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Report on the GEMS/AIR Regional Training Course on Air Quality Monitoring

23 - 27 October, 1994, Amman, Jordan

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WHO/CEHA/UNEP would like to thank all resource persons for their efforts in making this training course a success. The financial help of the United States Environmental Protection Agency (USEPA) in sending Mr Joe Elkins and Mr Jonathan Miller to give lectures is greatly appreciated.

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Environment Assessment Programme
United Nations Environment Programme
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1. INTRODUCTION

Urban areas have high concentrations of man-made air pollution sources, such as power generation, motor vehicle traffic, residential heating and industry. Urban air pollution not only poses a threat to human health and the urban environment, it also makes a significant contribution to regional and global atmospheric pollution problems. Air pollution is experienced in most urban areas which makes it a world-wide problem and an issue of global concern. Given this situation a description of it does not suffice, rather problem solving in the sense to take action in the implementation of clean air is absolutely necessary.

The marked increase in urban population occurring in the Eastern Mediterranean Region (EMR), combined with rural depopulation and industrialisation, will lead both to an increase in the emissions of pollutants, and to an increase in the public and environmental exposure to these pollutants. By the year 2000, close to 315 million people will be living in the Eastern Mediterranean Region, and about 45% of them are expected to be in urban areas.

2. OBJECTIVES OF THE TRAINING COURSE

The UNEP/WHO Regional Training Course on GEMS/Air Quality Monitoring was hosted by the WHO Regional Centre for Environmental Health Activities (WHO/CEHA) in Amman, Jordan from 23-27 October 1994. It was designed to promote air quality monitoring in the Eastern Mediterranean Region.

More specifically, the objectives of the training course were as follows:

- Raising awareness of the Global Environment Monitoring System's Urban Air Quality Management Programme (GEMS/Air) in the EMR.
- Fostering of regional cooperation and collaboration through a forum of discussions and exchange of experiences.
- Strengthening of national air quality monitoring and assessment capabilities.
- Identification of problems relating to air quality monitoring and identification of possible solutions.
- Training participants to, in turn, train other people in their own countries.
- Initiation of plans of action for improvement of air quality monitoring in the participating countries.

The agenda of the training course is presented in Annex 1.

3. PARTICIPANTS

The training course was attended by 13 participants from six countries, representatives from the organising, sponsoring and co-sponsoring organisations and lecturers from the united States Environmental Protection Agency (USEPA) see Annex 2 for full list of participants.

4. OPENING SESSION

The training course started with a presentation by Dr Adnan Gur on the objectives of the work of CEHA and the facilities available to them in their work. The course was then officially opened by Dr Sadok Attallah, followed by an address by Dr Z. Mihyu, AGFUND, who pointed out on behalf of the Director General of AGFUND that his institution provides up to 50% of the funding for training projects in member countries, particularly those related to women and children.

The WHO Representative for Jordan, Dr Omer Sulieman addressed the meeting on behalf of the Regional Director of EMRO, Dr H.A. Gezairy, by describing the problems of the region in relation to air pollution, and pointed particularly to the influence of sandstones and re-suspended particulates in SPM (Suspended Particulate Matter) monitoring. A representative for the Minister of Health, Jordan, welcomed participants to Jordan and emphasised the importance Jordan attaches to air pollution abatement. For further details of these opening statements see Annex 3.

After going through the election process, Dr Adnan Rashdan (Jordan) was elected as chairman of the meeting, Mr Mamoun Khourdaji (Syria) was elected as vice-chairman and Professor Shaukat Hayat (Pakistan) was elected as rapporteur.

In turn, each participant introduced himself/herself.

5. PRESENTATIONS

Initial lectures covered a wide range of air pollution related matters including health and environmental effects in view of primary and secondary standard setting in the USA and the GEMS/AIR air data flow. Discussions also covered standard setting procedures in the European Union. Participants went on to question the appropriateness of air quality monitoring procedures as employed in developed countries with respect to their own country context. In response to these remarks they were asked to voice their expectations with respect to the training they would receive from this course. The expectations of the participants were then taken into account by the trainer; these expectations were as follows:

- Help with reducing air pollution, monitoring methodologies, review of new monitoring equipment
- Methodological review of issues such as distance between monitoring stations, elevation and siting of stations in general
- Information on international emission and ambient air pollutant standards; monitoring priorities
- Identification of priorities from monitoring through remedial action; monitoring methodology, legislation and other remedies.
- Method of establishing a monitoring programme; site selection, information on monitoring equipment, formulation of standard in relation to local situation
- Approaches to reducing air pollution in big cities; sampling methodologies, sampling conditions and application of standards. Calibration techniques

5.1 WHO/CEHA

Dr A. Gur gave a brief presentation on the scope and objectives of this training course. He explained that monitoring is essential for the determination of the adverse effects of atmospheric pollution on human health and the physical environment. That data and information obtained from monitoring will constitute a firm basis for environmental management activities. For illustrative purposes he described the results of a study by USAID which found that the concentration of suspended particulate matter (SPM) in air in the Greater Cairo area is the worst environmental threat to human health that air pollution poses, and the second worst is the lead in the environment (in air, water and food). The concentration of SPM exceeds the US standards by a factor of nearly 10. Reducing SPM in the Greater Cairo area to the US standards would save some 14000 deaths per year. The average lead level in the blood of Cairo residents is about five times higher than levels in large cities throughout the industrialized world. This level of lead causes an estimated loss of 4 IQ points of brain capability for a child living in the Greater Cairo area.

