THE GLOBAL ENVIRONMENT MONITORING SYSTEM

Principles and Progress

UNITED NATIONS ENVIRONMENT PROGRAMME

Paper presented at the UNEP/WMO International Symposium on Global Integrated Monitoring of Environmental Pollution

M.D. Gwynne, F. Sella, C.C. Wallen

Riga, U.S.S.R. 12-15 December 1978

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(UNEP)

GEMS, the Global Environment Monitoring System, is a collective effort of the world community to acquire through monitoring the data needed for the rational management of the environment. While the origins of GEMS are associated with the UN Conference on the Human Environment held in Stockholm in 1972, the international effort to collect data through monitoring started decades earlier. Suffice it to remember the World Weather Watch within the UN system and, outside the system, the marine environment monitoring activities of the International Council for the Exploration of the Sea (ICES).

Following the recommendations of the Stockholm Conference, the United Nations Environment Programme was given among its tasks that of co-ordinating and stimulating international monitoring activities especially at regional and global level. This UNEP started doing at its inception in a small and almost haphazard way. It was not until 1975 that UNEP moved into the field of monitoring in a deliberate and systematic manner with the establishment of a Programme Activity Centre (PAC) for GEMS, located in Nairobi, Kenya. The role given to it by Governments is to co-ordinate the disparate international monitoring activities that are conducted throughout the world, particularly within the UN system, and to advise the Environment Fund on how best to support and stimulate the initiation of new activities or the expansion of ongoing ones through allocation of financial resources to these activities.

In discussing GEMS, it is essential to bear in mind the distinction between activities falling under GEMS merely by virtue of their international nature (e.g. those of OECD in the field of transboundary pollution and of contamination of wildlife by pollutants, those of ICES referred to above, or a large portion of the World Weather Watch) and the activities supported by the Environment Fund. Clearly the role of the GEMS PAC is much more direct in the latter case than in the former and it is mostly the latter group of activities that will be discussed here.

It is easier to outline the progress of these activities than the general principles that guide them. GEMS is not a system in which the various components hang together in a coherent and tightly knit whole, but rather an assembly of groups of activities each of which the GEMS PAC tries to direct towards the answer of specific questions - questions that become more complex as experience grows and knowledge is acquired.

Two courses of action were open to the GEMS PAC in expanding GEMS. Member States could have been asked what monitoring activities they were conducting. Whenever there was a prima facie case for assuming that activities were being correctly carried out, the PAC could have nominally absorbed them under GEMS, confining its role to organizing meetings at which participants would exchange experience, and, when necessary, through technical assistance and training activities, encourage countries that had not yet engaged in monitoring activities to do so. Networks comprising hundreds if not thousands of stations would have sprung up almost overnight and an avalanche of data of dubious comparability would have been steadily received.

A slower alternative was selected that went for the quality of the data first, rather than for their quantity. Without excluding the utilization of existing stations, and in many cases starting from them, small networks have been established, the main output of which is expected to be comparable data - an expectation which is not yet always borne out despite the repeated rounds of intercalibration that are built into most of the activities coordinated by the PAC.

The brief outline that follows will show how some networks aim at a size more or less pre-determined by the nature of the international programme of which they are part, while others, at least from the vantage point of the GEMS PAC, are clearly open-ended because their eventual size will depend on decisions to be taken at national level and, subordinately, on the availability of technical assistance.

Before going into the description of the main monitoring activities that UNEP supports and of their progress, it is worth emphasizing that UNEP, including its GEMS PAC, is in no way operational and works mostly through the intermediary of the Agencies in the UN system. The very limited financial resources that UNEP can commit to monitoring activities

would otherwise be almost entirely absorbed by staff costs and it is necessary to pay tribute here to the amount of resources, particularly high quality human resources, contributed by the agencies that are UNEP's partners in GEMS. Without the contribution of UNEP through the GEMS PAC, GEMS would certainly be smaller and its components would have perhaps not achieved such little coherence as they now have. But there would be no GEMS at all if UNEP had been asked to set it up alone.

The monitoring activities that UNEP currently supports fall rather neatly into five major categories:

(a) Climate-related monitoring
(b) Monitoring of long-range transport of pollutants
(c) Health-related monitoring
(d) Terrestrial renewable resources monitoring
(e) Ocean monitoring

They will be described here very briefly. One common feature worth underlining from the outset is that most of them have built-in evaluation and review mechanisms and that between 1981 and 1982 each of the main categories of activities and their results will be evaluated in detail by groups of government experts. The main activities also have built-in provisions for training and for technical assistance to ensure the participation of countries inadequately provided with personnel and equipment.

