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FINANCED BY: Nordic Development Funds	**Project Report**	QA DAK

Project:	IMPLEMENTATION OF A CENTRAL LABORATORY AND AN AIR QUALITY MONITORING NETWORK IN DAKAR
Agrement:	No 003/C/FND/05

QADAK Mission 2, 3-12 October 2005

Cristina Guerreiro, Bjarne Sivertsen and Herdis Laupsa

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Contents

Summary

Financed by the Nordic development Fund (NDF), the Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Management System for Dakar. This project is part of the component entitled as "Amelioration de la qualité de l'air en milieu urbain" (QADAK) of the "Programme d'Amélioration de la Mobilité Urbaine" (PAMU) operated by the Conseil Exécutif des Transports Urbains de Dakar (CETUD).

The second mission to Dakar was undertaken from 3 to 12 October 2005. The main purpose of this mission was to undertake an air pollution screening study in Dakar, to meet with relevant local experts and institutions, to discuss the air quality laboratory and personnel with DEEC and to collect further information on emissions as well as the organisation of the environmental work in Senegal.

During one week more than 50 sites were selected in the Dakar area and samplers were placed to collect concentrations of indicator gases for one month. A central station for measurements of CO, PM_{10}, $PM_{2,5}$ and VOC ambient air concentrations was established in Rue Carnot, in the central part of Dakar. Short-term measurements were also performed in selected areas such as industrial districts and in and along roads and streets, urban background areas and regional background areas. Preliminary results from these short-term studies were presented in a memo to CETUD and to DEEC.

Several meetings were held with different experts and institutions. One objective was to discuss air quality legislation in Senegal including guidelines, standards and limit values.

List of Abbreviations

AQ	Air Quality
CO	Carbon monoxide
CETUD	Conseil Excecutif des Transports Urbains de Dakar
CERER	Centre d'Etudes & Recherches sur les Energies Renouvelables
CNDD	Commission Nationale sur le Développement Durable
CSE	Centre de Suivi Écologique
CV	Curriculum Vitae
DEEC	Direction de l'Environnement et des Etablissements Classés
GIS	Geographical Information System
LERG	Laboratorie d'Enseignment et de Reserche en Geomatique
NDF	Nordic Development Fund
NILU	Norwegian Institute for Air Research
NO_2	Nitrogen dioxide
PAMU	Programme d'Amélioration de la Mobilité Urbaine
PM	Particulate matter
PM_{10}	Particulate matter with diameter Less than 10 micrometer
$PM_{2,5}$	Particulate matter with diameter Less than 2,5 micrometer
QADAK	Qualite de l'Air de Dakar
QA	Quality Assurance
QC	Quality Control
SO_2	Sulphur dioxide
SPIDS	Syndicat Professionnel des Industries et Mines de Sénégal
VOC	Volatile organic Compounds
UCAD	Université Cheikh Anta Diop de Dakar

1 Introduction

This report from the second mission to Dakar of the QADAK project includes information on preparations, data and information collection, as well as the performance of an air pollution screening study.

The project is financed by the Nordic development Found (NDF). The Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Monitoring and Management System for Dakar. This laboratory has been assigned to be located at DEEC.

The screening study will represent the input for designing a permanent network of air pollution monitoring stations in Dakar. The results from this study will also provide a first relevant database for air pollution concentration distributions and a basis for evaluating air pollution impact in Dakar. This work, however, will not be adequately reported until at least one year with continuous air pollution data has been collected and assessed, and the first air pollution model results have been presented.

To prepare the air pollution dispersion models a GIS based database is being established and air pollution emission data is being collected. The emission database, which is the key to modelling and air pollution planning, will represent a considerable part of the input data collection. The project team had already started collecting relevant information and data during Mission 1 (Guerreiro et al, 2005a). From NILU participated Cristina Guerreiro (CBG), Herdis Laupsa (HEL) and Bjarne Sivertsen (BS).

This report is also available in French (NILU OR 9/2006).

2 Schedule and people

A schedule for the Mission had been prepared and was adjusted as the agreements and meeting progressed. The final time schedule is presented in Appendix A. One main objective of the Mission was to undertake the screening study in Dakar as well as to continue collecting as much information about the existing air quality as possible. Organisation of environmental work as well as legislation, guidelines and norms were also discussed.

The Tasks covered during Mission 2 are as follows:

- 1: Assessment of existing Air Quality management structure.
- 2.2 / 7.1: Assessment of the existing data on emissions
- 2.4: Screening study
- 3.1: Specify laboratory requirements
- 3.2: Specify personnel skills and manpower
- 6.2: Establish databases for Dakar specific data
- 9.1: Air Quality training programme
- 11.1: Advice on AQ legislations
- 12: Project Management

A list of names, institutions and mail addresses of people met during Mission 2 is presented in Appendix B.

3 Project tasks

3.1 Task 1 Evaluate existing management structure

3.1.1 Task 1.1 Collect and evaluate existing organisation of AQ work

Different contacts and meetings were held during Mission 2 with the aim of understanding the current organization of the air quality in Senegal. The contacted institutions are:

- 'Direction de l'Environnement et des Etablissements Classés' (DEEC) (Appendix C5) ;
- 'Le Centre de Suivi Écologique '(CSE) (Appendix C6)

The National Report of Senegal, presented to the World Summit on the Durable Development, at Johannesburg, in August 26th - September 04th, 2002 Dakar (National Committee on the Durable Development, on 2002), describing the strategy of Senegal for the durable development was collected and studied (NCDD, 2000).

A work plan to come to the report "Evaluation of the current Air Quality management structure, gaps analyzes and recommendations for the organization of the Air Quality management" was made and granted with the CETUD and the DEEC.

This plan is presented in Appendix D and includes:

- Identification of the stakeholders of Air Quality management problem;
- A Starting up seminar for the project and a workshop where the stakeholders will discuss their roles in the management of the air quality in Dakar;
- Synthesis of the workshop discussions: elaboration of the report ' Evaluation of the operational structure of Air Quality management'.

3.2 Task 2 Assessment of air quality levels in Dakar

3.2.1 Task 2.2: Identify main potential air pollution sources

Traffic is the main air pollution source in Dakar. It has therefore been necessary to collect comprehensive data on traffic in order to be able to estimate emissions from traffic in Dakar.

A digitalised traffic network in Dakar and output data from a traffic model for Dakar will be obtained from GMAT in Canada, which is currently doing a project on traffic characterisation and traffic planning in Dakar for CETUD (see Appendix C4).

Detailed data concerning potential industrial air pollution sources will have to be identified. A first list of information was collected during Mission 1. This included consumptions and storage capacities of chemical products at some industries in Dakar. A list of main industries in Dakar for a first collection of data on stack coordinates and height was prepared.

Several contacts with SPIDS concerning an agreement of cooperation between CETUD and SPIDS have been established, in order to prepare a ground of cooperation between the industries and this project for future collection of data on industrial processes and emissions and cooperation on suggested emission reduction measures, etc. SPIDS was positive to cooperation but does not have the resources to cooperate in the collection of industrial data, necessary to the project.

3.2.2 Subtask 2.4: Design and perform screening study

During Mission 1 a few passive samplers were located at 5 different sites in Dakar city to give a first indication of the ground level concentrations and to support the design of screening study to be performed during the second mission. (Guerreiro et.al. 2005a).

The screening study, which will represent the basis for final design of the permanent air quality monitoring network in Dakar, was initiated during Mission 2 in October 2005. This screening was undertaken in three steps:

- A permanent station located in Rue Carnot, measuring PM_{10}, $PM_{2,5}$ and CO.
- A set of passive samplers located at 50 different locations in Dakar to measure NO_2, SO_2, VOCs and Ozone.
- A short-term study in selected streets, along roads, in the urban background and near industrial areas to measure PM_{10}, CO and VOC

The passive samplers of NO_2, SO_2, and O_3 was located at about 50 selected measurement sites in Dakar city and in surrounding suburban areas. The location of some of the sampling points is indicated on the map in Figure 1.

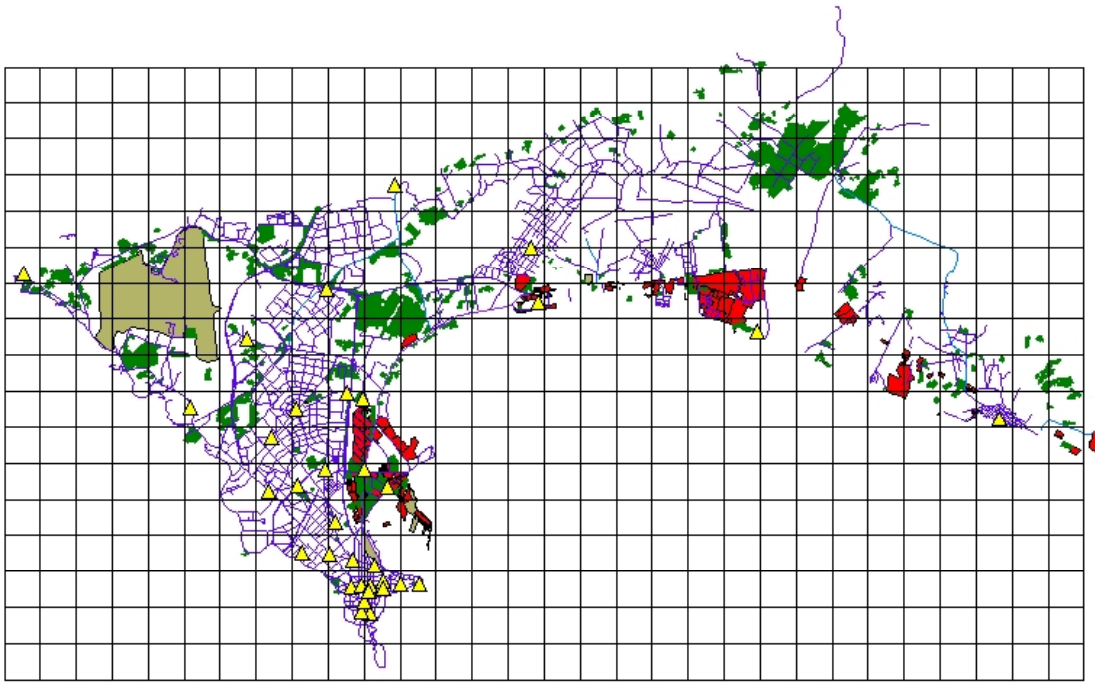

Figure 1: Some locations for the air quality sampling carried out during October 2005 in Dakar.

Preliminary results of the study were presented in a memo prepared for CETUD and DEEC (See Appendix E). A report is being prepared on the total screening study and will be presented when all the data have been analysed and assessed.

In the conclusions from the preliminary evaluation it was stated that the main problem seems to be suspended particulate matter. PM_{10} concentrations have been measured at average concentration levels, which may be 4 to 5 times the international standard levels. They also exceeded Senegal air pollution standards. The international standards are linked to the frequency of exceedances, which means that we will have to have data with longer records in time to draw final conclusions.

Many of the streets of Dakar experience frequent traffic jam. Some of our preliminary data shows that CO concentrations may be very high during these periods. We also experienced roads with much higher pollution loads of CO and PM than we measured with our instruments. Further studies will reveal these "problems" especially in the street canyons of the Dakar city centre and along the main roads where traffic can are frequently reported.

Some of the NO_2 concentrations collected during the screening studies also indicated that NO_2 concentrations might exceed limit values. The analyses of monthly data from 50 sites selected in Dakar from 3 October 2005 will be available at the end of 2005. We will know more about NO_2 and SO_2 concentration levels after that.

3.3 Task 3 Establish central AQ Laboratory

3.3.1 Subtask 3.1: Specify laboratory requirements

A final draft on the logistic requirements for the Laboratory (in Appendix F) were presented and discussed during the meeting with DEEC. For further details on discussion and conclusions see minutes in Appendix C5.

3.3.2 Subtask 3.2: Specify personnel skills and manpower

A draft on the requirements for the Laboratory on personnel skills and manpower (in Appendix G) were also presented and discussed during the meeting with DEEC. For further details on discussion and conclusions see minutes in Appendix C5.

The memo presented to DEEC will be the basis for advertising for experts. A time schedule for these procedures was also discussed and agreed upon. This time schedule indicated the following steps:

Before 30/10/2005	Publication of job announcements
Beginning of December 2005	Pre-selection based on the CVs
Before 15/01/06	Interviews of candidates
Before end of January 2006	Final selection and invitation of selected candidates
1 March 2006	Contracted experts start working at the Lab.

3.4 Task 6 Establish and operate the Air quality Management System

3.4.1 Subtask 6.2. Establish databases for Dakar specific data

During preparation for Mission 2, the following data for Dakar has been imported in the AirQUIS databases:

- Meteorological data obtained at CERER during Mission 1;
- Shape files with regions limits, position of main industries, population density, main roads, etc;
- Results from the preliminary screening study during Mission 1;
- Positions of measurements stations for the screening study during Mission 2.

3.5 Task 9 Institutional building and training

3.5.1 Subtask 9.1. Air quality training programme

A short workshop was held at the end of the Mission 2 to summarise the Mission and to present some of the findings from the screening study.

Some preliminary results were presented and discussed as part of training.
One representative from DEEC also participated in the screening studies as part of the training. Mrs. Aminata Gueye participated in the whole study and will be responsible for the collection of all samplers.

3.6 Task 11 Air Quality legislation advice

3.6.1 Subtask 11.1. Advice on AQ legislations

Prof. Ibrahima Ly was asked too continue the compilation of all legislation texts regarding air quality and environmental impact assessment in Senegal, including "norms", "décrets", "arrêtés", etc. issued from various ministries like Environment, Transport, Energy, etc. In addition, similar texts presently under preparation will also be compiled, as far as they can be available to Prof. Ly (Appendix C8).

Air quality standards for Senegal were presented and commented by Bjarne Sivertsen during the end-of-mission 2 meeting (Appendix C11).

3.7 Task 12 Project Management

The Progress report for 01/01/2005-31/08/2005 was handed out to CETUD, as well as 10 copies of each of the following reports:

- Mission 1 report (Rapport de demarrage);
- Echantillonnage Passif du SO_2 et du NO_2 dans l'air ambiant à Dakar, Etude préliminaire, Juin 2005.

4 Meetings

Several meeting were arranged during this Mission 2 of the QADAK project. The objectives were:

- Continue the work after Mission 1 in collecting as much information as possible about existing data (emissions, traffic, population distribution, industrial activities and digitalised data), legislation in Senegal and organisation of the air quality work in Senegal;
- Do the necessary preparations and actions to have the Air Quality Lab functioning from 1 March 2006;
- Start preparations for the Air Quality seminar in March 2006.