5.2 Country Reports

Participants, in turn, presented detailed reports on air pollution monitoring in their respective countries. They revealed a wealth of monitoring experience and knowledge; for example, in the Islamic Republic of Iran there are 10 operational monitoring sites in Tehran and at least one site in eleven other cities. For details of these country reports see Annex 4.

5.3 Health and Environmental Effects

Mr J. Elkins, USEPA, gave some useful historical insights into killer ambient air episodes; these included the London, Donora, and Meuse Valley. He also touched on two more cases which originated from industrial accidents: Bhopal, India in 1984 and Chernobyl, Ukraine, in 1990.

Ambient air can have and has had adverse impacts on human health. It can affect the human respiratory system, organ functions, circulatory system, neurological system, reproductive system and eyes and skin. The pollutants normally of greatest interest are particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead and ozone.

Specific health effects and sources of each of these pollutants were discussed.

The next major area discussed was the environmental effects of air pollution. The four broad categories of environmental effects are:

- Ecosystem effects
- Property damage
- Quality-of-life effects
- Global climate change

Details of each of these were discussed.

Problems of tropospheric and stratospheric ozone were discussed. In the troposphere there is often too much ozone with adverse effects on respiratory function and yet in the stratosphere is not enough ozone reducing the effective screening of UV radiation.

The distinction between SPM and PM_{10} measures were also discussed as were risk assessment, risk management and the problem of indoor air pollution.

5.4 GEMS/Air Data Flow Overview

Mr J. Miller explained that USEPA is responsible for the maintenance and user support of the database system to store the GEMS/Air data that has been collected.

The USEPA's Aerometric Information Retrieval System (AIRS) Air Quality Subsystem (AQS) is USEPA's national database used to store ambient air pollution concentration data and to perform data analysis functions. It is composed of an ambient database (AQS), facility emissions database, and a mobile emissions database. AIRS also includes a graphical display feature called AIRS Graphics. By using the various functions available in AIRS, members of GEMS/Air will be able to do data analysis for their region as well as compare their results with those of any other participants of the programme. AIRS AQS can be used to observe air quality, perform trends analysis, and perform precision and accuracy analysis in order to ensure the monitors are working properly.

If it is found that the analyzing capabilities of AIRS are not sufficient for the users, there are several personal computer-based systems that can use AQS data for analysis. Examples of these types of programs are AIRS Executive, and Voyager (developed by the Lantern Corporation). In short, the GEMS/Air programme provides an opportunity for countries to have a low cost, efficient, secure and extensive analysis tool at their disposal.

5.5 Monitoring Network Types

The following lectures were given by Mr J. Elkins, USEPA. Here he pointed out that ambient air monitoring network design depends on the monitoring objectives of each specific network. Monitoring networks may be developed for a number of reasons including:

- Assessment of air pollutant concentrations
- Testing compliance with air quality guidelines and standards
- Assessment of sources; with the help of dispersion models
- Support of causal analysis of health and environmental effects
- Development of control strategies

Networks can focus on the following air pollutants:

- Sulfur dioxide (SO_2)
- Nitrogen oxides (NO_x)
- Ozone (O_3)
- Carbon monoxide (CO)
- Suspended particulate matter (SPM)
- Lead (Pb)

A monitoring network is set up with a general operating time schedule (short term, long term, etc.)

5.6 Ambient Air Monitoring Objectives

The defining of ambient air monitoring objectives is not only the first step but it is one of the most important steps in ambient air monitoring because it leads to the determination of the specific data quality objectives (DQO). UNEP/WHO has determined that useful monitoring objectives are:

- establishing a sound scientific basis for policy development;
- determining compliance with statutory criteria;
- assessing population/ecosystem exposure;
- gathering public information;
- identifying pollution sources or risks; and
- evaluating long-term trends.

As an example of another set of monitoring objectives, the USEPA has set the following monitoring objectives for its State and Local Area Monitoring Stations (SLAMS):

- recording highest concentrations;
- recording representative concentrations in high population density areas;
- assessing the impact on ambient pollution levels of significant sources; and
- determining background levels.

Monitoring objectives have an important impact on every other step in the process of developing and executing a monitoring network.

5.7 Network Design

There are two different approaches to designing an ambient air monitoring network. In the grid approach monitoring devices are exposed in a regular spacing pattern. This can be a resource-intensive approach requiring a large number of monitors/samplers.

A second approach that provides considerably more flexibility involves the selection of representative sampling sites for which different spatial scales of representativeness become important. The terms normally used to describe spatial scales are:

- microscale which represents an area less than 0.1 km in diameter;
- middle scale which represents an area between 0.1 km and 0.5 km;
- neighbourhood scale which represents an area from 0.5 km to 5 km;
- urban scale which represents an area 4 to 50 km; and
- regional scale which represents an area larger than 50 km.

5.8 Siting of Monitors

When siting monitors one should consider the following:

- monitoring objectives;
- sources and emissions in the area;
- prevailing meteorological conditions and topographic conditions;
- existing air quality data;
- model simulations;
- demographic/health/land use data;
- access to site and potential vandalism;
- site sheltering; and
- infrastructure (electricity, telephone, etc.).

Each of these are discussed briefly in GEMS/Air Methodology Review Handbook Series Volume 1.