Climate-related monitoring aims at providing the information required to understand climatic conditions and variability, and, conversely, to understand the effects on climate of human activities (e.g. pollution, man-made changes in earth's surface reflectance). This type of monitoring has so far largely consisted of two activities - the Background Atmospheric Pollution Monitoring and the World Glacier Inventory. The first aims at establishing trends in atmospheric composition, particularly changes in the contents of CO_2 and ozone and in atmospheric turbidity, as well as trends in the chemical composition of precipitation. Some 100 stations have been established in cooperation with UNEP by WMO as part of the World Weather Watch at sites so located that they are little affected by the proximity of pollution sources. Details will be found in Dr. Kohler's

contribution to these proceedings. The other activity is being conducted with UNESCO and the Swiss Federal Institute of Technology. It is a major work involving the digestion and evaluation of information from 43 countries on glacier distribution and masses. The inventory will serve as a baseline against which changes in glacier masses with time as a result of climatic changes can be assessed.

Both activities are intended to be brought under the common umbrella of a climate-related monitoring programme, which, beside continuing the activities mentioned above, though not necessarily at the same rate of funding, may include the collection of data from existing climatological and radiation-measuring stations that will provide the improved information required for research on climate and its variability. The programme, which was developed with the advice of a group of government experts, may also include the centralized collection and analysis of old records of meteorological data, and of historical evidence on climate. In general an attempt will be made to collect both contemporary and historic data from those parts of the world from which only very little information is at present available.

Among monitoring activities to be continued, highest priority will be given to those related to the chemical composition of the atmosphere and to the various components affecting the heat-budget of the earth-atmosphere system. The results of such monitoring should be closely linked with detailed studies of the cycling of CO_2 in the atmosphere, the biosphere and the hydrosphere. It is also planned to measure systematically surface and subsurface ocean temperature, the the extent of the snow cover and the changes of the world's sea ice.

The programme on long-range transport of pollutants over Europe is conducted in partnership with the Economic Commission for Europe and the WMO as a follow up to the conclusion of a preliminary study by the Organization for Economic Cooperation and Development on the trans-boundary movement of pollutants over Western Europe alone. The current project aims at providing data on deposition of pollutants (particularly sulphur oxides and their transformation products that are responsible for acid rains) in relation to the movement of air masses from the pollutant sources to distant targets, so that models of

transport, especially over national boundaries, can be tested. A network of 42 stations in 12 countries is now collecting and analyzing samples of air, rain and airborne particulates all over Europe. The meteorological information required to assess the transport of pollutants is collected, analysed and synthesized by a meteorological centre in Western Europe which will be joined shortly by a companion centre in Eastern Europe.

Health-related monitoring started with three virtually independent activities on air pollution, water quality and food contamination monitoring. An urgent need was to bring unity to this programme. With the advice of a group of government experts it was decided to aim at gearing those activities towards the assessment of human exposure to pollutants by implementing two additional projects of a pilot nature that would show the feasibility, costs and returns, in terms of useful information, of determining the exposure to air pollutants on the one side and the body burdens of other pollutants on the other.
It is also felt that too little is known about the transfer of pollutants between media, say from atmosphere to crops, directly or through uptake from soil, and eventually to man, and that the gap needs to be filled urgently in order to be able to predict the exposure of populations or critical groups from given sources or practices, without necessarily tracking down the pollutants through costly monitoring activities in all media. Here also the possibility of a pilot project is being considered.

It is expected that, by 1981, the results of these pilot projects will have made possible the development of a really comprehensive programme of health-related monitoring that will at the same time provide the information on envrionmental levels of pollutants that may be necessary to assist governments to control pollution affecting human health and, wherever required, provide information on the actual exposure to pollutants of human populations or of critical groups, thus making it possible to assess the risks they incur from certain sources or practices - the ultimate criterion for any pollution abatement policy. As of today 180 air monitoring stations in 60 cities (14 of them without any prior experience in monitoring) report data, and 19 countries already contribute data on food contamination. The GEMS water quality monitoring programme, which will be operational in early 1979, will eventually comprise 300 to 400 sampling stations over the world.