4.1 Administrative meeting at Performance

An introductory meeting between NILU and Performances was held at Performance on Monday 30 May 2005. The schedules and meetings to be arranged during the Mission were discussed. Several meetings had to be reconfirmed and approved.

4.2 Meeting at CETUD

The objective of this meeting was to present the program of Mission 2 to the director of CETUD, Mr. Latyr Ndiaye. CETUD updated NILU on the contacts with CERER and on the project for the new DEEC building, which will accommodate the Central Lab. For further details, see Appendix C1.

4.3 Meeting with Cheick Mbow at Performances

The meeting was a short discussion of the contributions of Cheick Mbow to the project. For further information on what was discussed and agreed see Appendix C2.

4.4 Meeting with CERER

The objective of this meeting was to agree on the terms of cooperation between CERER and CETUD, within this project. A minute from the meeting is presented in Appendix C3.

4.5 Meeting with Mr. Diako at CETUD

The objective of this meeting was to obtain information on GMAT's project progress and agree with CETUD on the form of the request to GMAT for traffic data. A minute from the meeting is presented in Appendix C4.

4.6 Meeting at DEEC

The objectives of this meeting were the following:

- Present the needs of the laboratory in terms of personnel (Appendix G);
- Discuss the time schedule for engaging these personnel before the project seminar in March (Appendix H);
- Present the needs of the laboratory in terms of building and equipment (Appendix F);
- Get information from DEEC on the plans of the building, financing plans, schedule of construction; constructor if chosen;
- Agree on a temporary solution to host the laboratory from 1 March 2006 until the new building is operative;
- Get the view of DEEC on the present structure of the air quality management in Dakar
- Present the work plan for Task 1 - Evaluation of existing AQ management structure (Appendix D).

A minute from the meeting is presented in Appendix C5.

4.7 Meeting with Centre de Suivi Ecologique (CSE)

The objective of this meeting was to know what is the work that is presently done in CSE that could be of interest for the Air Quality Lab and to define the role of CSE in the Air Quality Management Structure. A minute from the meeting is presented in Appendix C6.

4.8 Meeting at LERG on GIS data for Dakar

The objective of this meeting was to be informed on the work progress so far and agree on a work plan for the next months. NILU received an excel file with population data on 3 levels: "department", "arrondissement" and "commune d'arrodicement" and a file with monthly average meteorological data for 53 years (from 1950 to 2003). For further details, see Appendix C7.

4.9 Meeting with Prof. Ibrahima Ly on environmental legislation in Senegal.

The objective of this meeting was to define and clarify the contribution NILU expects from Ibrahima Ly to the project on the compilation of environmental legislation in Senegal. For further details, see Appendix C8.

4.10 Meeting with Mr. Pascal Vardon at Ministère de L'Environnement.

The objective of this meeting was to discuss with M. Pascal Vardon the best way of obtaining the necessary information on the emissions from the main industries in Dakar.

Mr. Vardon informed us that the DEEC is planning a measurement campaign of the emissions of some chosen industries in Senegal. Cristina pointed out that after our 1st Mission to Dakar

and after the meetings hold with Institute Pasteur and the DEEC we had arrived to the conclusion that there are no laboratories in Senegal with the competence and the tools to make stack emission measurements. Since the price of engaging a foreign laboratory for these measurements would be above the available budget, we proposed that the budget would rather be used on an inquiry to some main industries in Great Dakar area in order to have the necessary information to estimate the emissions, rather than in emission measurements that would not be done following the standards. Bruno informed Mr. Vardon that the SPIDS were willing to cooperate with CETUD within our project, but that they do not have the capacity to execute this enquiry at the present stage, given their limited human resources. Never-the-less SPIDS is willing to lead such an enquiry to their member industries, if they were given the necessary resources. We agreed with Mr. Vardon that he would contact Mr. Cheikh Sylla at DEEC, in order to discuss the replacement of the emission measurements for the air component only (the measurements of emissions to water would remain as planned) with an inquiry lead by the SPIDS.

For further details, see Appendix C9.

4.11 Meeting at CETUD the 11 October 2005

The objective of this meeting was to clarify some questions CETUD had on the invoices sent by NILU for the project work done from the beginning of the project until end of September 2005 and to agree on an invoice format that would simplify the control work of the accountability in CETUD. It was agreed that NILU would take back the invoices for the period 01/01/2005 to 31/08/2005, and would send new invoices on a format agreed with CETUD's accountability department during this meeting.

4.12 Meeting with the president of AfricaClean in Senegal, Prof. Amadou Diouf, at the Department of toxicology at UCAD.

The objective of this meeting was to present the project goals and main activities to Pr. Amadou Diouf and to know the projects and actions Africa Clean and Department of toxicology at UCAD are involved in within air pollution and related health effects. For further details, see Appendix C10.

4.13 End of Mission meeting

A meeting was arranged at CETUD on 12 October 2005 to summarise and to distribute responsibilities.

The main objectives with this meeting were to:

- Summarise the work done so far in the project;
- Present the work done during Mission 2 and the preliminary results from the screening study,

- Make detailed plans for the work ahead until next Mission in March 2006,
- Distribute tasks and responsibilities,
- Agree on a list of main industries in Dakar for the first collection of data to the emission inventory

Cristina gave a summary presentation of:

- The meetings hold during Mission 2 and of the outcomes of those meetings;
- Tasks we have worked on since the beginning of the project;
- Tasks covered during Mission 2;
- Proposed organisational structure for the Central Lab (Appendix G);
- Calendar for employment of experts at the Central Lab (Appendix H);
- Methodology of work for the Evaluation of the air quality management structure (Appendix D).

Bjarne made a presentation of the screening study executed during Mission 2, including conception and design, goals, methods and preliminary results.

For further details, see Appendix C11.

5 References

Commission Nationale sur le Développement Durable (CNDD) (2002) Sommet Mondial sur le Développement Durable, Rapport National du Senegal, Johannesburg, 26 Août – 04 Septembre 2002.

Guerreiro, C., Laupsa, H. and Sivertsen, B. (2005) Passive sampling of SO_2 and NO_2 in ambient air in Dakar, Preliminary study, June 2005. Kjeller (NILU OR 46/2005).

Guerreiro, C., Sivertsen, B. and Laupsa, H. (2005a) QADAK Mission 1, May-June 2005. Kjeller (NILU OR 45/2005).

Appendix A

Time schedule of Mission 2

Date	Hr.	Meetings/actions	Participants	Appendix
Mon 3 Oct	10:00	Meeting at Performances	CBG, BS, Hel, BL	
	11:30	Meeting at CETUD with Latyr Ndiaye	CBG, BL, L.Ndiaye, Mr. Lo, P. Sagna	C1
	12:00	Place passive samplers in the city centre	CBG, BS, Hel, BL, AG	
Tue 4 Oct	08:00	Place passive samplers	BS, AG	
	08:00	Measurements of CO and PM10 conc. In the centre	HeL, Charles Diene	
	10:00	Meeting with Cheikh Mbow (Performances)	CBG, BL, CM	C2
	13:00	Installation of PM10 sampler	CBG, HeL, BS, BL, AG	
	15 :00	Place passive samplers	BS, AG	
Wed 5 Oct	08:00	Place passive samplers (all day)	BS, AG	
	08:00	Measurements of CO and PM10 conc. In the centre	HeL, Charles Diene	
	10:00	Meeting at CERER	CBG, BL, M. Sall	C3
		Meetings at CETUD	CBG, BL, Sagna, Lo, Diakho	C4
Thu 6 Oct	08:00	Place passive samplers, Measurements of CO and PM10 conc.	BS, HeL, AG	
	15 :00	Meeting at DEEC	CBG, BS, BL, Pascal Sagna, Mme Toure, Mme Seck, Gatta Ba, Mr. SOW	C5
Fri 7 Oct	10:00	Meeting at CSE	CBG, BS, HeL, BL, Mr. Ndione, Mr. Toure	C6
	13 :00	Installation of CO monitor	CBG, HeL, BL , AG	

Date	Hr.	Meetings/actions	Participants	Appendix
	15:00	GIS data – meeting at LERG	HeL, CBG, AG, CM, BL	C7
Sat 8 Oct		Replace VOC samplers, Measurements of PM10		
Sun 9 Oct		Measurements of PM10		
Mon 10 Oct	10 :00 13 :00 15 :00	Meeting with Prof. Ibrahima Ly Collect VOC sampler at st.1 and check monitors Meet Mr. Vardon	CBG, BS, BL, I. Ly CBG, BS CBG, BS, BL, Mr. Vardon	C8 C9
Tue 11 Oct	10 :30 14 :30 Collect VOC samplers	Meeting at CETUD - contability Meeting with psdt Africa Clean BS	CBG CBG, BS, BL, Prof. Amadou Diouf	C10 C11
Wed 12 Oct	15:00 16:30	End-of-2-mission meeting with the project team at CETUD. Meeting with director of CETUD	CBG, BS, BL, CM, AG, TD, P. Sagna, Mme Seck CBG, BS, BL, L.Ndiaye, Sagna	C12

Appendix B

Contact persons

Secteur	**Institution**	Contact	**e.mail/telephone**	**Fonction**	Activités
Environnement	DEEC	Fatima Dia Touré	fdtoure@sentoo.sn	Directrice	Implantation du laboratoire
	MENV	Pascal Vardon		Cons. Technique	Financement campagnes de mesure DEEC
	DEEC	Ousmane Sow		Ing. Chimiste	Camion Laboratoire (financement budgétaire). Suivi de la qualité de l'air et des eaux
	Prestige	Ibrahima Ly	ibraly2005@yahoo.fr	Juriste, spécialiste en environnement	
	DEEC	Gatta Ba	gattasouleba@yahoo.fr		
	DEEC	Aita Seck	aitasec@yahoo.fr		
	CSE	Dr. Assize Toure	assize@cse.sn	Directeur Technique	
Santé	UCAD	Amadou Diouf		Toxicologue	AfricaClean – Fac de médecine (toxicologue)
Transports	CETUD	Karfa DIAKO		Ingénieur en Aménagement et Trafic	
	CETUD	Latyr NDIAYE	cetud@telocomplus.sn	Directeur Général	
	CETUD	Pascal SAGNA	cetud@telocomplus.sn psagna@ucad.refer.sn pascalsagna@hotmail com	Environnementaliste	QADAK
Cartes	ESP	Cheikh Mbow	cmbow@ucad.sn	Chercheur	Laboratoire de Géomatique. Travaux sur la pollution industrielle
	ESP	Aminata Guèye			PhD student
Meteo	CERER	Dr. Mactar Sall		Chercheur	Responsable par les mesures de données meteorologiques

Secteur	**Institution**	Contact	**e.mail/telephone**	**Fonction**	Activités
Consultants	Performances	Bruno Legendre	legendre@ariane-service .com performance@avc.sn tlf :221 8230705 fax.221 230778		
	NILU OFFICE Dakar		221 8230777		

Appendix C

Minutes of meetings

Appendix C1

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FINANCEMENT: **Fonds Nordique de Développement**	**Compte rendu d'entretien**	QA DAK

Projet:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	NO 003/C/FND/05

Appendix C1

Titre	**Meeting at CETUD with Mr. Latyr Ndyae**
Date	3 October 2005
Participants	CETUD: Mr. Latyr Ndiaye, Mr. Pascal Sagna, Mr. Lo NILU: Cristina Guerreiro Performances: Bruno Legendre
Auteur	CBG
Distribution	Rapport de mission 2
Référence No	O-105010

The objective of this meeting was to present the program of Mission 2 to the director of CETUD, Mr. Latyr Ndiaye.

Cristina Guerreiro and Bruno Legendre presented in general lines the work to be done and the meetings to be held during the project's 2nd mission, as presented in Appendix A of the Mission 2 report.

Mr. Ndiaye informed NILU that NDF is waiting for the approval from NILU on the project plan for the Central Laboratory, which exists at DEEC. These building plans and specifications should be made available to NILU at the meeting at DEEC on Wednesday 5 Oct. CETUD has requested the payment of 50% of 150 000 DTS (1 DTS= 780 FCFA) to start building the Central Laboratory inside the bigger building for DEEC.

CETUD reported that Mr. Sagna had contacted CERER in order to start cooperation within the framework of this project for exchange of meteorological data, as requested by NILU. The agreement has not been concluded, since the president of CERER had not at the time answered the letter from CETUD and had not formulated which compensation they expect from the project. CETUD requested NILU to negotiate the final agreement with CERER. NILU indicated that a possible already informally suggested compensation could be a new PC for CERER. CETUD agreed to this project expense as long as it would not mean an extra expense for the total cost of the project and suggested it to be under " frais divers - carte SIG de Dakar", which has obtained at no cost.

NILU asked about the GMAT traffic data. CETUD informed that the engineer responsible for the GMAT project at CETUD, Mr. Diako, was still in London and

CETUD has apparently not yet received the reports from GMAT. Mr. Latyr Ndiaye requested NILU to make a written request of the data, specifying in detail the necessary traffic data for the current project.

10 copies of each of the following reports were handed out to CETUD:

- Mission 1 report (Rapport de demarrage);
- Echantillonnage Passif du SO_2 et du NO_2 dans l'air ambiant à Dakar, Etude préliminaire, Juin 2005.

Cristina has handed one original copy of the Contract between NILU and CETUD and reported that the other copy had been sent directly to Mr. Mats Borgenvall in NDF.

It was agreed that in the future all project e-mails and letters will be sent directly to the director of the CETUD.

The NILU invoice for the period 01/01/2005 to 31/08/2005 and the progress report (Rapport d'avancement 01/01/2005-31/08/2005) were handed out to the director's secretary, as agreed with Mr. Ndiaye during the meeting.

Appendix C2

Client:
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Project:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Appendix C10

Title	**Discuss contribution of Mbow to project**
Date	4 October 2005
Participants	Cristina Guerreiro (CBG), Bruno Legendre (BL), Cheick Mbow (CM)
Author	CBG
Distribution	Mission 2 report
Reference No	O-105010

The meeting was a short discussion of the contributions of CM to the project. The following was discussed and agreed:

CM has the total use of coal for Dakar. It could be affected to the different areas of Dakar by scaling by population, but since the use of coal is also varying with the area, CM will try to apply, in addition, a correction factor so that the coal consumption in each area reflects both the number of inhabitants in the area and the type of area. CM will also try to see if there are more refined information on Coal consumption by area within Dakar.

There is a report from the WB on the emissions of methane from the uncontroled landfield at Mbeubeuss, BL has given an electronic copy of the report to CBG. This is the main landfield in Dakar. The other smaller landfields are only used for intermediate deposition of waste, before transport to the final destination Mbeubeuss. It is unknown how long the waste stays in the intermediate landfields and if they have spontaneous burnings. CM would check this point. The GIS map of Dakar has defined the areas of these landfields and of Mbeubeuss.