5.9 Data Requirements for New Sites for GEMS/Air

Mr J. Miller explained the GEMS/AIR data requirements in relation to the structure of the AIRS in which all monitoring sites must be registered on the system prior to the reporting of data for that particular monitoring site. The basics of AIRS data input, the type of site and monitor information that is required was discussed. It was emphasised that it is the responsibility of the participating country to validate, report and analyse their data.

5.10 Air Quality Standards in the EMR

Mr S. Atallah gave a very useful presentation of the results of questionnaires seeking information on air quality standards in the Eastern Mediterranean Region. Details of this presentation can be found in Annex 5.

5.11 Information Resources

Of the many information resources available on ambient air monitoring the USEPA provides training courses conducted by the Air Pollution Training Institute (APTI) and information through the Office of Air Quality Planning and Standards (OAQPS) Technology Transfer Network (TTN).

The APTI offers courses on many ambient air areas including air pollution monitoring, emissions inventories, dispersion modelling etc..

The OAQPS-TTN offers an electronic bulletin board accessible through the internet to distribute its information products. There are also information centres on:

- Ambient Air Monitoring Technology Information Center (AAMTIC)
- emission measurements - EMTIC
- modelling - SCRAM
- emission factors - CHIEF
- air toxic - Air Risk

5.12 The GEMS/AIR framework and the outcome of the UNEP-HEM Workshop

Dr D. Schwela first described the framework of GEMS/AIR and listed the programme objectives as:

- conduct global assessments of air quality and link corresponding data with other environmental and socio-economic data for integrated environmental assessments to contribute to policy formulation

- act as a data/information broker

- facilitate review and validation of assessments and establish codes of best practice

- establish/identify regional centres/experts to coordinate and support activities according to the needs of the regions

- produce technical documents in support of all aspects of air quality management

- run global database with validated data from an expanded number of cities
- facilitate the establishment of monitoring; through, for example, acting as a clearing house linking donors of air quality equipment and expertise with needy recipients
- conduct annual reviews and distribute them widely He went on to describe the tools of GEMS/AIR:

5.12.1 Collaborative Reviews

The objective of a collaborative review of the capacities and capabilities of a city in air pollution monitoring is to

- identify the areas of need
- provide support to network participants in
- obtaining data of known quality appropriate for their intended use and
- determining the comparability of data within the network, and improving it

under the motto of "scientists help scientists".

Collaborative reviews have been and are being performed for Latin America, South East Asia and will be performed in Eastern Europe and Africa.

5.12.2 Rapid Inventory Assessment System (RIAS)

For an easy and rough, but sufficiently accurate, estimation of the emissions of point, area, and line sources a scheme has been developed to obtain a fairly reliable emissions inventory for an urban area. This scheme has been published under the umbrella of the Inter-Agency Project on Risk Management in a joint effort of UNEP, WHO, United Nations Industrial Development Organization, and International Atomic Energy Agency (IAEA). The RIAS is presently being computerized to be used on a PC. The programme will enable country air pollution abatement engineers to develop an emissions inventory as a basis for air pollutant concentration simulations, estimations of the success of control action, and when used together with a dose-response -model for the causal analysis of the compounds and their sources responsible for observed effects.

5.12.3 Training Courses

Regular regional training courses for GEMS/AIR participants and country engineers interested in future participation in GEMS/AIR are essential for obtaining data of known quality. These workshops cover the issues of health and environmental effects of air pollution, ambient air monitoring objectives, air quality guidelines, standards and regulations, monitoring devices and networks, siting criteria, data requirements, quality control and assurance, problems of ambient air monitoring methods, costs and benefits of air pollution monitoring, and database considerations. Training on the rapid emission inventory approach includes the consideration of alternative source inventory approaches,

the source and control system modelling approach, and exercises in source assessment and air quality modelling. Future training courses will consider appropriate dispersion models in more detail and their use in particular situations as well as population exposure estimates and the implementation of epidemiological studies.

5.12.4 Twinning Project

This exciting new development comes under the new clearing house function of GEMS/AIR. Many cities of developing countries are in need of monitoring devices. On the other hand, monitoring devices are abundant in developed countries and, due to the successful efforts of having reduced the emissions of individual sources the monitoring networks in developed countries are being reduced. For this and other reasons a lot of monitoring devices are available at monitoring offices which are not used any more but are still operational. This fact gave birth to the idea of the Twinning Project developed by the UNEP and WHO with the help of the United States Environmental Protection Agency (USEPA). The basis of the idea is to provide developing countries with used monitoring devices not being used in developed countries but still operational. As a first example the Twinning Project has been realized between Ventura County, California, USA as a donor of monitoring devices and The Philippines as a recipient. Intensive on-site training for Philippine air pollution engineers was also provided in the United States before shipping the devices and in the Philippines after implementation of the devices through US consultants.

Other cities in developing countries have expressed their interest in obtaining monitoring devices and training via the twinning arrangement and air pollution control organizations of developed countries showed interest in acting as donors.

Dr. Schwela went on to report on the results of the UNEP-HEM meeting on quality assurance, held in Munich in September 1994.

5.13 Ambient Air Monitoring Methodologies

UNEP/WHO divide ambient air monitoring devices into five generic categories: passive samplers; active samplers, automatic analysers; remote sensors; and bio-indicators. Further details are summarized in Table 1 (adapted from GEMS/Air Methodology Review Handbook Series Volume 1).

It is normal to use the simplest, most cost effective method that will meet the specific monitoring objectives of the network under development.

