-recorded firms as zero. This is an underestimate, so the Lower Bound intensities should be conservative. In both Upper and Lower Bound cases, we know that the presence of large outliers in the data can have an important impact on sector-specific results. As an alternative, we have computed pollution intensities for all plants separately using the subsample of matched data, and then estimated Interquartile Mean intensities. This eliminates the possible influence of outliers and provides a robust measure of central tendency. Each set of statistics can be useful in particular contexts, as discussed in the paper.

IPPS has already been applied in several World Bank analyses, most notably in two recent World Bank publications: Carter Brandon and Ramesh Ramankutty, Asia: Environment and Development (1993); and Richard Calkins, et. al., Indonesia: Environment and Development (1994). Inside the Bank, sector reports for Mexico, Malaysia and several Middle Eastern countries have also used IPPS-based estimates. IPPS has been used to produce the first comprehensive cross-country estimates of toxic pollution in World Resources 1994-95 (Table 12.4) published by the World Resources Institute. Recent work on trade and the environment by the OECD has also been based on IPPS, most notably the paper by David Roland-Holst and Hiro Lee: "International Trade and the Transfer of Environmental Costs and Benefits" (OECD, December 1993).

During the next year, we anticipate very rapid movement on Phase II of IPPS development: adjustment to conditions in other economies. At the conclusion of Phase I, we can offer a massive database of pollution parameters which are immediately usable for environmental planning and analysis. Many of our results are available in .wk1 and ASCII-tab delimited format from the Intensities Datasets page.

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FACSIMILE COVER SHEET AND MESSAGE

DATE: July 29, 1995 **NO. OF PAGES:** 1 (including cover sheet) **MESSAGE NO.:** 1

TO: Margaret Kalin
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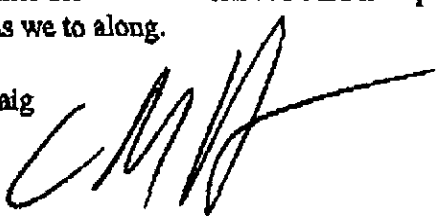
SUBJECT: **Burkina Faso**

MESSAGE: Margarete:
Thanks for the fax of the 25th. I was out of town the latter half of last week hence my tardy reply.

I am attaching a copy of your expense report which we have filled out based on the information (received 24 July) you supplied to us. I had, in fact, signed this before my departure last week and we have submitted it so you can get paid quickly. There is a slight discrepancy between the amounts in your original fax and the amounts calculated here. This is due to the fact that we did not know what exchange rates you received and hence the machine adopts a default exchange rate. You will note that I have authorized a hotel payment for you in Zurich. I am checking up with the person that handles the contracts. They are normally slow.

I hope to receive your report by the end of this week so I can comment on it. In preparing it please bear in mind that I am interested in as much detail as possible - perhpas a running commentary based on your notes. We need to know what information re: the environment is already available at Poura, in Ouaga, and at the artisanal mining sites; what, in your professional judgement, are the gaps in the datasets and knowledge that could and should be filled; the types of professional and scientific skills existing already and additional skills required; whether any further assessment work at Poura is required. Try your best and I can give you comments as we to along.

Hope this is helpful to you. Craig



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VTSA 925-8108

Burkina Faso

TERMS OF REFERENCE
ENVIRONMENTAL CONSULTANT
BURKINA FASO MINING SECTOR PROJECT PREPARATION

Background

The government of Burkina Faso, assisted by relevant Bank staff, is preparing an IDA credit to fund technical assistance for the mining sector. The credit is expected to be in the amount of US$ 15-18 million and be implemented over five years. The principal components of the credit are designed to: (i) reform the regulatory/fiscal conditions and strengthen government supervisory institutions; (ii) up-grade the geology and land management databases; (iii) restructure key government institutions and build capacity within them to better execute their mandates; and (iv) strengthen the government's ability to manage and monitor the environmental impacts that mining development may have.