Industrial sources:
CM has worked on the original list of 3 sector activities registered in Dakar and has now a list only comprising the industries. He would send this list to CBG, so that CBG would chose a small list of main industries for which CM will collect some data on stack coordinates and height. This smaller list will also be based on te information obtained from the database at DEEC.

CM informed that the GIS map shapes has been converted to the same projection of the coordinates as the satellite images.

It was agreed that all the raw rata from the measurements during the screening study, as well as the report, will be given to Aminata Guey, for her use in her PhD work.

CM may have installed AirQUIS during the project, if possible. There may be a problem in the ORACLE license.

A new meeting to see and approve the work done so far and discuss future work in detail was scheduled for Friday 15 h.

Appendix C3

Client:
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Project:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Appendix C3

Title	**Meeting at CERER**
Date	5 October 2005
Participants	Cristina Guerreiro (CBG) Bruno Legendre (BL) Mactar Sall
Author	CBG
Distribution	Mission 2 report
Reference No	O-105010

The objective of this meeting was to agree on the terms of cooperation between CERER and CETUD, within this project.

CBG explained Mr. Mactar Sall that NILU was starting a field campain (screening study) with measurements of air quality over Dakar for which NILU would like to have meteorological data, in order to improve the interpretation of the results. CBG said that the hourly meteorological data (wind speed, wind direction and temperature) CERER is measuring between 01 Oct and end of Desember 2005 would be very useful for the project and that a future cooperation, where CETUD/Air Quality Laboratory and CERER could exchange data and knowhow on meteorological measurements would be advantageous for both parts.

Mr. Sall said that the director of CERER was positive to the request of cooperation he had received from the director of CETUD. It was agreed that the project would offer CERER a PC in order to improve their data collection and storage capacity, since CERERs present equipement is rather old and unable to take backups of the data. It was further agreed that the director of CETUD would send a written propostion of cooperation to the director of CERER with a concrete offer of data equipement to the CERER.

Appendix C4

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Sous-traitants: Performances, Senegal
Prestige, Senegal

Project:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Appendix C4

Title	**Meeting with Mr. Karfa DIAKO on traffic data**
Date	5 October 2005
Participants	CETUD: Mr. Karfa Diako NILU: Cristina Guerreiro Performances: Bruno Legendre
Author	CBG
Distribution	Mission 2 report
Reference No	O-105010

The objectiv of this meeting was to obtain information on GMAT's project progress and agree with CETUD on the form of the request to GMAT for traffic data.

Mr. Karfa Diako informed NILU that some problems had occurred in the progress of GMAT's project and that they planned to finish the reference scenarion (current traffic situation) for Dakar in November 2005. He insisted that NILU should use the traffic data presently being generated by GMAT, because it will be the best available to caracterise the traffic in Dakar at the present stage.

NILU presented Karfa Diako the request NILU had prepared with the list of the necessary traffic data, attached here under. Mr. Karfa Diako informed NILU that he already had mentioned to GMAT NILU's need for traffic data and it was agreeded that NILU would send directly the request of the data to GMAT.

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Sous-traitants: Performances, Senegal
Prestige, Senegal

Project:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	N°: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Titre	**Traffic information needed from GMAT's project for CETUD**
But	Collect the available traffic data from GMAT's project for CETUD
Distribution	CETUD, GMAT
Auteur	Cristina Guerreiro (project leader)
Date	04.10.2005
Référence No	Task 7/CBG

The Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Management System for Dakar. This project is part of the component entitled as "Amelioration de la qualité de l'air en milieu urbain" (QADAK) of the "Programme d'Amélioration de la Mobilité Urbaine" (PAMU) operated by CETUD.

In order to be able to model the dispersion of air pollution from traffic within this project, it is necessary to obtain a set of data on the road network and traffic in Dakar. This kind of data is currently being generated within the project GMAT is working on for CETUD. NILU wishes to obtain the available data GMAT has generated within their project and in the digital format that is available. For details, direct contact must be established between NILU and GMAT.

The necessary data is described as follows:

a) A description of the complete road network in Dakar as a digital map, given as shape files (and associated files including a .dbf file) containing:
   - Static road link data:
     1. Unique ID and name for each road link;
     2. Start and end node coordinates for each road link (road section);
     3. Length of each road link;
     4. Total road width or number of lanes (in both driving directions);
   - Dynamic road link data:
     1. Annual daily traffic (ADT) (total or in each direction) for each road link;
     2. Average driving speed for each road link;

3. Vehicle class fraction in percentage for each road link, corresponding to the registered vehicle classes (e.g. private cars and taxis, heavy duty vehicles, cars rapides, busses, “ndiagadiaye”, etc.).

b) Vehicle class statistic for Dakar:
   - List of registered vehicle classes defined for dynamic road link data nr. 3, private cars and taxis, heavy duty vehicles, cars rapides, busses, “ndiagadiaye”, etc.
   - Percentage of vehicles with diesel/gasoline engines for each registered vehicle class;

c) Traffic time variation:
   - Weekly variation in traffic flow for the whole year (52 weeks)
   - Daily variation in traffic flow for an average week, divided in 7 days or 5 weekdays, Saturday and Sunday;
   - Hourly variation in traffic flow for an average weekday, Saturday and Sunday.

Appendix C5

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Project:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Annexe C5

Titre	**Meeting at DEEC**
Date	6 October 2005
Participants	Cristina Guerreiro (CBG), Bjarne Sivertsen (BS) Bruno Legendre (BL), Pascal Sagna **Mme Toure, Mme Seck, Gatta Ba, Mr. SOW**
Auteur	CBG
Distribution	Rapport de mission 2
Référence No	O-105010

The objectives of this meeting were the following:

- Present the needs of the laboratory in terms of personnel (Annexe D);
- Discuss the time schedule for engaging these personnel before the project seminar in March (Annexe E);
- Present the needs of the laboratory in terms of building and equipment (Annexe F);
- Get information from DEEC on the plans of the building, financing plans, schedule of construction; constructor if chosen;
- Agree on a temporary solution to host the laboratory from 1 March 2006 until the the new building is operative;
- Get the view of DEEC on the present structure of the air quality management in Dakar
- Present the « Calendrier d'identification des parties intéressées au projet et de description de la situation de gestion de qualité de l'air présent» (Annexe G).

Laboratory site

The DEEC has a site.
It's objective is the construction of a six-storeyed building.
In a short-term, it is to achieve a first stage of three floors, for the accommodation of a conference room, some offices and 3 laboratories: air quality laboratory, water quality laboratory, and a hazardous waste managing center.
Plans have been realized.
A building contractor has been identified by mutual agreement : it's EGEEB the company of Masse Sall. He has established an estimate of 129 MFCFA HTVA and the project market has been submitted to the 'CNCA (Commission Nationale des Marchés)'.

The Netherlands budgetary support for the the year 2005, is about 120 MFCFA.

In October 2005, the Environment Ministry asked the project management to be entrusted to AGETIP. A meeting has been held on the 07/10/05, and a previsional plan for the carrying out of this building site has been issued.
This new project includes, the building of the Environment Ministry head-office.

Recruitment of personnel
The DEEC will lead the recruiting operation, but the advertisement costs will be supported by CETUD.

The current practice of english language cannot be established as a recruiting condition, but only as an advantage. Besides, if the presence of Bjarne to the interviews with the preselected candidates is wished, he has to be with an interpreter (BRL) in order not to penalize the candidates whose english is not perfect.

The planning proposed by NILU, with an objective of taking up one's duties at the end of february 2006, is approved. The DEEC asserts to have buildings which could be assigned to them at this date, at least 2 offices, but the provision of a 3rd office would ensure the existence of a sufficient space to lodge the laboratory while waiting for the end of the building work

Air quality management structure
The DEEC has the role to control pollution and nuisances.
Among the actions undertaken relevant to air quality there are :

- Elaboration of the code of environment, regulation texts, standards
- Achievement of pollution measurements, with the Pasteur Institute, in 2004
- Current approval of many laboratories : CERES-Locustox formerly specialized in pesticides research, but who has now skills in water and air, 'Laboratoire de Physique de l'Atmosphère (Ecole Supérieure Polytechnique)'
- Acquisition of a mobile laboratory : équipped at present to measure SO2, CO, O3, and progressively NOx (2005), COV, PM2.5, PM10 (2006). It's also equipped with a meteorological station.
- Sensibilisation of sensitive groups as the constabulary (environment squad) and the police : workshop project on familiarisation with the questions relevant to pollution and its control. The objective is to lead them to collaborate in the implemantation of standards.

DEEC has given to NILU 3 copies of the video recently made about the PAMU program.

BS promised to write (in english) a memo on the preliminary results from the screenning study, to be given to DEEC in the beggining of the next week.

After the meeting, Mr. SOW showed CBG, BS and BL the mobile station DEEC had just acquired. The station is equipped with a SO2, CO and O3 monitors. In addition, DEEC is going to acquire for the mobile station one Nox, one PM10 and one VOC/BTX monitor, as well as an electricity generator.

Appendix C6

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Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Appendix C6

Title	**Meeting at Centre de Suivi Ecologique (CSE)**
Date	7 October 2005
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS) Performances: Bruno Legendre (BL) CSE: Jacques-André Ndione, climatologue Assize Toure, technical director
Author	BRL
Reference No	O-105010

The objective of this meeting was to know what is the work that is presently done in CSE that could be of interest for the Air Quality Lab and to define the role of CSE in the Air Quality Management Structure.

Institutional position of CSE

- CSE is an 'Association d'Utilité Publique' this gives it the capacity to both get financing from the government and be directly financed by donors or through the sales of its services. Actually the government's contribution to CSE consists in affectation of 3-4 human resources (which receive a complementary indemnity by CSE), tax exemption, and occasionally furniture and equipements
- CSE's board of directors is headed by the ministry of Environment.
- In the set up of the ministry of Environment, CSE appears at the same level of authority/competence than the 3 other departments ('Directions'). It is important because it means that CSE is completely independent from the Direction of Environment : both of them report directly to the ministry. They can collaborate on specific projects, but only on the basis of mutual agreements. They actually are working together on various issues :
  - Climate change
  - Elevation of the sea level
  - Environmental Impact Studies
- CSE has established collaboration agreements with various other institutions, such as

- LPA (Laboratoire de Physique de l'Atmosphère) for the implementation of a 'Environment and Health' research project.
- DMN (Direction de la Météorologie Nationale), from which they can get, free of charge, any meteorological data (upon justification of their use).

Organisation

CSE is organised in three departments

- Geomatic (GIS, databases, teledetection…)
- Natural resources management and environmental impact assessments
- Environmental monitoring (monitoring of agricultural production, biomass production, bush fires…)

It is to participate in the Green House Gazes new inventory which has started in 2004, implemented by the National Climate Change Committee and is coordinated by DEEC (Massamba Ndour).

The National Climate Change Committee (actually headed by EH Diagne, representative from SPIDS) is composed of 2 sub-committees, Energy and Carbon, and another GHG sub-committee is to be created.

Air Quality

CSE has not been involved in the conception of the setup for the establishment of the Air Quality lab.
In 1998, it has only been discussed the eventuality to created within CSE an 'Environment Laboratory'.

CSE is publishing annually and updated 'Annuaire de l'Environnement', which makes an inventory of all the actors in the field of environment and the data they are collecting or working with.

CSE is going to publish shortly (novembre 2005 ?) a report on the state of the environment in Senegal. LPA and DEEC have collaborated on this report, which might approach the thematic of air quality.

Appendix C7

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Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Appendix C7

Title	**Meeting at LERG on GIS data for Dakar**
Date	7 October 2005
Participants	Cristina Guerreiro (CBG), Herdis Laupsa (HeL) Bruno Legendre (BL) Cheick Mbow (CM), Aminata Gueye
Author	CBG
Distribution	Mission 2 report
Reference No	O-105010

The objective of this meeting was to be informed on the work progress so far and agree on a work plan for the next months.

CM gave CBG an excel file with population data on 3 levels: department, arrondissement and commune d'arrodicement. CM will input this data into GIS format, in order to have shape files with population data at the lowest level: commune d'arrodisssement.

CM will transform the shape of the airport into the old projection of the GIS map of Dakar.
CM gave to NILU a file with monthly average meteorological data for 53 years (from 1950 to 2003), comprising: wind speed, wind direction, temperature, precipitation, relative humidity and insulation.

It was agreed that the actions to be taken concerning the collection of coordinates and height of stacks from the main industrial sites would depend on the enquiry that might be conducted by the SPIDS to the main industries. BL will follow up this question and directives will e given to CM later.

CM will make the shape of the area of the waste disposal land field of Beubeuss.
The list of the main industries in Dakar will be finished after the final meeting.

LERG will deliver a shape of the coastline and the digitalised topography.

Cristina mentioned that Aminata could get training within dispersion modelling during the Mission in March, in the workshop for the experts. CBG will send references on literature giving an introduction to air pollution dispersion modelling.

CM asked if it would be possible to have AIRQUIS installed on his computer, since this would facilitate his work within the project. CBG answered that NILU was considering allowing AIRQUIS installations in some universities/research institutions for use restricted to internal and research work and for divulgation of the software in the country. CM would never the less need to have an ORACLE license. CBG will take up this question at NILU.

Appendix C8

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Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Appendix C8

Title	**Meeting with Prof. Ibrahima Ly on environmental legislation in Senegal**
Date	10 October 2005
Participants	Cristina Guerreiro (CBG), Bjarne Sivertsen (BS) Bruno Legendre (BL) Ibrahima Ly
Author	CBG
Distribution	Mission 2 report
Reference No	O-105010

The objective of this meeting was to define and clarify the contribution NILU expects from Ibrahima Ly to the project.

CBG explained that the expected contribution from Prof. Ly to the project was a compilation of all legislation texts regarding air quality and environmental impact assessment in Senegal, including "norms", "décrets", "arrêtés", etc. issued from various ministries like Environment, Transport, Energy, etc. In addition, a short summary on the contents of these texts was required.

It was agreed that Prof. Ly will make a list of all legislation related with Air pollution /AQ and Environmental Impact Assessment (EIA), including information on which institution edited the legislation, the previewed control authority, the type of sanctions for non compliance, and if the law has been applied in practice, or if it is just written, without implementation. This list and the compilation of all the legislation texts (in electronic format whenever available and in paper) will be delivered before the end of November. Legislation on the technical control of the vehicles will also e included.