Table 1: Instrumented Air monitoring Techniques

Method	Advantages	Disadvantages	Capital Costs
Passive Samplers	Very low cost Very simple Useful for screening and baseline studies	Unproven for some pollutants In general only provide weekly and monthly averages	$ 2-4 per sample
Bio-indicators	Very low cost Very sensitive Useful for screening and baseline studies	Not too specific for single pollutants In general only provide weekly, fortnight or even longer term averages	$ 5-10 per sample
Active Samplers	Low cost Easy to operate Reliable operation performance Historical dataset	Provide daily averages Labour intensive Laboratory analysis required	$ 2-4 K per unit
Automatic Analysers	Proven for all pollutants High performance, Hourly data, On-line information and low direct costs	Complex Expensive High skill required High recurrent costs	$ 10-20 K per analyser
Remote Sensors	Provide path or range-resolved data Useful near sources and for vertical measurements in the atmosphere Multicomponent measurements	Very complex and expensive Difficult to support. operate, calibrate and validate Not always comparable with conventional analyzers	> $ 200 K per sensor

5.14 Methodology Costs and Procurement

There are a number of general cost considerations associated with air quality monitoring; these include the costs of: network design and siting, station installation, sampling, analysis, maintenance, data management and reporting, quality assurance (QA), and management and supervision.

5.15 Activities of the Royal Scientific Society in Air Quality Monitoring

Dr A. Al-Hassan, Royal Scientific Society (RSS), Jordan, gave a presentation of immediate relevance to the participants on the various air quality monitoring projects carried out by the RSS in Jordan. Objectives of these RSS projects were:

- Air quality assessment (establishing time trends)
- Establishing background/baseline levels
- Environmental impact assessment
- Accumulating data for setting national standards and regulations

Dr Al-Hassan touched on various technical issues and explained some of the potential problems associated with different analysers; he also stressed certain quality assurance procedures. Problems with hydrogen sulphide, where the WHO guidelines are often exceeded, and with sulphur dioxide, where singular exceedences occur, and an empirical, linear relationship between SPM and PM_{10} were discussed.

5.16 Field Visit to the Monitoring Stations in Hashimiyah

The training course visited an RSS monitoring project in the town of Hashimiyah where a petroleum refinery and thermal power plant are located.

Monitoring stations were located in a public building and the power plant. Both were well sited for continuous measurement of sulfur dioxide (SO_2), hydrogen sulfide (H_2S) and nitrogen oxides (NO_x) concentrations.

Incidentally, previous measurements of ozone and NO_x from close to the power plant indicated very high values of ozone and very low values of NOx; indicating that local climatic influences substantially increase the reaction constances of the Nox-O3 conversion.

5.17 Ambient Air Quality Assurance (QA)

Mr J. Elkins explained that QA is a system of activities which assures that a measurement meets defined standards of quality with a stated level of confidence; i.e. data of known quality. It is therefore be best to develop a QA plan before beginning monitoring. The UNEP/WHO GEMS/AIR QA/QC objectives can be summarized as:

- data representative of ambient conditions
- accurate and precise measurements
- inter-comparable and reproducible data
- results tractable to metrology standards
- measurements consistent over time, and
- adequate data capture

5.18 Ambient Air Data Uses

Generated data is most frequently used to determine compliance with a standard or guideline. With greater refinement data is also used to develop or refine control actions. Ambient air quality data is also used to determine abatement priorities. Ambient air quality information can also be used to derive alert levels and therefore reduce the impact of air pollution. Sometimes ambient air data is evaluated in the form of an index; this facilitates a wider understanding of air quality issues.

5.19 Ambient Air Monitoring Regulations and Guidance

For many countries guidance from international organisations or other countries may be useful. For this purpose the GEMS/AIR Methodology Review Handbook Series is very useful, see Annex 6.

5.20 Summary of Training Course

Dr. D. Schwela summarized the training course in emphasizing that this was a GEMS/AIR training course coordinated by WHO and funded by UNEP. He went on to elaborate on the important fact that this training course has provided to the participants personal acquaintance, mutual confidence, and the possibility of information transfer and help for needy countries through WHO and UNEP if countries remain in contact with UNEP/WHO. He emphasized that a requirement for the success of GEMS/AIR is to provide data of known quality appropriate for their intended use, to develop quality assurance plans for monitoring, and to include also results of non-GEMS/AIR monitoring sites in the database. UNEP/WHO will install Regional support Centres which will provide technical support, conduct training courses, and collaborative site reviews, help ensure regular data submission, and support development of local QA plans. UNEP/WHO will also enforce the twinning project by seeking donor agencies and finding out the needs of recipient countries. Requirements for the donor agencies will be to make used but operational monitoring devices available. Requirements for recipient countries include assuring that the equipment will be used, the commitment to adequate funding and staff to support operation and maintenance, to adequate housing of equipment, to adequate quality assurance, and to waiving customs fees and paperwork. Recipient countries should be inclined to put the data into the GEMS/AIR database and to agree to publication of data by UNEP/WHO.

Dr. Schwela concluded by requesting the participants to look positively into the future of GEMS/AIR.

6. WORKING GROUP SESSION

Each of the lectures described above was followed by a substantive discussion; in turn, the lecture series was followed by a working group exercise. Participants were asked to state what they felt were their country/region specific requirements from (1) GEMS/AIR training, and (2) the wider GEMS/AIR programme. They were also asked to respond to questions related to country action plans as drafted by WHO/CEHA. These questions were as follows:

- What sampling site exist in your country?
- Range of variables tested during the monitoring activity

- Problems limiting the effectiveness of monitoring
- Reporting to GEMS/Air Programme
- Training needs in air quality testing in your country
- How did you design your network?
- What methodology has been used in your monitoring?
- Actions individuals would undertake after the workshop (by this, participants are asked to identify programmes in which they would personally be involved in the implementation upon return to their country which would improve air quality monitoring practices).