Environmental Component

Burkina has little institutional capacity or international best practices experience with respect environmental protection in the mining sector. The Bank and other donors have funded some efforts to develop a National Environmental Action Plan and have been instrumental in setting up the Ministry of the Environment and Tourism. In view of the very significant impacts that mining can have on the environment the credit will fund technical assistance to enhance government capacity to: (i) prepare relevant environmental legislation and regulations, including standards and norms to be applied in the sector; (ii) increase human capacity, in both the public and private sectors, to better control and be aware of environmental protection; (iii) increase government capacity to evaluate environmental impact statements and to assess the measures and plans proposed by the investor to protect the environment; (iv) provide training in the scientific disciplines necessary for monitoring compliance; (v) encouragement of a local goods and services industry with respect to environmental protection; (vi) carry out programs to educate and sensitize the artisans in environmental protection, mine health, safety, security and sanitation; (vii) conduo an environmental baseline study of selected areas where significant exploration activity is taking place; (viii) acquire some laboratory and field testing and analytical equipment; and (ix) study the environmental impact of artisanal workings.

The only operating industrial mine in Burkina Faso at Poura was commissioned in 1984 and was designed to incorporate the then current international standards in terms of the environment, especially in respect of tailings and toxic waste disposal. Nonetheless, over the years of operation there could be "hidden" environmental liabilities. The assessment and eventual remediation of these liabilities will be a key element if the government is to attract private sector partners to this mine. A new private sector investor will not wish to assume responsabilities for past environmental liabilities. Therefore, the project would fund an environmental audit of the mine to determine the nature and extent of any pre-existing environmental liabilities. The project may also fund remediation of environmental problems detected during the audit, to the extent to which such remediation is required to successfully conclude the privatisation of the mine. Further, assuming that the current efforts to privatise the mine do not succeed and the government takes the decision to close the mine, the project will fund environmental remediation and closure costs to render the site safe.

Consultant Duties

A senior environmental consultant is required to participate in the preparation of this project. As a member of the mission team the consultant will be responsible for preparing the environmental component of the credit. The consultant will work with relevant government officials and other mission team members to:

1) Assess the extent and adequateness of current environmental legislation and regulations, the government administrative set-up for environmental management, and the skill capabilities of local public and private staff. Based on this assessment, the consultant will prepare the major activities and terms of reference (including rough cost estimates) for technical assistance to complete the legislative framework and build capacity. Particular emphasis should be placed on training requirements, encouraging private sector response, education and public sensitization campaigns, and requirements for laboratory and testing equipment.

2) Numerous artisanal workings exist throughout the country. The consultant will prepare an initial preliminary assessment of the environmental problems associated with these workings. The consultant will propose project activities and terms of reference (including rough cost estimates) for any remedial and site rehabilitation work, if warranted.

3) The consultant will visit the Poura gold mine and make a preliminary assessment of the environmental problems and conditions which may be associated with it. The consultant will prepare terms of reference, including cost estimates, for consultancy services for an environmental audit of the mine. Based on the consultant's experience, a rough estimate should also be made of the scope and cost of services required for any remediation of environmental problems.

4) Numerous local and international companies are active exploring in Burkina Faso. It is likely that over the next several years one or more major gold mines could be developed. The consultant will prepare terms of reference (including cost estimates) for environmental baseline studies to be prepared for selected areas considered the most prospective for mine development. The baseline studies would provide the fundamental environmental parameters to be considered by the government and private sector investors regarding the impacts and protective measures required for mine development.

5) Other duties as may be requested by the task manager during the mission.

Assignment Duration

The duration of the assignment will be 25 working days. Of this, approximately 22 days will be spent in the field.

Qualifications

The consultant will have at least 20 years experience with environmental and/or earth sciences departments of major academic institutions or research institutes. The consultant will be thoroughly conversant with the environmental problems associated with the mining industry including, but not limited to: acid mine and rock drainage, tailings treatment and stabilization,

rehabilitation and contouring of land surfaces, disposal of toxic substances, and biodiversity issues. In addition, familiarity with international best practices in respect of environmental regulations and standards would be useful as well as the functions and requirements of government institutions to enforce and monitor environmental compliance. Basic research and application of "organic" or "non-engineered" techniques of in-pit acid water remediation is required. The consultant will be able to converse in the French language and have appropriate academic credentials.