Appendix C9

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Sous-traitants: Performances, Senegal
Prestige, Senegal

Project:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Appendix C9

Title	**Meeting with M. Pascal Vardon at Ministère de L'Environnement on industrial emission data**
Date	10 October 2005
Participants	NILU: Cristina Guerreiro (CBG) Performances: Bruno Legendre Pascal Vardon
Author	CBG
Distribution	Mission 2 report
Reference No	O-105010

The objective of this meeting was to discuss with M. Pascal Vardon the best way of obtaining the necessary information on the emissions from the main industries in Dakar.

Mr. Vardon informed us that the DEEC is planning a measurement campaign of the emissions of some chosen industries in Senegal. Cristina received from Mr. Vardon the description of the planned measurement.

Cristina pointed out that after our 1st Mission to Dakar and after the meetings hold with Institute Pasteur and the DEEC we had arrived to the conclusion that there are no laboratories in Senegal with the competence and the tools to make stack emission measurements. Cristina presented to Mr. Vardon the US-EPA standards for particle (PM10) sampling and the list of promulgated test methods for the measurement of particle and gases concentrations in the emissions, as well as the determination of flow rate and velocity (Method 2 of US-EPA).

Since the price of engaging a foreign laboratory for these measurements would be above the available budget, we proposed that the budget would rather be used on an inquiry to some main industries in Great Dakar area in order to have the necessary information to estimate the emissions, rather than in emission measurements that would not be done following the standards. Bruno informed Mr. Vardon that the SPIDS were willing to cooperate with CETUD within our project, but that they do not have the capacity to execute this enquiry at the present stage, given

their limited human resources. Never-the-less SPIDS is willing to lead such an enquiry to their member industries, if they were given the necessary resources.

We agreed with Mr. Vardon that he would contact Mr. Cheikh Sylla at DEEC, currently away on mission, in order to discuss the replacement of the emission measurements for the air component only (the measurements of emissions to water would remain as planned) with an inquiry lead by the SPIDS. We also agreed that NILU would support in the definition of the ToR for such a project and would prepare the forms of the inquiry to be filled in by the industries, as well as the list of industries to be inquired. This work would have to be done until the end of October.

Appendix C10

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Agreement:	Nº: 003/C/FND/05

FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Appendix C10

Title	**Meeting with the president of AfricaClean in Senegal, Pr. Amadou Diouf, at the Depatment of toxicology at UCAD.**
Date	11 October 2005
Participants	Cristina Guerreiro (CBG), Bjarne Sivertsen (BS) Bruno Legendre (BL) Pr. Amadou Diouf
Author	CBG
Distribution	Rapport de mission 2
Reference No	O-105010

The objective of this meeting was to present the project goals and main activities to Pr. Amadou Diouf and to know the projects and actions Africa Clean and Department of toxicology at UCAD are involved in within air pollution and related health effects.

CBG presented the main goals and activities of the project, in particular the screening study currently done and in the future the installation of an air quality monitoring nettwork that will generate air quality data. Long-term series of air quality data is necessary to do epidemiological studies, in order to study the relationship between some air pollution indicators and health effects on Dakar's population. This would be a usefull area of cooperation between Africa Clean, the Dep. Of toxicology and the future Air Quality Laboratory, and it would support the future air quality management in Dakar.

Pr. Amadou Diouf made a short presentation of the Africa Clean network. There are 15 members in Senegal within the areas of transport, environment and health. Pr. Amadou Diouf gave a short overview over several activities Africa Clean has participated in or promoted, like measurement of emissions from vehicles while stopped with running engine, and air concentration measurements of BTX in Dakar. These projects were known to us from earlier meetings and Mission 1. It was also discussed a study conducted by Pr. Amadou Diouf on the measured concentration of lead (Pb) in the blod of children living in Dakar and in the countryside. The title of the publication on this study is "NIVEAU D'EXPOSITION AU PLOMB ELIMINE PAR LA CIRCULATION AUTOMOBILE – IMPACT SUR LE STRESS OXYDATIF ET LE STATUT NUTRITIONNEL DES ENFANTS SENEGALAIS", by DIOUF A., SHIRALI P., THIAW C., GARÇON G., DIOP Y., FALL M., NDIAYE B., SIBY T., ZERMECK BA D., HAGUENOER J.M.

BL informed that there will be a seminar in March to present the project to all air pollution stakeholders in Dakar, followed by a workshop to discuss the present and future role of each institution/stakeholder in the management of air quality, in cooperation with the future Air Quality Laboratory. Africa Clean and Prof. Amadou Diouf will be invited.

Pr. Amadou Diouf informed that the University of Dakar in cooperation with another French university would organise a Conference in 2006 on environment and health.

Appendix C11

Client:
Conseil executif des transports Urbains de dakar (CETUD)
Route de Front de Terre, B.P. 17 265 Dakar –Liberté - Tél. n°(221) 859 47 20 - fax n°(221) 832 47 44 - E-mail.: cetud@telecomplus.sn

Consultant:
Norwegian Institute for Air Research
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Tel.: +47 63 89 80 00 – Fax: +47 63 89 80 50
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FINANCEMENT: **Fonds Nordique de Developpement**	**Meeting minutes**	QA DAK

Project:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	Nº: 003/C/FND/05

Appendix C11

Title	**End-of-Mission 2 meeting with project team**
Date	12 October 2005
Participants	Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Bruno Legendre (BL), Tidiane Dieng (TD), Cheick Mbow (CM), Aminata Gueye, Pascal Sagna, Mme Seck
Author	CBG
Distribution	Mission 2 report
Reference No	O-105010

The objectives with this meeting were to:

- Summarise the work done so far in the project;
- Present the work done during Mission 2 and the preliminary results from the screening study,
- Make detailed plans for the work ahead until next Mission in March 2006,
- Distribute tasks and responsibilities,
- Agree on a list of main industries in Dakar for the first collection of data to the emission inventory

Cristina gave a summary presentation of:

- The meetings hold during Mission 2 and of the outcomes of those meetings;
- Tasks we have worked on since the beginning of the project;
- Tasks covered during Mission 2;
- Proposed organisational structure for the Central Lab (Annexe G);
- Calendar for employment of experts at the Central Lab (Annexe H);
- Methodology of work for the Evaluation of the air quality management structure (Annexe D).

Bjarne made a presentation of the screening study executed during Mission 2, including conception and design, goals, methods and preliminary results.

Appendix I summarises detailed plans for the work ahead under each task following Mission 2, and specifies deadlines and responsible experts.

The project team selected the 17 most important industries in Dakar for a first collection of data to the emission inventory, namely:

- Afrique Azote
- CCIS at Dakar and Rufisque
- Colgate-Palmolive
- Grands moulins de Dakar
- Industrie Chimique du Sénégal (ICS) Mbao
- SAF – savons (data that Aminata already have)
- Senelec Bel Air
- Senelec Cap-des-Biches
- Société africaine de Raffinage (SAR) - Mbao
- Sococim industries
- Sonacos
- ICOTAF
- GTI – Cap des Biches, Production d'électricité
- SAPEC Peinture – (VOCs, Pb)
- Seigneurie Afrique
- Carnaux Metal Box
- Société de régénération des huiles à Bel Air

AQ DAK

Qualite de l'air en Milieu Urbain de Dakar

End of Mission 2
Meeting
12 October 2005

Mission 2
3 - 12 October 2005

Project team:

- *Cristina Guerreiro*
- *Herdis Laupsa*
- *Bjarne Sivertsen*

Performances:

- *Bruno Legendre*
- *Cheick Mbow*
- *Tidiane Dieng*

Prestige: *Ibrahima Ly*

LERG: *Aminata Gueye*

12 meetings

1. Administrative meeting at Performance
2. Project meeting at CETUD
3. Meeting with CERER
4. Meeting with transport engineer at CETUD
5. Meeting with Direction de l'Environnement
6. Meeting at CSE
7. Meeting at E.S.P Dep. Geomatique
8. Meeting jurist Prof. Ibrahima Ly
9. P Vardon, Ministère de l' Environnement
10. Meeting with psdt Africa Clean
11. Meeting with Mr. Ndiaye CETUD
12. End of Mission

Travail réalisé

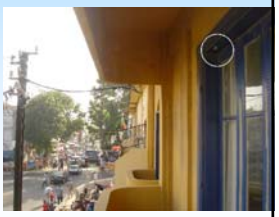
Tâches			Juin	Juil	Aout	Sept	Oct
1		**Evaluation de la structure de gestion de la Qualité de l'Air (QA)**					
	1.1	Evaluation de la structure existante					
	1.2	Recommandations pour l'organisation de gestion de la qualité de l'air					
2		**Evaluation des niveaux de qualité de l'air dans la ville de Dakar**					
	2.1	Identification des données existantes sur la QA et météorologiques					
	2.2	Identification des principales sources de pollution de l'air					
	2.3	Modélisation simple de dispersion					
	2.4	Conception et réalisation des campagnes de mappage géographique de la QA					
3		**Mise en place du Laboratoire central de la qualité de l'air**					
	3.1	Définition des besoins du laboratoire					
	3.2	Définition des compétences du personnel et évaluation des effectifs nécessaires					
7		**Inventaire des émissions**					
	7.1	Identification des données existantes et analyse des lacunes					
9		**Développement des capacités institutionnelles et formation**					
	9.1	Programme de formation sur la Qualité de l'Air					
11		**Appui-conseil en Législation en matière de Qualité de l'Air**					
	11.1	Conseils sur la Législation en Qualité de l'Air					
12		**Gestion et durabilité du projet**					
	12.1	Planification et Coordination					
	12.2	Contrôle de Projet					
	12.3	Elaboration des rapports					

Tasks covered in 2nd Mission

- 1 Assessment of existing AQ management structure
- 2.2 / 7.1 Assessment of the existing data on emissions
- 2.4 Screening study
- 3.1 Specify laboratory requirements
- 3.2 Specify personnel skills and manpower
- 6.2 Establish databases for Dakar specific data
- 9.1 Air Quality training programme
- 11.1 Advice on AQ legislations
  - o Evaluate existing legislation
  - o Air quality standards and guidelines
  - o Standards and institutional responsibilities

Measuring air pollution

Near Sandaga market



The Air Quality Screening study October 2005

QA DAK

Qualite de l'air en Milieu Urbain de Dakar

www.NILU.no

Air Pollution Indicators

First priority pollutants

- SO_2 (Sulphur dioxide)
- NO_2 (Nitrogen dioxide)
- PM_{10} (Particles with aerodynamic diameter < 10 micrometer)
- Pb (lead)

Not all compound in the atmosphere can be measured !

Limit values developed for other indicators:

- Ozone
- Benzene
- CO
- $PM_{2,5}$

Dakar:
PM_{10}, $PM_{2,5}$, SO_2, NO_2, CO, O3, VOC

www.NILU.no

Guidelines and Limit values (µg/m³) WHO & Senegal

Pollutant	Averaging time	Maximum Limit Value	
		WHO	Senegal
Sulphur Dioxide (SO_2)	1 hour 24 hours Year	500 (10 min) 125 50	- 125 50
Nitrogen Dioxide (NO_2)	1 hour Year	200 40-50	200 40
Ozone (O_3)	1 hour 8 hours	150-200 120	- 120
Carbon Monoxide (CO)	1 hour 8 hours	30 000 10 000	- 30 000 (24h)
Particles <10 µm (PM10)	24 hours Year	50 * 30 *	260 80
Lead (Pb)	Year	0.5-1,0	2

**) EU limit values*

www.NILU.no

EU Directives

Particulate matter

Measures as PM_{10} = max. diameter 10 µm, or as $PM_{2,5}$ = max. diameter 2,5 µm.

Time period	Limit value (µg/m³)
24-hour average value, 96 percentile	50
Yearly average value	30

The 96 percentile of the 24-hour average value means that the value may be exceeded at the most 14 times a year.

Limit values, Stage I: *Taking effect January 1, 2005.* Stage II (2010): 50 µg/m³ (98%), 20 µg/m³

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Micro environments and Indicators

Station type /Microenvironment	Compounds
Regional background	O3, NO_2 , SO_2 , PM_{10} ,
Industry	PM_{10}, SO_2, NO_2, VOC,
City centre	PM_{10}, $PM_{2,5}$, NO_2, SO_2, O3, CO, VOC
Traffic/street canyon	PM_{10}, NO_2, SO_2, CO, VOC
Urban background	PM_{10}, NO_2, SO_2, O3
Suburban	NO_2, SO_2, O3

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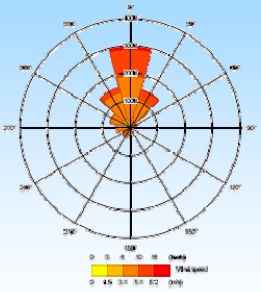
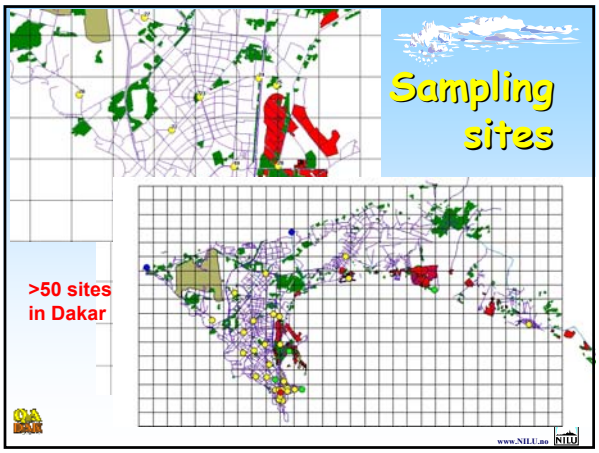
Wind Rose Dakar (1997-2001)

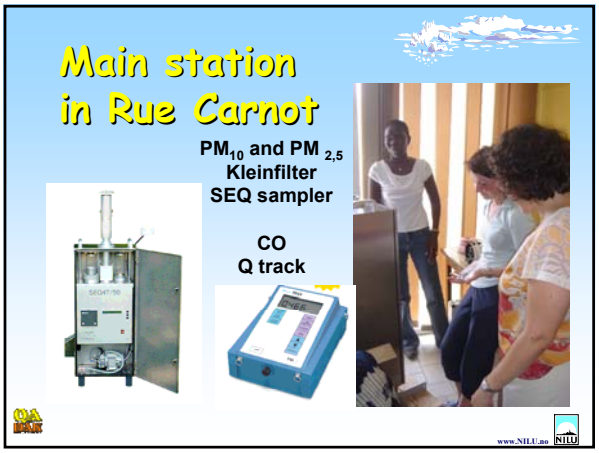


L'évaluation s'est basée sur des données météorologiques relevées à Dakar toutes les heures pendant cinq ans par le cabinet de consultants Trinity. Les données portent sur les années 1997 à 2001. Dakar est le lieu le plus proche qui soit représentatif des conditions météorologiques rencontrées sur le site de la future implantation. La rose indique que le vent dominant vient du nord.