6.1 Recommendations

6.1.1 GEMS/AIR Training:

- improvement of workshop by using practical applications, monitors and examples, related to the regional problem
- training periods be closely tailored to the intended work programme
- national level training be provided including electronic and chemical calibration, operation and maintenance

6.1.2 GEMS/AIR Programme:

- supply of spare parts and chemicals be provided to expert institutions where needed
- establishment of more than one monitoring station in a city
- fast establishment of GEMS/Air regional support centres
- fast extension of "Twinning Projects" to other countries
- identifying existing resources by country with regard to resource requirements and priorities of work
- GEMS/Air coordinator to look for new and additional resources to facilitate the functioning of the programme/ project

6.1.3 Country Action Plans:

Participants presented useful information on their respective National urban air quality monitoring/management capacities (see Annex 3). However, many of them were not comfortable with the Action Plan excercise; they said that they were air pollution experts and not policy formulators.

7. CLOSING SESSION

Dr M. I. Sheikh, Director Environmental Health Programme spoke on behalf of EMRO/CEHA. He expressed his appreciations for the successful fulfillment of the workshop's objectives and thanked the participants for their valuable contributions to the activity and wished them a happy return journey home. Dr Sheikh also thanked UNEP and WHO/HQ representatives and the two consultants from USEPA for their genuine efforts for making this training course successful.

UNEP and WHO thanked all the participants and encouraged them to maintain contact with the GEMS/AIR Secretariat.

Dr A. Rashdan spoke on behalf of the participants. He thanked the organizers for the excellent management of the training course and the presenters for the quality of the material they made available.

ANNEX 1: AGENDA

Sunday, 23 October 1994

08:30 - 09:30 Registration and tour of CEHA

09:30 - 10:00 Opening Ceremony
- Address by **Dr Z. Mihyu**, AGFUND
- Message by **Dr Hussein A. Gezairy**, Regional Director, WHO Eastern Mediterranean Regional Office (EMRO)
- Address by His Excellency the **Minister of Health**, Jordan
- Adoption of agenda and election of officers, Chairman, Vice-Chairman, Rapporteur
- Introduction of participants

10:30 - 11:00 Objectives, Scope and Purpose of the Workshop, by **Dr A. Gur**, ITA/CEHA

11:00 - 13:00 Country Presentations - Current Monitoring Projects and Networks

13:30 - 14:45 Health and Environmental Effects, by **Mr J. Elkins**, USEPA

15:00 - 16:30 GEMS/Air data flow overview, by **Mr J. Miller**, USEPA

Monday, 24 October 1994

08:30 - 09:30 Monitoring Network Types, by **Mr J. Elkins**

09:30 - 10:30 Ambient Air Monitoring Data Objectives, by **Mr J. Elkins**

11:00 - 12:00 Network Design, by **Mr J. Elkins**

12:00 - 13:00 Siting of Monitors, by **Mr J. Elkins**

13:30 - 15:30 Data Requirements for Siting, by **Mr J. Miller**

15:30 - 16:00 Air Quality Standards in the EMR, by **Mr S. Atallah**, Acting Coordinator, CEHA

16:00 - 16:30 Information Resources, by **Mr J. Elkins** and **Mr Mazen Malkawi**, CEHA

16:30 - 17:00 Outcome of the UNEP-HEM Workshop, by **Dr D. Schwela**, WHO/HQ/UEH

Tuesday, 25 October 1994

08:30 - 09:30 Ambient Air Monitoring Methodologies, by **Mr J. Elkins**

09:30 - 10:30 Methodology Costs and Procurement, by **Mr J. Elkins**

11:00 - 12:00 RSS Activities in Air Monitoring, by **Dr Ayman Al-Hassan**, WHO Temporary Adviser, Royal Scientific Society

12:30 Field Trip to Hashimiya

Wednesday, 26 October 1994

08:30 - 10:30 Ambient Air Quality Assurance, by **Mr J. Elkins**

11:00 - 13:00 Ambient Air Data Uses, by **Mr J. Elkins**

13:30 - 14:30 General Discussion

14:30 - 17:00 Working group session

Thursday, 27 October 1994

08:30 - 09:00 Ambient Air Monitoring Regulations, by **Mr J. Elkins**

09:00 - 09:30 Monitoring Issues Review, by **Mr J. Elkins**

09:30 - 10:00 GEMS/AIR Review, by **Mr J. Miller**

10:00 - 10:30 Summary of Training Course, by **Dr. D. Schwela**

11:00 - 13:00 Working Group Session

13:00 - 14:30 Recommendations

14:30 - 15:00 Closing Session

ANNEX 2: LIST OF PARTICIPANTS

Countries Participants

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ANNEX 3: OPENING STATEMENTS

Mr Sadok Atallah, the Acting Coordinator, CEHA welcomed the Under-Secretary, the Ministry of Health, WR/Jordan, representatives of WHO/HQ, UNEP/HQ and AGFUND, lecturers from USEPA and participants from Member States and expressed good wishes for a successful training workshop during the week in Amman. Then he invited the speakers to make their addresses.