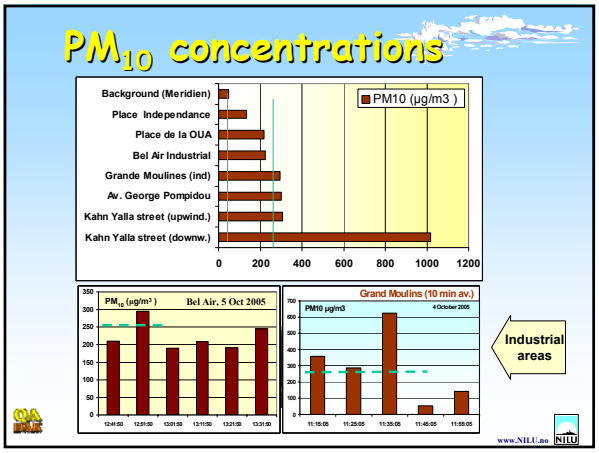
www.NILU.no

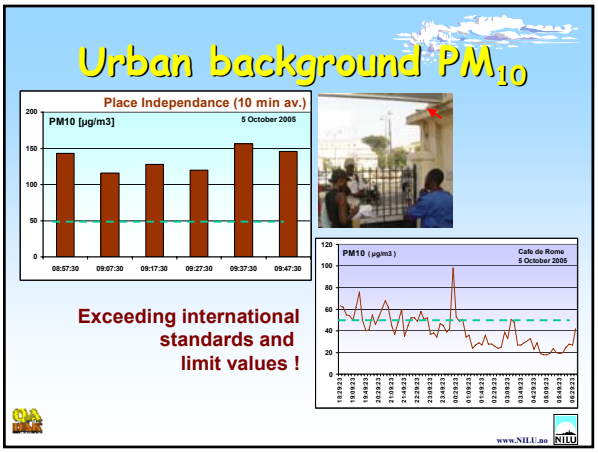

Sampling sites
>50 sites in Dakar
www.NILU.no


The passive samplers
Plastic tube
Impregnated filter
Pre filter
The passive sampler
www.NILU.no

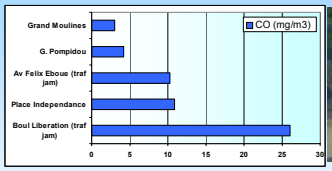

Main station in Rue Carnot
PM10 and PM 2,5
Kleinfilter
SEQ sampler
CO
Q track
www.NILU.no


Pl. Catral
Sites
Khar Yalla
Marche Sandaga
www.NILU.no

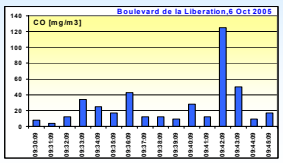

PM10 concentrations
Background (Meridien)
Place Independance
Place de la OUA
Bel Air Industrial
Grande Moulines (ind)
Av. George Pompidou
Kahn Yalla street (upwind.)
Kahn Yalla street (downw.)
PM10 (µg/m3)
0
200
400
600
800
1000
1200
Bel Air, 5 Oct 2005
Grand Moulins (10 min av.)
Industrial areas
www.NILU.no


Urban background PM10
Place Independance (10 min av.)
PM10 [µg/m3]
5 October 2005
Exceeding international standards and limit values !
Cafe de Rome
5 October 2005
www.NILU.no

CO in the streets of Dakar



High CO in streets with traffic jam



Preliminary screening

Weekly average concentrations :
SO_2 : from 5 to 60 µg/m³
NO_2 : from 21 to 68 µg/m³

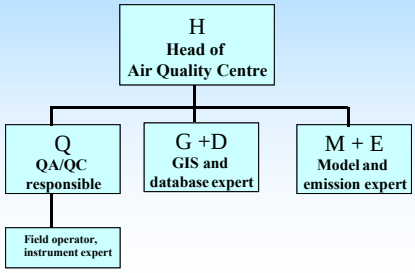
Sampling period				Sampling period	Site name	Average Concentrations µg/m³	
From:		To		Days	Position		
date	hr.	date	hr.			SO_2	NO_2
31.5.05	0800	7.6.05	0830	7.0	Café de Rome	60	68
31.5.05	0830	7.6.05	1405	7.2	CETUD	30	40
1.6.05	0907	7.6.05	1745	6.4	Universitetet	19	28
1.6.05	0930	7.6.05	1725	6.3	Boulev Centannaire	14	21
1.6.05	1400	6.6.05	1500	5.0	Performances	5	
1.6.05	1200	1.6.05	1430	0.1	In traffic		344

NO_2 40 µg/m³
SO_2 50 µg/m³

Conclusions
from preliminary analyses !!!

- ✓ The main problem is PM
- ✓ PM exceeds all standards!
- ✓ High CO in streets with dense traffic
- ✓ NO2 may exceed standards near streets and roads
- ✓ SO2 has not been identified as a major problem yet, Industrial areas?

Proposed organisational structure for the Central Lab



Calendar for employment of experts at the Central Lab

Date	*Action*
Latest 30/10/05	**Publication of job announcements**
Beginning of December	**Pre-selection of candidates based on CVs**
Middle of January	**Job interviews w/ BS**
30/01/2006	**Final selection / Invitation of selected candidates for the positions**
01/03/2006	**Start work at the Central Lab**

Evaluation de la structure de gestion de la Qualité de l'Air

Methodology of work:

- Identification of stakeholders

Beginning Dec.	BL sends proposed list of stakeholders to DEEC and CETUD
Beginning Jan.	Final stakeholders list including suggestions from DEEC and CETUD
January	Invite identified stakeholders to kick-off seminar and workshop

- Project kick-off seminar with presentation of the project and work done so far;
- Stakeholders workshop to discuss the role of each within AQ management and recommendations for a future AQM structure

Actions and responsibilities

	Actions to take / To do	Respon sible	Partici pants	Deadline
1. Évaluation de la structure de gestion de la QA				
1a	Identify Air Quality stakeholders Send list of stake holders to CETUD and DEEC for their input Finalise list of stake holders and invite them too the Project Seminar & Stakeholders workshop Describe AQ management structure considering input from workshop Elaborate proposition for future AQM structure	BL BS	BS, CBG BL, CBG 	Nov. Dec Jan 06 Apr 06 Apr 06
1b	Collect all norms and legislation regarding AQ in Senegal	IL	BL, BS, CBG	Aug 05
1c	Write report on evaluation of present and recommendation on future structure	BS	BL, CBG	May 06
2. Évaluation des niveaux de QA dans la ville de Dakar				
2a	Finalise cooperation agreement with CERER	CETUD	BL	Oct
2b	Maintenance of PM10/PM2,5 and CO monitors	Aminata	BL	Nov
2c	Collect SO2, NO2 and O3 passive samplers	Aminata	BL	Nov
2d	Send passive samplers to NILU for analysis / Send monitors to NILU	BL	Aminata	Nov./ Dec
2e	Analyse passive samplers	NILU		Dec
2d	Write screening study report	BS, HeL	CBG,BL TD	Jan 06

Actions and responsibilities

	Actions to take / To do	Respon sible	Partici pants	Deadline
3. Mise en place du Laboratoire central de la QA				
3a	Send specifications of the Central Lab to NFR and report on building status	CBG		Oct
3b	Publish job announcements for the Central Lab	DEEC	BL, CETUD	Oct
3c	Pre-selection of candidates based on CVs	BS & DENV	BL, CBG	Dec
3d	Selection interviews /approval of candidates	BS & DENV	BL	Jan
3e	Identify temporary place for the Central Lab	DEEC	CETUD	Jan
3f	Furnish and install internet connections and telephone in temporary Central Lab	DEEC	CETUD	Feb
3g	Equip the central lab with hardware/software	BL	TD	Feb
3h	Make the necessary actions for the import of the server to Senegal free of tax	CETUD		May/ June

Actions and responsibilities

	Actions to take / To do	Respon sible	Partici pants	Deadline
6. Établissement et fonctionnement d'un Système de gestion de la qualité de l'air				
6a	Send shape files of aeroport, coastline and Beubeuss in GIS map projection to HeL	CM	HeL	Nov.
6b	Complete shapes with population data on commune d'arrondissement	CM		Nov.
6c	Check if there is information on coal consumption data on areas on Dakar	CM		
6d	Get road network and traffic data from GMAT (shape files)	CBG	CETUD	January
6e	Fit shape files from GMAT into QADAK GIS	CM		
7. Inventaire des émissions				
7a	Identify main industries in Dakar area	CBG	BS, CM, BL	October
7b	Design inquiry for data on industries Collection of necessary data from industry? Get coordinates and height of staks from main industries	CBG	 SPIDS? CM?	October Nov-Jan
7c	Work on emission factors for vehicle park in Dakar	CBG		

Actions and responsibilities

	Actions to take / To do	Respons ible	Participa nts	Dead line
9. Développement des capacités institutionnelles et formation				
9a	Plan and prepare Project Seminar in March 2006	CBG, BL	BS, HeL, TD	Nov-Feb
9b	Plan and prepare Stakeholders workshop in March 2006	BL	CBG, BS, TD	Feb
9c	Plan and prepare workshop on introduction to meteorology, dispersion models and air quality planning	BS	BL, CBG, HeL, TD	Feb
11. Premier évaluation de la législation en vigueur en matière de qualité de l'air				
11a	Make a compilation on present legislation, air quality standards and limit values for Senegal.	IL		Oct
12. Gestion et durabilité du projet				
12a	Rapports d'avancement trimestriels, rapports financiers, facturation	CBG	BL	Dec
12b	Plan d'intervention du personnel du consultant pour Dec 05 – Mai 06	CBG	all	Nov
12c	Establish formal agreement with Meteo	CETUD		

Final comments

- Objectives of Mission 2 were met
- Next Missions:
  - January 2006 – Job interviews (BS)
  - Beginning of March 2006 (CBG, BS, HeL)

Tasks and obligations will be followed-up

Keep in touch on: QADAK@nilu.no

Reports/Working documents on:
http://www.nilu.no/pip/login.cfm
User: qadak_user ; Pwd: qadak

Norwegian Institute for Air Research

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Appendix D

Working plan for Task 1 - Evaluation of existing AQ management structure

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Urbains de Dakar (CETUD)
Route de Front de Terre, B.P. 17 265 Dakar–Liberté
Tél. n°(221) 859 47 20 - Fax n°(221) 832 47 44
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P.O. Box 100, N-2027 Kjeller, Norvège
Tél. n°(47) 63898000 – Fax n°(47) 63898050
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FINANCEMENT: **Fonds Nordique de Développement**	**MEMO**	QA DAK

Projet:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Contrat:	Nº 003/C/FND/05

Titre	**Description de la structure de gestion de la qualité de l'air à Dakar**
But	Méthodologie
Distribution	CBG, DEEC, CETUD
Auteur	BL
Date	05/10/05
Référence No	inst-051005

L'élaboration de la description de la structure de gestion de la qualité de l'air à Dakar se déroulera en 3 étapes :

1. **Identification des parties concernées par la problématique de gestion de la qualité de l'air**

   L'objectif sera d'élaborer une liste d'acteurs, avec une description courte de leurs actions récentes les plus significatives en regard de la qualité de l'air et qui justifient leur intégration dans cette liste.

   On entend par 'acteur' toute structure (administration, association, collectivité locale, entreprise) qui entreprend des actions visant à évaluer la pollution de l'air, analyser ses impacts, la contrôler, informer et sensibiliser le public, etc..

   Cette liste pourra inclure certains acteurs estimés comme 'potentiels' parce que le champ d'action qu'ils se sont donné pourrait les amener à participer activement à la gestion de la qualité de l'air s'ils étaient sollicités.

   Programmation des activités :

   - Début décembre : l'équipe de projet éditera une première liste d'acteurs identifiés à l'occasion des divers contacts qu'elle aura eu et à travers l'étude du cadre réglementaire en vigueur. Cette liste sera communiquée à la DEEC et au CETUD, mais aussi à divers acteurs ayant déjà manifesté leur soutien aux objectifs du projet.
   - Début janvier : intégration des suggestion de ces différents partenaires pour une édition de la liste définitive

2. **Atelier de lancement du projet**

   Les acteurs identifiés lors de l'étape précédente seront invités à participer à l'atelier de 'lancement' du projet qu'il est prévu de tenir au début du mois de mars 2006. L'objectif de cet atelier est de présenter les activités du projet

'qualité de l'air à Dakar' et les premiers résultats des analyses de l'état de la pollution.

Au cours de cet atelier, un moment sera réservé pour présenter les participants et la raison pour laquelle ils sont invités à participer à l'atelier. A l'issue de cette présentation, un débat sera ouvert sur leurs rôles respectifs dans la gestion de la qualité de l'air à Dakar. Il permettra d'affiner notre perception des relations entre ces acteurs : elles constituent le cadre opérationnel de la 'structure actuelle de gestion de la qualité de l'air'.

Eventuellement, une session de travail complémentaire pourra être organisée au cours de l'atelier pour évaluer avec les acteurs intéressés les disfonctionnements et déficiences de la structure actuelle et émettre des recommandations pour son amélioration.

3. Synthèse des discussions de l'atelier : élaboration du rapport 'Evaluation de la structure opérationnelle de gestion de la Qualité de l'Air'

Le rapport sur la structure actuelle de gestion de la qualité de l'air se présentera comme une synthèse de ces divers travaux et débats. En restituant la perception qu'en ont les différentes parties concernées, il permettra de décrire cette structure sous un angle opérationnel.

Dans le planning du projet, il est prévu de remettre ce rapport au 12ème mois, soit en mai 2006.

Appendix E

Preliminary screening results

Preliminary results of the air pollution screening study in Dakar 2005

By: Bjarne Sivertsen, Herdis Laupsa, Cristina Guerreiro

1 Introduction

A screening study of air pollution in Dakar was performed in October 2005. The main objective was to collect background information for designing a permanent air quality monitoring programme for the area in the future. The results give a simplified picture of the total concentration distribution over the city. A preliminary study was carried out in June 2005.

Passive samplers of NO_2, SO_2, VOC and O_3 was located at about 50 selected measurement sites in Dakar city and in surrounding suburban areas. The location of some of the sampling points is indicated on the map in Figure 1.