A message from **His Royal Highness Prince Talal Bin Abdulaziz**, President of AGFUND was read out by Dr Zuhayr Mihyu, Director of Program Section, AGFUND. His Royal Highness conveyed his greetings and best wishes for the success of the meeting and pointed out that the environment and its protection are of international concern. The awareness of the international community regarding this issue is not recent. The establishment of the World Commission on Environment and Development by the UN in the early eighties marked a major step in humanity's endeavour to restore natural order in the environment, hence its implications on human health. The UN Conference on Environment and Development (UNCED) in 1992 adopted Agenda 21 which was the global culmination of environmental awareness. It focussed the consciousness of the world on the achievement of sustainable development.

In response to Agenda 21 of UNCED, WHO produced the "Global Strategy for Health and Environment" and EMRO produced its "Regional Strategy for Health and Environment". The Regional Strategy stressed the importance of capacity building in institutions of Member States and stated that "capacity building for sustainable action on health and environment should take precedence over projects featuring ad hoc problem solutions". This is exactly what AGFUND believed. Therefore, training, upgrading of skills and human resources development constitute the basis for the major solution to global health and environmental problems in a rapidly changing world.

Finally, it was reiterated that the prominent collaborative work between AGFUND and WHO in the field of environmental health was initiated in 1986. With the generous grant from AGFUND, The CEHA was able to consolidate itself in the early years of its existence.

A message from **Dr Hussein A. Gezairy**, Regional Director, was read out by Dr Omer Sulieman, WHO Representative in Jordan.

Dr Gezairy, in his message, pointed out that environmental pollution is increasingly becoming one of the most important subjects for consideration and, indeed, concern throughout the world. It is one of the clearly recognized forms of environmental pollution as it is readily seen, smelt and, in some cases, tasted. It affects the lives of people in all parts of the world.

The Global Environmental Monitoring System (GEMS) is the collective effort of the world community to monitor the environment in order to protect human health and preserve essential natural resources. Implementation of the GEMS Programme has been made possible by the active participation and data support of Member States.

Air pollution is already a significant environmental problem in large urban centres of the Region such as Cairo, Karachi, Teheran, and Damascus which all suffer from heavily congested traffic. Almost 50-60% of air pollutants in the big cities of our Member States is produced by vehicle emissions, and aggravated by the use of lead-containing fuels, poorly maintained engines, and the long life of vehicles.

The population of the Member States is increasing, and there is a lot of rural migration with people in economically depressed areas migrating to cities to find work. In the absence of effective control measures these two factors will inevitably result in deteriorating air quality in urban centres in the Eastern Mediterranean Region.

The convening of this training course is a demonstration of real cooperation and collaborative efforts of international and national organizations such as the WHO, the UNEP, the USEPA for the purpose of capacity building through human resources development in the EMR.

Major efforts will be needed to improve and strengthen the infrastructure in most of these Member States for dealing with air pollution problems. National capabilities for the control of air pollution in the Region lag behind the capabilities for dealing with water pollution or solid waste problems. There is a clear and urgent need to strengthen air quality monitoring capabilities, as well as for legislation, enforcement and abatement strategies.

Dr Gezairy concluded his message by thanking participants for taking part in the activity and expressed good wishes for a successful meeting and pleasant stay in the beautiful city of Amman.

A message from His Excellency the **Minister of Health**, Jordan, **Dr Aref Al Bataineh** was read out by Dr Hani Eweis, Under-Secretary, Ministry of Health.

Dr Al-Bataineh, in his message, welcomed the participants and lecturers wishing them a happy stay in Amman. He also extended thanks and appreciations to everyone from WHO and UNEP who had taken part in the organization of this scientific activity of air quality monitoring.

The Ministry of Health, Jordan pays utmost attention to environmental quality, as the environment has a strong and direct influence on public health. As a result of this serious attention, the Ministry decided to establish a new department in its Directorate of Environmental Health in early 1994. This department is responsible for monitoring the quality of air in the country to determine its impact on human health and material resources.

The Ministry realizes the importance of provision and enhancing of information and knowledge for human resources development. This training course is one of the important means of enhancing knowledge and exchanging experiences which will benefit all EMR countries.

Finally Dr Bataineh reminded everyone that the task of paying attention for maintaining the quality of atmospheric environment over the globe is a shared task, as its impact recognizes no geographical or political boundaries.

ANNEX 4: COUNTRY REPORTS

EGYPT

Air quality monitoring in Egypt was started by the Environmental Monitoring Centre (EMC) of the Ministry of Health in 1971 with three pieces of equipment for monitoring SO_2 and smoke. The equipment was good and easy to operate and monitoring continued until the equipment became out of order due to a shortage of funds for maintenance and spare parts. Monitoring started again this time with 10 pieces of equipment of the same type and two high volume samplers for suspended particulate matter. This equipment was provided through the WHO budget. After few years of operation, the same problems of funds occurred and the monitoring had to be stopped in five stations, for short periods of time.

In 1984, with the assistance of the Egyptian Environmental Affairs Agency (EEAA), a large monitoring programme commenced having a budget for purchasing equipment, spare parts, and laboratory materials and maintenance. With a good training programme, having incentives for the staff, EMC trained its staff locally. It is possible to send some of their chemists abroad for further training.

At the moment, the national network of air quality monitoring covers 15 out of 26 governorates in Egypt. The monitoring network is functioning under the responsibility of the Centre for Environmental Monitoring and Working Environment Studies, Ministry of Health.