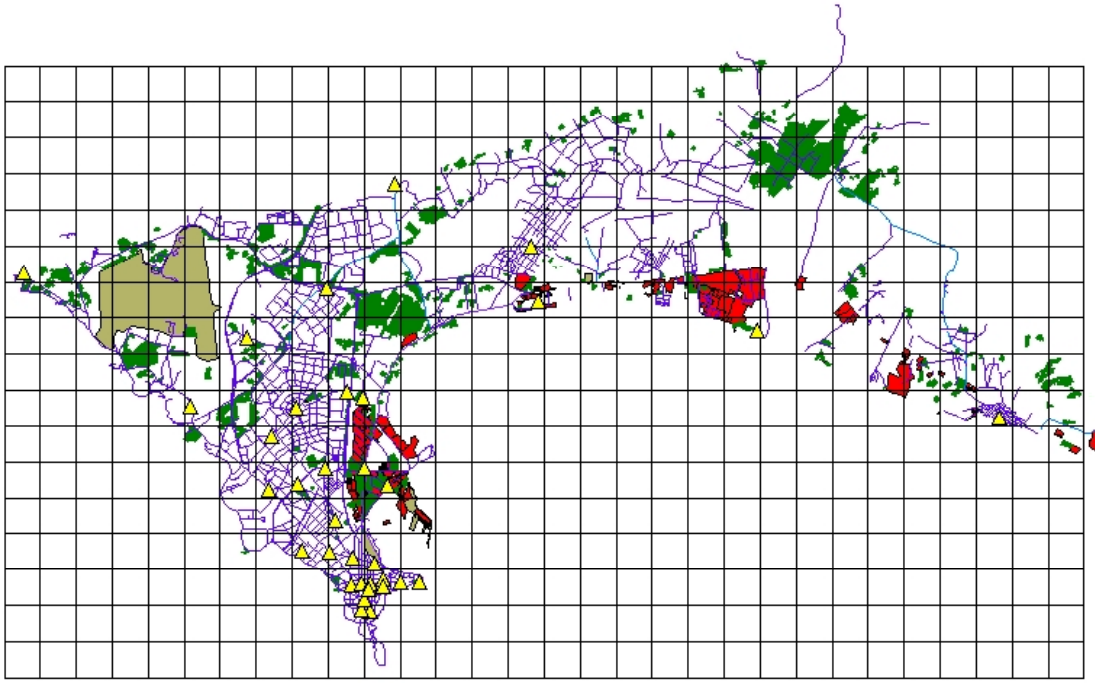

Figure 1: Some locations for the air quality sampling carried out during October 2005 in Dakar.

A sequential sampler for suspended particles (PM_{10} and $PM_{2,5}$) as well as a CO monitor was located in a busy street in the city centre. These instruments will collect data for one month, and results will be available at the end of 2005.

Parallel and in addition to the sampling programme presented above, short term data were collected in selected areas of the city during a campaign lasting from 3 to 7 October 2005. The preliminary results presented in this memo are based on these short-term measurements, as well as results from the preliminary study in June 2005.

The short-term samples included PM_{10}, VOC and CO. Measurements were undertaken in different microenvironments during the screening period. One objective for this part of the study was to identify background concentrations and potential hotspots.

2 Investigation background

The background for the design of the screening is the identification of main emission sources and areas of highest impact of pollution, existing air quality data (Guerreiro, C et. al, 2005 and Guerreiro, C et. al 2005) and meteorological data (Guerreiro, C et. al , 2005).

The sites were selected from three main criteria:

1. Measure in different microenvironments (e.g. road side, urban background, industry area, regional background etc).
2. Selection of component to measure at the different microenvironments depending on emission sources
3. Prevailing wind directions for the campaign period

2.1 Meteorological data

Climatologically data shows that the dominant wind directions in October and November are mainly from around north. Most of the samplers are therefore, if possible, located at the downwind side of the emission sources. Major part of the samplers is located along traverses perpendicular to the prevailing wind. We have designed the sampling program along four traverses as far as feasible.

2.2 Emission sources

The most imported industrial areas and heavy traffic area have been identified. Most of the emissions in Dakar are assumed to be ground level sources.

Traffic jams on some of the main roads produce high emissions of CO. High traffic density on the main roads also lead to large emissions of NOx and particles. The general

activities in the city seem to produce high background levels of suspended particles. The industrial areas, especially located in the eastern part of the city (e.g. Bel Air area) causes emissions of PM, SO_2, VOC and NOx.

2.2.1 Compounds and indicators

A number of air pollution indicators have been selected to identify the air quality level in Dakar. The selections of components to measure in the different microenvironments have been decided by the local emission in sources. A list of typical indicators is presented in Table 1 below.

Table 1: Air pollution indicators measured in microenvironments.

Station type /Microenvironment	**Components**
Regional background	NO2, SO2, PM10, O3
Industry	NO2, SO2, VOC, O3
City centre	NO2, SO2, O3, PM10, PM2.5, CO, VOC
Traffic/street canyon	NO2, SO2, O3, CO, VOC
Urban background	NO2, SO2, O3
Suburban	NO2, SO2, O3

Ozone is a secondary pollutant formed by chemical reactions in the atmosphere. Measurements of ozone, especially in the background air, are essential for understanding the formation of NO_2 in the city.

2.3 Air quality limit values

For the comparisons with some selected international standards, limit values and guidelines we have presented limit values for SO_2 and NO_2 from the European Commission (EU, 1999) in Figure 2.

The air quality guidelines presented by the World Health Organisation (WHO, 2000) are similar to the EU limit values. WHO does not give a limit for PM_{10} as they claim that PM_{10} may have health effects down to the zero exposure level.

Air quality standards have also been presented for Senegal. For SO_2 and NO_2 the limit values are the same as those given by WHO:
SO_2 annual 50 µg/m^3, 24-hour average limit 125 µg/m^3
NO_2 annual 40 µg/m^3 24-hour average limit 200 µg/m^3
For PM_{10} the limit values given for Senegal is much higher than other international standards:
Annual average: 80 µg/m^3 , 24 hour average 260 µg/m^3 .

A summary the EU Daughter Directives limit values are given below.

Averaging time	1 h	24 h	annual
SO_2	350 (24)	125 (3)	20*
NO_2	200 (8)	-	40
PM10 2005		50 (25)	30
Pb			0.5

* related to ecosystems

Stratagic threshold levels 50 - 60 % of AQS

Figure 2: Limit values given by the European Commission (1999).

In addition to the limit values presented above both the European Commission and WHO give limit values for CO concentrations at 10 mg/m^3 as a 8-hour average and 30 mg/m^3 as a one hour average value.

3 Preliminary results

The preliminary results presented below are based on two short campaign periods of air quality measurements in Dakar. PM, CO and VOC was measured during the second campaign from 3 to 7 October 2005.

The first screening period with passive samplers for SO_2 and NO_2 lasted between 5 and 7 days and was undertaken in the beginning of June 2005. If the weather and dispersion conditions during the field measurement periods were representative for the average meteorological conditions, the concentrations of SO_2 and NO_2 measured would be an indication for the long-term average concentrations to be expected in Dakar. PM, CO and VOC measured during the second campaign will have to be compared to hourly or daily concentration limit values.

3.1 PM_{10} concentration

Concentrations of suspended particles in the air as measured by the indicator PM_{10} seem to be the most serious air pollution problem in Dakar. We have during the campaign period tried to cover industrial areas, streets and roads as well as urban and regional background areas.

A summary of results of the short-term field measurements is presented in Figure 3.

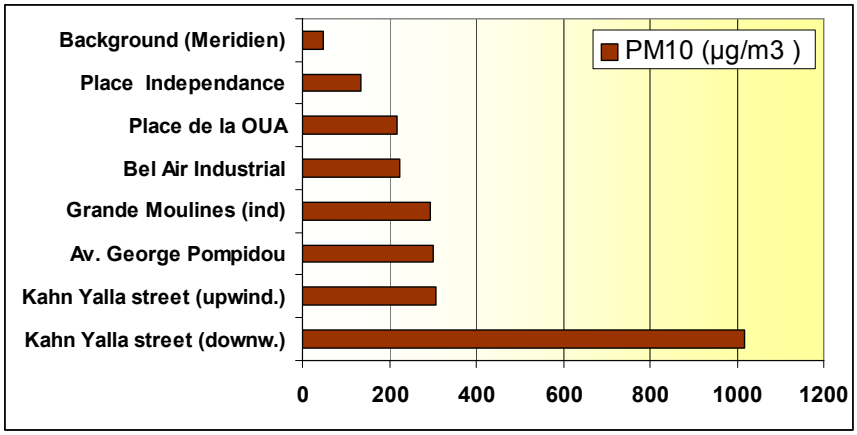

Figure 3: Average concentrations of PM_{10} ($\mu g/m^3$) measured at different sites during the field campaigns in Dakar 4 to 6 October 2005.

In most of the city area PM_{10} concentrations ranged from 160 to 300 $\mu g/m^3$. The highest concentration measured over an average period of ten minutes was more than 1000 $\mu g/m^3$, on the sidewalk of a busy street.

3.1.1 Industrial sites

Generally high concentrations were measured near the industrial areas of Dakar. Average concentration in the industrial area of Grand Moulins was 388 $\mu g/m^3$.

At another site close to the Bel Air industrial areas of Dakar we measured PM_{10} concentrations ranging from 200 to 300 $\mu g/m^3$. These were ten-minute averages, but indicate that very high concentrations of suspended particles are to be expected in this area.

Figure 4 below summarises the ten-minute average concentrations of PM_{10} measured at the two industrial areas of Dakar. If these situations were persistent we might expect daily average concentrations at about 200 $\mu g/m^3$, which is four times the limit values given by the European Union Directives.

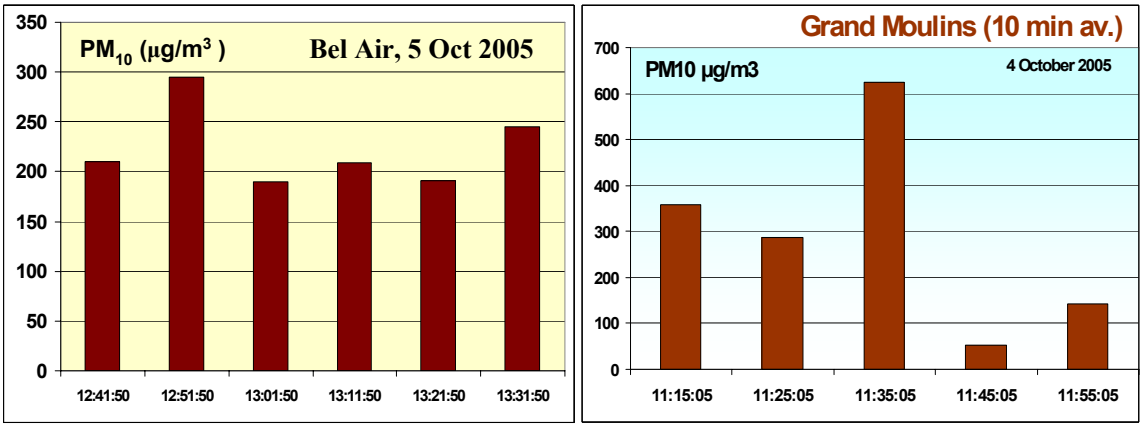

Figure 4: Ten minute average concentrations of PM_{10} ($\mu g/m^3$) measured at two industrial sites during the field campaigns in Dakar 4 and 5 October 2005.

3.1.2 Along streets and roads

In Avenue Georges Pompidou we measured a ten minute average of 301 $\mu g/m^3$.

At Kahn Yallah in the northern part of the city measurements were conducted at both sides of one of the main streets. On the upwind side of the street the ten-minute average PM_{10} concentration was 308 $\mu g/m^3$, downwind from the street the concentration was 1017 $\mu g/m^3$. These measurements indicated that the PM_{10} level around the streets of Dakar may at times be high enough to represent a health problem. The measurements in Kahn Yallah were taken at around 1100 hours on a normal Thursday; 6 October 2005.

Near one of the larger roads at (Rue 4, BCCD) we measured 280 $\mu g/m^3$ at 10:25 hrs on 6 October 2005.

3.1.3 Urban background

To evaluate the typical urban background concentrations of PM_{10} sampling was preformed in the middle of the park area at Place de l' Independence. The data were collected at the fountain away from the streets in the morning of 5 October 2005.

There was no traffic jam on the streets around the square during the sampling period. It was windy during the sampling period and it was partly clouded. The lawn was trimmed during the sampling period.

The ten-minute average concentrations measured at the square are presented in Figure 5 below.

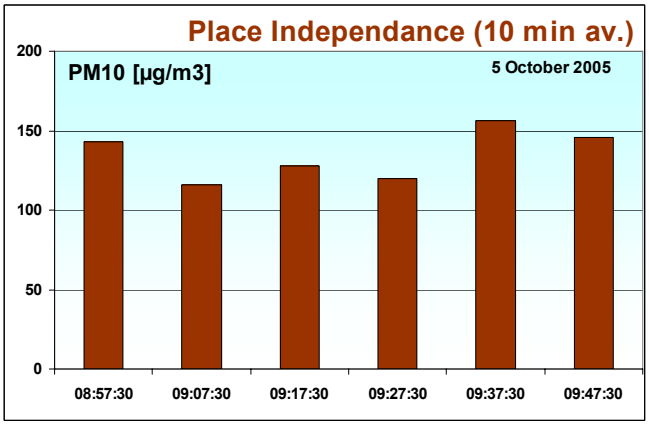

Figure 5: Ten minute average concentrations of PM_{10} ($\mu g/m^3$) measured at Place Independence in the city centre of Dakar during the field campaign on 5 October 2005.

From Figure 5 we see that the PM_{10} concentrations did not vary much during the period of sampling. Ten-minute concentrations ranged between 120 and 160 $\mu g/m^3$. If the situation were typical for Dakar we could expect the diurnal average concentrations also to exceed 100 $\mu g/m^3$ in the urban background air.

To check the nighttime concentrations of PM_{10} measurements were undertaken from the second floor of the Café de Rome hotel in the city centre of Dakar (Bd de la Republique).

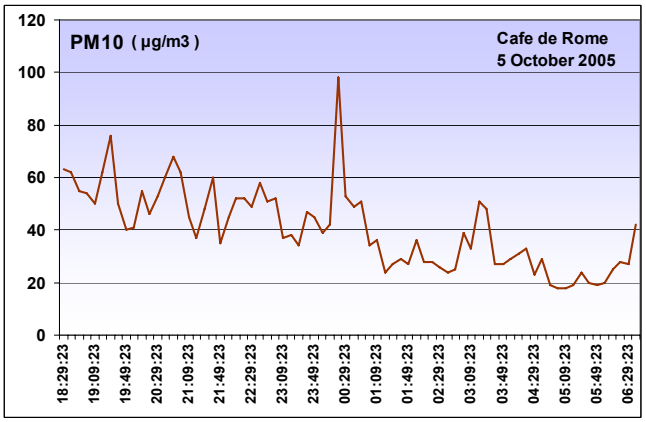

Figure 6: Ten minute average concentrations of PM_{10} ($\mu g/m^3$) measured during night time from the second floor of hotel Café de Rome in the city centre of Dakar on 5 October 2005.

The results presented in Figure 6 indicate that the ten-minute average concentrations ranged from 20 to 100 µg/m^3. Additional measurements taken in the following nights confirmed that the concentrations were in the order of 40 to 60 µg/m^3.

All these data indicated that the PM_{10} concentrations in the urban areas of Dakar are expected to exceed international limit values.

3.1.4 Regional background concentrations

Concentrations of PM_{10} were also measured in regional background areas at the northern coast of Dakar. Measurements were taken at Meridien hotel and in the Yof area. Typical concentrations here were about 40-60 µg/m^3. This was surprisingly high, and indicated that the background air moving into the Dakar area from north east had a fairly high "natural" burden of particles.

These data have to be confirmed with longer series of quality assured measurements of suspended particulate matter.

3.2 CO concentrations

High concentrations of CO might be expected in street canyons during traffic jam. Situations of high CO concentrations are often linked to rush hour traffic.

A summary of some short-term measurements of CO undertaken in Dakar during the field campaigns in October 2005 show in Figure 7 that the concentrations ranged from 3 to 27 mg/m^3.

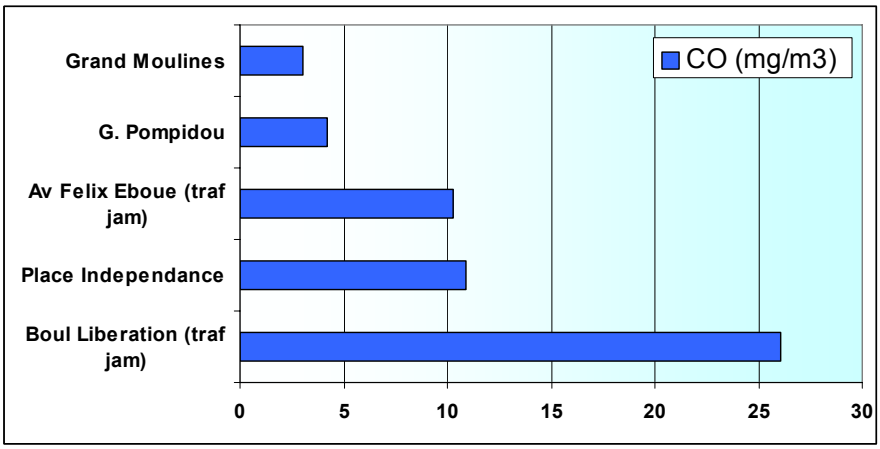

Figure 7: Average concentrations of CO (mg/m^3) measured at different sites during the field campaigns in Dakar 4 to 6 October 2005.

The highest concentrations were measured along a busy street with traffic jam. The two-minute average and one minute average concentrations measured along two busy streets of Dakar are presented in Figure 8.

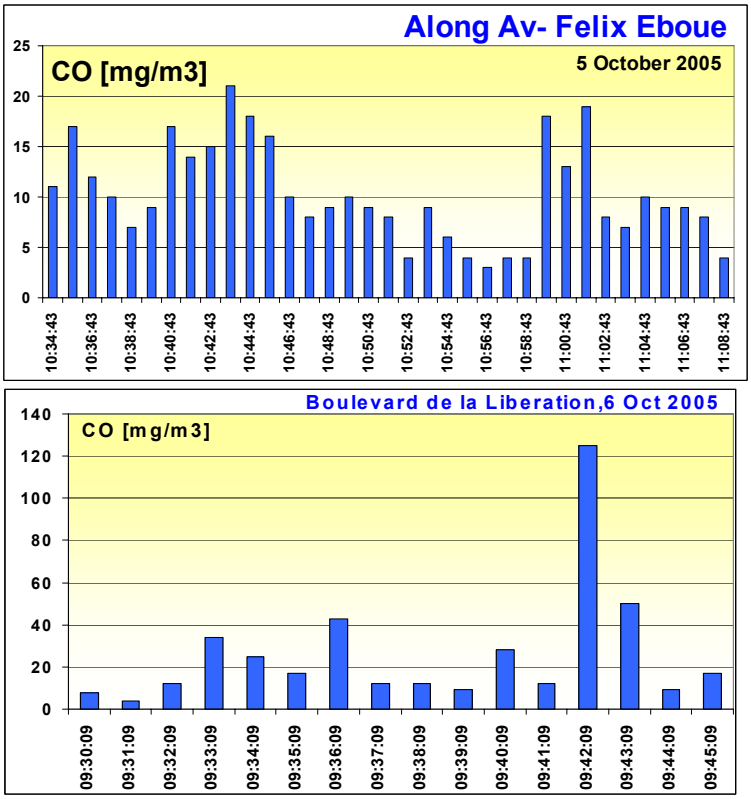

Figure 8: Minute average concentrations of CO (mg/m^3) measured along two streets on 5 and 6 October 2005.

We see that the CO concentrations in a few cases reached more than 120 mg/m^3. Concentrations were also recorded with average times less than ten seconds in streets with high traffic. In many of these cases the concentrations exceeded 100 mg/m^3. Further studies will have to be undertaken concerning CO levels.

3.3 NO_2 concentrations

Some preliminary results from the first passive sampling campaign in June 2005 indicated that the long- term average NO_2 concentrations might exceed the WHO guideline values at two out of four stations. Concentrations across the city (only 6 sites!) ranged from 21 to 68 µg/m^3. The concentration level measured while in traffic was approximately 75% higher than the hourly EU limit value.

The concentration levels were highest at hotel Café De Rome in the city centre of Dakar. This indicates that the most polluted areas might be in the street canyons with high traffic. There are probably other street canyons that are more polluted. As expected the lowest concentrations are at the urban background station.

3.4 SO_2 concentrations

The weekly concentrations of SO_2 measured in June 2005 ranged from 5 to 60 µg/m^3. Similar concentration levels were measured during a field campaign in 2004 (Ndiaye S.A., 2005, personal communication). The air pollution levels are comparable with levels measured in other polluted cities in the world (Sivertsen, 2005).

The SO_2 concentrations were close to or exceeded the EU limit value for long-term average concentrations at three out of the five stations. Only at Café the Rome the SO_2 concentration was above the WHO guideline value.

4 Summary and conclusions

From the very preliminary results of air pollution measurements presented in this memo, there are indications that the air pollution levels in Dakar may exceed international limit values.

The main problem seems to be suspended particulate matter. PM_{10} concentrations have been measured at average concentration levels, which may be 4 to 5 times the international standard levels. However, these standards are linked to the frequency of exceedances, which means that we will have to have data with longer records in time to draw final conclusions.

Many of the streets of Dakar experience frequent traffic jam. Some of our preliminary data shows that CO concentrations may be very high during these periods. Further studies will reveal these "problems" especially in the street canyons of the Dakar city centre.

Some of the NO_2 concentrations collected during the screening studies also indicated that NO_2 concentrations might exceed limit values. The analyses of monthly data from 50 sites selected in Dakar from 3 October 2005 will be available at the end of 2005. We will know more about NO_2 and SO_2 concentration levels after that.

5 References

EU (1999) Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. OJ L, 163, 29.06.1999 p.41.

World Health Organization (2000) Air quality guidelines for Europe. 2nd. ed. København, WHO Regional Office for Europe (WHO Regional Publ., European Series, 91).

Guerreiro, C., Sivertsen, B. and Laupsa, H. (2005) QADAK Mission 1, May-June 2005. Kjeller (NILU OR 45/2005).

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Sivertsen, B. (2005) Air pollution levels. Memo produced for the WHO updated WHO Guidelines. (NILU TR x/2005, in press)

Appendix F

Laboratory requirements on logistics

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FINANCEMENT: Fonds Nordique de Développement	**MEMO**	QA DAK

Projet:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	PAMU/FND/C/08/04

Title	**Air Quality centre room and facilities**
Propose	A first description of provisory facilities for the Central laboratory
Distribution	Cristina (CBG), Herdis (HEL)
Author	Bjarne (BS)
Date	September 2005
Reference No	O-105010

The air quality monitoring and management centre (Central Laboratory), rooms and facilities

Two rooms will be needed to operate the air quality monitoring and assessment programme:

1. The data acquisition and computer centre
2. A calibration and repair laboratory (Reference laboratory)

In addition there may be a request for an additional office for the Head of the Centre (The programme Manager).

The data acquisition and computer centre

The computer room will act as the main centre in the air quality monitoring and management programme.

Figure 1: The interior of a typical computer centre for an air pollution monitoring and assessment programme.

This room will typically be about 5 m x 8 m and include desks and tables for a server with 3 clients. Three experts will be permanently located to this centre. The room need air conditioning.

Calibration and repair laboratory

The calibration and repair laboratory will have to be at least 5m x 5 m. It will include chairs, desk and shelves for papers and printouts. A specific shelf is required for manuals and written procedures.

An instrument rack will be placed along one of the walls to include monitors for multipoint calibrations. The room will also contain calibration gases in steel bottles. The reference lab room air must be ventilated out in order to keep the span gas concentration levels at a minimum.

This room will need air conditioner to maintain a stable temperature in the reference laboratory. It is advisable to locate the room on the ground floor to reduce the difficulties in transporting instruments and calibration gases in and out.

Office for project manager

It may be required to include a room for the project manager. The size of this air-conditioned office may be 3m x 5 m. The office will be equipped with a PC and possibly a client for the database and management system and a printer.

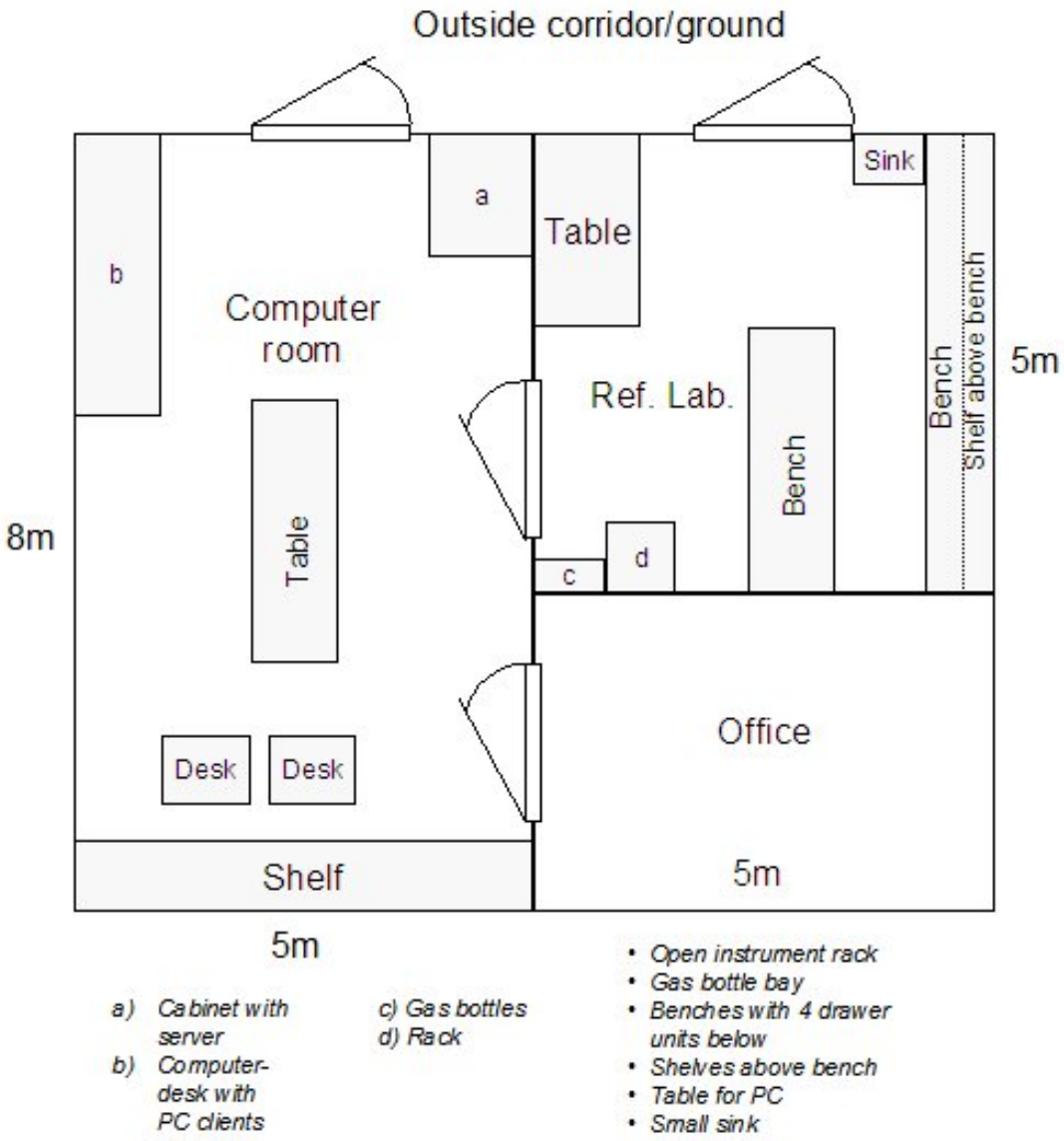

Figure 2: Typical layout of the air quality monitoring and management facility.

Appendix G

Laboratory requirements on personal

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FINANCEMENT: Fonds Nordique de Développement	**MEMO**	QA DAK

Projet:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Agreement:	N°: 003/C/FND/05

Title	**Tasks and activities for the future air quality management team**
Propose	Description of tasks and obligations for the personnel needed to undertake future operations of an air pollution monitoring and management center in Dakar.
Distribution	Cristina (CBG), Herdis (HEL), Bruno (BL), CETUD, DEEC
Author	Bjarne (BS)
Date	16 September 2005
Reference No	Task 3, O-105010

1 The air quality monitoring and assessment organisation

The new air quality monitoring and assessment centre in Dakar (AQMAD) will have to undertake several tasks as part of the future air quality monitoring and assessment system for Senegal. Some of these tasks will be to:

- Operate local monitoring programmes, sampling and analyses,
- Perform daily and weekly data quality controls and follow-up,
- Perform weekly calibrations and data controls,
- Retrieve data daily to the local data bases,
- Undertake QA/QC and SOP follow-ups,
- Perform modelling and collect relevant input data,
- Prepare emission inventories
- Report results on a monthly and annual basis,
- Produce state of the environment reports

To meet these requirements the administrative set-up of the centre will be organised to fulfil the tasks needed to meet the obligations of such a centre. We believe that a minimum of five experts will have to be identified and trained to undertake the different operations.