SO_2, smoke and total suspended particulates are being measured. Carbon monoxide and nitrogen dioxide were monitored for short periods in two of the sites in the Greater Cairo Area.

Several laws and decrees on air quality control legislation were promulgated by different ministries during 1971 -1994.

ISLAMIC REPUBLIC OF IRAN

The Ministry of Health and Medical Education is responsible of carrying out air quality monitoring and assessment of its impact on human health. The Environmental Health Department of the Ministry of Health and Medical Education is presently operating 10 monitoring stations in Teheran in collaboration with the WHO, three of which are GEMS/Air stations. SPM and lead are monitored by collecting two samples per week at each site on a 24 hours basis; SO_2 and black smoke are measured by taking seven samples per week. . Measurements indicated that Teheran is one of the most polluted cities in the world and much of the pollution is from vehicles but industrial and residential sources also contribute. The topography and meteorological conditions of Teheran contribute to the problem.

Relatively few air pollutant control measures are practised. As more and more natural gas is being provided, a reduction of emissions of SO_2 and black smoke is to be expected. In addition, lead-free gasoline patrol is about to be made available. The Ministry of Health and Medical Education is actively collaborating with the Municipality of Teheran which strongly commits itself to undertake a number of initiatives, including improvements in the physical infrastructure and in the management of urban transport. Air pollution monitoring is also performed in Tabriz, Esfahan, Mashad, Shiraz, Arak, Jazd, Uromieh, Ahvaz, Abbadan, Mahshar, Hamadan, and Zanjan.

The Air Quality Control Company, a subsidiary of the Municipality of Teheran, has already started several projects with the aim of measuring and reducing pollutants from major sources in collaboration with international organizations such as the World Bank, JICA, UNIDO, etc.

In its second 5-yearly plan, the government of Iran has prepared the necessary guidelines for all executive organizations, in order to reduce air pollutants from motor vehicles, and domestic, commercial, and industrial sources in large cities throughout the country. This plan constitutes a very ambitious program for developing air pollution control strategies within the framework of already existing legislation with well defined goals of substantial reduction of CO, HC, NO_x, SO_2 and SPM in Tehran and other cities of Iran.

IRAQ

The monitoring of environmental pollutants in general and conducting studies and special research related to sources of pollution, its monitoring and control are some of the main objectives and duties of the Environmental Protection Centre (EPC) which is a department within the Ministry of Health in the Republic of Iraq.

The main ambient air quality monitoring programme is carried out by the EPC in specific locations, most of which are in Baghdad City. Only a few parameters are being measured due to limited monitoring equipment and supplies. Ambient air quality standards were first set in 1984 with a very short list of parameters such as CO, NO_2 and SO_2 for different exposure durations. The established limiting values are maximum concentrations not to be exceeded more than once a year. Emission standards are not promulgated in Iraq.

After 1991, the air pollution monitoring programme has almost stopped due to the UN sanctions which inhibit the importation of new sampling and measuring equipment, spare parts, reagents, chemicals and other supplies that are essential to conduct a monitoring programme.

JORDAN

Concerned agencies (governmental and non-governmental) are realizing the importance of the impact of air pollution on human health and environment. Hence, many of these agencies have started conducting works related to air quality monitoring.

The Ministry of Health established the Air and Space Monitoring Department at the beginning of 1994, with limited resources. Available equipment and materials include high-,medium-, low-volume air samplers to monitor SO_2 and NO_x, SPM and heavy metals, and organic vapours, moreover impinger tubes, chemicals, activated carbon columns, and glass microfibre filters. Laboratory capabilities, including gas chromatography and atomic absorption, are utilized in completing the analytical part of the work. The work in the department is divided into a regularly scheduled part and an on-request part. Examples of measurements of SPM and Pb at different sites in Amman are presented.

Jordan was the first country in the region that has issued its own National Environment Strategy which outlines a systematic approach to deal with sources of air pollution and suggested actions to be taken. Unfortunately the detailed environmental legislation is still lacking which is necessary to implement the strategy.

Some air quality programmes are implemented by the Royal Scientific Society (RSS); other agencies are also conducting air quality monitoring programs

PAKISTAN

The Federal Environmental Protection Agency finalized Environmental Quality Standards for industrial gaseous emissions and for motor vehicle exhaust gases and noise. These were approved by Pakistan Environmental Protection Council, which is headed by the Prime Minister, in 1993. However, work is still to begin on ambient air quality standards. For the time being, the WHO Guidelines and World Bank Standards are being used.

Currently, there is no air quality monitoring programme established as such for regular monitoring and data collection for the country. However, certain government organizations like SUPARCO, EPA-Sindh in collaboration with PCSIR are monitoring air quality but not on a regular basis.

The GEMS/Air Programme established the Institute of Public Health Engineering and Research, University of Engineering and Technology, Lahore as focal point in 1976. SPM were measured at the Institute's building during 1977-89 and SO_2 during 1977-1979. Further monitoring was dispensed with due to problems with the instruments.

European Community Commission (ECC) recently sponsored three projects in Pakistan: a physico-chemical characterization of suspended particulates, an air pollution study with bio-indicators and mobile laboratories.

SYRIAN ARAB REPUBLIC

The Higher Institute of Applied Science and Technology established an air monitoring laboratory in 1982. Equipment available in this laboratory is: one mobile air pollution monitoring laboratory, one fixed station, four high volume air samplers for monitoring SO_2, NO_x, O_3, and CO and some hydrocarbon compounds, and two Sierra high volume samplers for the collection of SPM.