With such a limited staff some of the experts will have to have double roles, and a close co-operations between the team of five is of utmost importance for the success of this centre. Also we know from experience that it will take years to fully

understand the importance of quality assurance, emission inventories, and modelling and air quality in general.

We will propose that the AQMAD centre will be organised with the following experts:

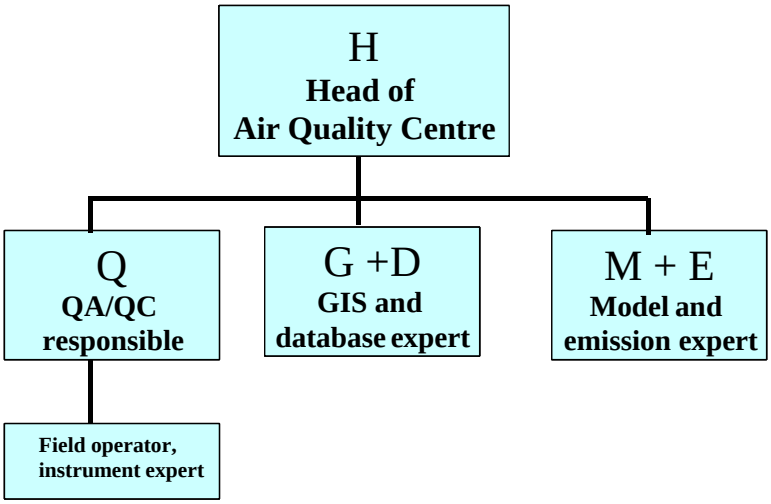

Figure 1: Organisation of the air quality monitoring and managing centre.

2 Tasks and duties

2.1 Head of the AQMD centre

The Head of the AQMD centre will be responsible for:

- Implementation of the Air Quality Monitoring and management programme in Dakar/Senegal
- Project Management: planning, monitoring, reporting and financial management;
- Update service contracts and plan changes and improvements
- Leading, coaching and further developing of the local project team (4 team members);
- Establishing and maintaining contacts and close co-operation with relevant national and local authorities, in particular the Direction de L'Environnement (DEEC) and CETUD;
- Capacity building of partners and supporting them through technical advice;
- Networking with other national and international programmes active in the same or related fields, with the aim to create synergies and forge strategic alliances;
- Supporting Senegal authorities in building up sectoral competencies in the field of air quality management;
- Responsible for reporting, monthly and annual; state of the environment report
- Data dissemination and web applications.

2.2 QA/QC officer

The quality Assurance and Quality Control (QA/QC) responsible expert will be responsible for data quality and quality assurance routines in all aspects of the AQMAD centre. These include:

- Define QA/QC requirements and data quality objectives;
- Be responsible for daily data retrievals and data quality controls and "corrections";
- Participate in the preparations of standard operations procedures and see that these are being followed;
- Study international directives and collect documents, electronic and paper;
- Prepare list of manuals and books for data quality assurance;
- Prepare and follow up the routines for Air Quality data quality assurance; daily-weekly – monthly, update manuals and keep records;
- Responsible for the operation of a reference and calibration laboratory, Support annual calibrations and reference laboratory functions;
- Prepare and apply routines for QA/QC of emission data;
- Describe routines and documents for data trace-ability;
- Discuss and prepare accreditation

2.3 GIS and database expert

The GIS and database expert will mainly work with the GIS based database, and will also together with the QA/QC officer participate in the daily data retrieval process. He will be finally responsible for the data available in the air quality database. Some of his obligations will be:

- Define and prepare the air quality database;
- Develop protocol for retrieving data;
- Collect maps for all areas included in the monitoring and assessment programme;
- Identify and get all digital maps available;
- Receive training in the use of the GIS based database system;
- Define and update the modelling areas for Dakar;
- Prepare GIS with adequate layers for the modelling areas;
- Import hourly air quality data (together with the QA/QC officer);
- Import hourly meteorological data (together with the QA/QC officer);
- Prepare input data for modelling purposes;
- Support the emission inventory expert in collecting input data;
- Plan and prepare data acquisition from monitoring stations
- Keep updated records of all data available

2.4 Model and emission expert

The expert responsible for air pollution modelling including emission inventories will have the following responsibilities:

- Prepare emission templates for collection of source data;
- Collect raw data and emission factors for the emission inventory;
- Check available traffic data; verify all factors and time variations;
- Import emission data from industries and point sources;

- Evaluate emission factors, prepare national emission factors;
- Update and quality assure area sources and population data;
- Prepare and report National emission inventory;
- Receive training and read textbooks on AQ modelling;
- Receive training in model applications;
- Use the available models as part of hand-on training;
- Import input data to the models and run test examples;
- Import complete sets of emission data for Dakar;
- Evaluate model output data, quality assure and verify;
- Prepare air quality assessment reports based on models and measurements;
- Identify and participate in training courses on meteorology and modelling;
- Report modelling results and prepare web solutions for data dissemination.

2.5 Field operator, instrument expert

At least one instrument expert is needed to operate the instruments in field and to participate in the calibration of instruments. This person will have the following obligations:

- Responsible for the daily operations of monitoring stations
- Weekly site visits to check infrastructure, technical performance of the sites;
- Perform weekly field calibrations of all instruments;
- Receive training in operation of specific instruments;
- Maintain and repair instruments;
- Operate reference calibrations under QA/QC officer;
- Report deviations and malfunctions at sites and on instruments;
- Report to QA/QC officer about all malfunctions and support him to keep records;
- Participate in any installations and changes in the field operations.

3 Job qualifications

Job descriptions for the personnel needed to operate the air quality monitoring programme and to report the results of measurements and assessments have been presented above. In the following texts we have briefly indicated what qualification are normally necessary to fill the different positions.

3.1 Head of Air Quality Centre

The head of the centre should have a university degree (PhD) with at least 5 years of experience in scientific oriented work or a MSc degree within engineering/scientific field with at least ten years experience in scientific oriented work.

The head of the centre should speak English and French and have some international experience in co-operative work. Reporting in both languages will be necessary. He/she should have ability to develop sound management strategies and feasible technical concepts in a complex, intercultural environment.

Preferably the person should also have some experience in computers and data handling. The head of the centre should also have some background related to environmental issues and be acquainted with reporting results from scientific work. Some background and knowledge of air pollution and air pollution legislation national and international may be required.

He/she should have some experience in leading, coaching/supporting and managing people.

3.2 QA/QC responsible officer

The quality assurance officer should have a MSc degree within engineering/scientific field and have some background in computer and data science.
He/she needs some background in statistical treatment of data, as one of the tasks will be the final acceptance of data to the database.
The QA/QC officer will also have to know instrumentation and the operations of instruments in the sense of calibrations and quality requirements. He/she will be responsible for the Reference/Calibration Laboratory and will have to be experienced in managing people.
The QA/QC officer needs to know English and French language and be able to report in both languages. Some background in co-operation and management as well as international communication will be needed.

3.3 GIS and database expert

The GIS and database manager will have to have sound experience in the use of computers and should also have a MSc degree within engineering/scientific field and have at least 5 years of experience in scientific oriented work.
Preferably this person should have experience in working with digital maps, data handling and the development of databases. Some experience in the application of ArcInfo and ArcView and Oracle would be preferred. He will also receive training in map data technologies.
Some experience in the development and use of graphical and statistical tools would be preferred.

3.4 Model and emission inventory expert

The modelling expert will need a university degree within science/technology, preferable a PhD or at least MSc degree.
Experience in computer science and numerical methods will be preferred. Also modelling experience and basic mathematics, geophysics or environmental science background would be needed. Knowledge of programming languages as Fortran and C++ is an advantage.
The modelling expert will have to co-ordinate several people and will have the responsibility for reporting. He/she will have to master English and French language, and may be involved in international meetings for presentation of results.
Some experience from Internet and Web development will be preferred.
Several years of experience in computer applications are necessary.

3.5 Field operators, instrument experts

The field operator and instrument expert should have engineering background preferable within electronic engineering. Several years of experience in instrumentation and the use of scientific instruments is needed.
The expert should understand English, as most of the training will be given in English. This expert will also be involved in maintenance and repair at the Reference and Calibration Laboratory and will thus be trained to check, repair and calibrate specific monitors.

4 Future tasks

The AQMAD centre will have to train experts to undertake the different tasks presented above. They will have to operate a monitoring programme with adequate quality control and collect source data for the annual updated emission inventory. They may also perform model estimates as part of the permit procedures and impact evaluations.

Following the selection of candidates, interviews will be undertaken together with NILU experts. Training needs assessment will be identified and reported, and a training programme will be developed.

All experts should be available as soon as possible, to be able to follow seminars and workshops performed by NILU experts. The local experts should also participate in the preparatory work undertaken by NILU. On-the-job training is the best way to receive an adequate background for assuring sustainability in the programme.

Appendix H

Schedule of recruit of the Lab experts

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FINANCEMENT: Fonds Nordique de Développement	**MEMO**	QA DAK

Projet:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
Contrat:	N° 003/C/FND/05

Titre	**Calendrier pour le recrutement du personnel du laboratoire**
But	Personnel en place lors de l'atelier de lancement du projet
Distribution	CBG, DEEC, CETUD
Auteur	BRL
Date	05/10/05
Référence No	lab-051005

Le memo lab-051003 décrit les profils des différentes personnes à recruter et les tâches dont elles seront responsables au sein du laboratoire central.

L'objectif à atteindre est que ces personnes soient recrutées par la DEEC et participent aux travaux de l'atelier de lancement du programme, qui réunira les différentes parties concernées par la gestion de la qualité de l'air à Dakar. Il est prévu de tenir cet atelier entre fin février et début mars 2006.

Le calendrier suivant est proposé pour atteindre cet objectif, sachant que les candidats retenus auront éventuellement besoin d'un préavis d'au moins un mois pour se libérer de leurs emplois actuels :

Au plus tard le 30/10/2005	Publication des avis de recrutement
Début décembre 2005	Pré-sélection sur la base des CV
Avant le 15/01/06	Entretiens de recrutement, en présence d'un expert de Nilu
Avant fin janvier 2006	Avis de recrutement des candidats sélectionné
Fin février 2006	Entrée en fonction des personnes recrutées

Il est par ailleurs important que dès leur prise de fonction les personnes recrutées disposent de bureaux fonctionnels (accès internet, téléphone, ordinateurs connectés en groupe de travail) afin qu'elles soient rapidement intégrées dans les activités du projet.

Appendix I

Task list for work ahead

Actions to take / To do		Responsible	Participants	Deadline
1. Évaluation de la structure de gestion de la QA				
1a	Identify Air Quality stakeholders Send list of stake holders to CETUD and DEEC for their input Finalise list of stake holders and invite them too the Project Seminar & Stakeholders workshop Describe AQ management structure considering input from workshop Elaborate proposition for future AQM structure	BL BS	BS, CBG BL, CBG	Nov. Dec Jan 06 Apr 06 Apr 06
1b	Collect all norms and legislation regarding AQ in Senegal	IL	BL, CBG, BS	Aug 05
1c	Write report on evaluation of present and recommendation on future structure	BS	BL, CBG,TD	May 06
2. Évaluation des niveaux de QA dans la ville de Dakar				
2a	Finalise cooperation agreement with CERER	CETUD	BL	Oct
2b	Maintenance of PM10/PM2,5 and CO monitors	Aminata	BL	Nov
2c	Collect SO2, NO2 and O3 passive samplers	Aminata	BL	Nov
2d	Send passive samplers to NILU for analysis / Send monitors to NILU	BL	Aminata	Nov./ Dec
2e	Analyse passive samplers	NILU		Dec
2d	Write screening study report	BS, HeL	CBG, BL, TD	Jan 06
3. Mise en place du Laboratoire central de la QA				
3a	Send specifications of the Central Lab to NFR and report on building status	CBG		Oct
3b	Publish job announcements for the Central Lab	DEEC	BL, CETUD	Oct
3c	Pre-selection of candidates based on CVs	BS & DENV	BL, CBG	Dec
3d	Selection interviews /approval of candidates	BS & DENV	BL	Jan
3e	**1.1.1.1.1 Identify temporary place for the Central Lab**	DEEC	CETUD	Jan
3f	Furnish and install internet connections and telephone in temporary Central Lab	DEEC	CETUD	Feb
3g	Equip the central lab with hardware/software	BL	TD	Feb
3h	Make the necessary actions for the import of the server to Senegal free of tax	CETUD		May/Jun
Actions to take / To do		**Responsible**	**Participants**	**Deadline**
6. Établissement et fonctionnement d'un Système de gestion de la qualité de l'air				
6a	Send shape files of aeroport and Beubeuss in GIS map projection to HeL	CM	HeL	November

6b	Complete shapes with population data on commune d'arrondissement	CM		November
6c	Check if there is information on coal consumption data on areas on Dakar	CM		
6d	Get road network and traffic data from GMAT (shape files)	CBG	CETUD	January
6e	Fit shape files from GMAT into QADAK GIS	CM		
7. Inventaire des émissions				
7a	Identify main industries in Dakar area	CBG	BS, CM, BL	October
7b	Design inquiry for data on industries Collection of necessary data from industry? Get coordinates and height of staks from main industries	CBG	 SPIDS? CM?	October Nov.-Jan.
7c	Work on emission factors for vehicle park in Dakar	CBG		
9. Développement des capacités institutionnelles et formation				
9a	Plan and prepare Project Seminar in March 2006	CBG, BL	BS, HeL, TD	Jan-February
9b	Plan and prepare Stakeholders workshop in March 2006	BL	CBG, BS, TD	February
9c	Plan and prepare workshop on introduction to meteorology, dispersion models and air quality planning	BS	BL, CBG, HeL, TD	February
11. Premier évaluation de la législation en vigueur en matière de qualité de l'air				
11a	Make a compilation on present legislation, air quality standards and limit values for Senegal.	IL		October
12. Gestion et durabilité du projet				
12a	Rapports d'avancement trimestriels, rapports financiers, facturation	CBG	BL	December
12b	Plan d'intervention du personnel du consultant pour Dec 05 – Mai 06	CBG	all	November
12c	Establish formal agreement with Meteo	CETUD		
	Check on special AirQUIS license agreement with universities in order to disseminate airquis	CBG		

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ABSTRACT
The Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Management System for Dakar. This is the report of the second mission to Dakar, Senegal, 3-12 October 2005. The main purpose of this mission was to undertake an air pollution screening study in Dakar, to meet with relevant local experts and institutions, to discuss the air quality laboratory and personnel with DEEC and to collect further information on emissions as well as the organisation of the environmental work in Senegal.

NORWEGIAN TITLE

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ABSTRACT (in Norwegian)

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