In addition, other equipment is available such as GC, HPLC, Atomic Absorption.

The air monitoring laboratory has performed many studies in this field. Monitoring was carried out in 1982 in Damascus for a month. In 1986 a programme was initiated to scan six cities in Syria. Since February 1994 there has been continuous monitoring for CO, SO_2; NO_x, and SPM at a fixed station in Fardos Square, Damascus.

ANNEX 5: AIR QUALITY STANDARDS IN THE EASTERN MEDITERRANEAN REGION

The Eastern Mediterranean Regional Office (EMRO) of WHO conducted a survey into air quality standards in member countries in March 1993. Carefully designed questionnaires were sent to national focal points seeking information about their air quality standards. Information gathered was examined, collated and updated using the earlier information collected from country report presentations of participants during intercountry meetings on the subject, as well as the assignment reports of the WHO short term consultants. 14 countries responded to the questionnaires.

Table 2 summarizes the situation in 9 EMR countries in which air quality standards have been promulgated. In Jordan, Morocco, Oman, Pakistan, Sudan, and Yemen national ambient air quality standards do not exist.

Table 2: Ambient air quality standards in countries of the Eastern Mediterranean Region

Pollutant	Cyprus	Egypt c	Iran	Iraq	Kuwait	Saudi Arabia	Syria	Tunisia	WHO Guidelines
CO [mg/m^3] 1 h [ppm] 1 h	30 a			35	35	35	26	40	30
CO [mg/m^3] 8 h [ppm] 8 h	10 a			9		9	9	10	10
CO [ppm] 24 h		2.5	9		8				
O_3 [μg/m^3] 1 h [ppb] 1 h	175 b			120	80	150	120	235	150-200
O_3 [μg/m^3] 8 h [ppb] 8 h	110						50-80		100-120
O_3 [ppb] 24 h		3	140						
NO_2 [μg/m^3] 1 h [ppb] 1 h	400 a			250		350	210	660	400
NO_2 [μg/m^3] 24 h [ppb] 24 h	150 a	100			50		79 d		150
NO_2 [μg/m^3] 1 yr [ppb] 1 yr			50	50		50	54	200	
SO_2 [μg/m^3] 1 h [ppb] 1 h	250 a		80	150	170-300	280	134		350
SO_2 [μg/m^3] 3 h								1300	
SO_2 [μg/m^3] 24 h [ppb] 24 h	80 a	75		100	60-200	140	47 e	365	125
SO_2 [μg/m^3] 1 yr [ppb] 1 yr				20		30	30	80	50
Pb [μg/m^3] 1 h	2.0								
Pb [μg/m^3] 24 h	1.0 a	0.014		2	2				
Pb [μg/m^3] 3 mo							1.5	2.0	
Pb [μg/m^3] 1 yr				1.5					0.5-1.0
SPM/ Black Smoke 24 h	150 a 250 a	150	260	350	350		150	260	120
SPM/ Black Smoke 1 yr				150			90	80	
PM_{10} [μg/m^3] 1h	250 a								
PM_{10} [μg/m^3] 24 h	100 a 150 a	60				340			70

a: 98-percentile; b: 95-percentile; c. maximum authorized concentration; d: not to be exceeded more than twice a month; e: not to be exceeded more than thrice a month

ANNEX 6: INFORMATION RESOURCES

A list of documents on air pollution is available at CEHA's Documentation Centre.
Quality Assurance in Urban Air Quality Monitoring.

- GEMS/Air Methodology Review Handbook Series, Vol. 1 "Quality Assurance in Air Pollution Monitoring"

- GEMS/Air Methodology Review Handbook Series, Vol. 2 "Primary Standard Calibration Methods and Network Inter Calibration for Air Quality Monitoring".

- GEMS/Air Methodology Review Handbook Series Vol. 3 "Measurement of Suspended Particulate Matter in Ambient Air".

- GEMS/Air Methodology Review Handbook Series, Vol. 4 "Passive and Active Sampling Methodologies for Measurement of Air Quality"

- GEMS/Air Methodology Review Handbook Series, Vol. 5 "Guidelines for GEMS/AIR Collaborative Reviews"

- Selected Presentations, CEHA Document No. TLM-2, Regional Training Course on Air Pollution, Amman 4-9 August 1990.

- Assessment of Sources of Air, Water and Land Pollution, Part One "Rapid Inventory Techniques in Environmental Pollution", Geneva 1993.

- Assessment of Sources of Air, Water and Land Pollution, Part two "Approaches for Consideration in Formulating Environmental Control Strategies", Geneva 1993.

- Guidance for estimating Ambient Air Monitoring Costs for Criteria Pollutants and Selected Air Toxic Pollutants, EPA-454/R-93-042.

- National Air Quality and Emissions Trends Report, 1992, EPA 454/R-93-031.

- List of Designated Reference and Equivalent Methods, 1994.

- Code of Federal Regulations 40 Protection of Environmental Ambient Air Quality Surveillance, Part 58, 1993.

- Optimum Site Exposure Criteria for SO_2 Monitoring, EPA-450/3-77-013.

- Network design and Optimum Site Exposure Criteria for Particulate Matter, EPA-450/4-87-009.

- Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air, Section 2.8, 1981.

- Air Quality Guidelines for Europe, European Series No. 23.

- Air Quality Maps for Alternative Standards and supporting Materials MD-15, USEPA