It is important to note that in health-related monitoring we deal with international activities of a basically different kind than in the case of climate-related monitoring. The international nature of the health-related monitoring activities arises more from the near ubiquity of local problems than from the need to contribute to the solution of a problem that faces mankind as a whole. The programme aims, therefore, more at providing the tools and the machinery to obtain comparable data than at obtaining on a large scale data, the majority of which, as is particularly the case with air pollution in urban areas, are largely of local concern.

Although the activities of terrestrial renewable resource monitoring stem to a large extent from precise recommendations of the Stockholm Conference, there were at the time of the Conference few methodologies available to carry them out. UNEP with FAO and UNESCO, had, therefore, to work out for instance the methodology for assessing the state and rate of soil degradation. This has now been done and the methodology is now ready for field testing at a scale larger than the one (1:5M) at which it has so far been utilized.

Similarly, methodologies based on an appropriate combination of satellite and aerial photograph interpretation,, aerial sampling and ground surveys had to be developed, and were applied, through FAO's co-operation, to the inventorying and monitoring of the forest cover in three tropical countries of West Africa. Similar methodologies will be utilized in other parts of the world as soon as the conclusions of the pilot exercise, the results of which are becoming available now, have been fully evaluated. In addition, as a background and baseline to future forest monitoring, GEMS, in cooperation with FAO, is attempting to assess the present state of tropical forest resources at the world and regional levels. This is being accomplished using existing knowledge, both published and unpublished, supplemented and verified by analysis of appropriate satellite images for areas for which little data exists.

UNEP's direct concern with the renewable resources of arid and semi-arid ecosystems involves two very closely related monitoring fields - rangelands and desertification. Here, the operational basis is in each case the Ecological-Monitoring-Unit (EMU) approach developed

during the last 12 years for use in the arid lands of tropical Africa. Basically, this involves repeated multi-stage sampling from three data acquisition levels - space, air and ground. Information is obtained from earth resource assessment satellites, very low level systematic reconnaissance flights, and representative ground sites. Data are collected on important resource and habitat variables related to climate, biota, physical features and human activities. Monitoring is done in the short term, thus providing information on seasonal movements and variability. Repeated short-term monitoring is, however, the basis of long-term monitoring which establishes trends and changes with time (e.g. livestock population increases) and so makes it possible to correlate with each other a number of variables.

A pilot project on pastoral ecosystem monitoring in West Africa is in the process of being established in co-operation with FAO. It will serve two purposes: to allow monitoring methods developed elsewhere to be tested and adapted to the rangeland conditions peculiar to the Sudano-Sahelian zone; and to show to the countries of the region the practical benefits which can acrue from an EMU. Further clusters of similar projects will form the two Transnational Desertification Monitoring Programmes in South America and Southwest Asia.

At this point, it is perhaps worthwhile drawing attention to a fact that is obvious but which has nevertheless taken a long time to be grasped, namely that natural resource monitoring and natural resource management are closely related. Another important point is that renewable resources usually have a very great economic value to the countries in which they occur. In many cases this economic value is of such significance that countries wish to consider them primarily from a national point of view.

These reasons make the establishment of a global natural resource monitoring network very different from establishing, say, a climate monitoring programme or even a health-related monitoring programme. Global natural resource monitoring is therefore being developed by encouraging the formation of appropriate national Ecological Monitoring Units through the provision of advice and by example, and by advocating standard methodologies. Periodic meetings of the national EMU's will allow regional and global statements to be made from time to time.

In the field of ocean monitoring there is only one pilot activity under direct GEMS PAC responsibility. This is carried out in co-operation with IOC and the WMO, and is aimed at monitoring, within the framework of IGOSS, marine pollution by petroleum hydrocarbons along major shipping lanes. This is done through visual observations of oil slicks from ships of opportunity, collection of tar balls through neuston nets, chemical analyses of ocean water samples and tar-ball counts on beaches. The pilot project will come to completion in 1979. A workshop will evaluate the results obtained and advise whether such an activity is worth continuing.

Apart from this project, most of the monitoring activities related to oceans are organized through UNEP's Action Plans for Regional Seas and are the responsibility of the Programme Activity Centre Centre for Regional Seas (temporarily located in Geneva) and not of the GEMS PAC.

At present, the most developed regional monitoring programme is the Mediterranean Pollution Monitoring and Research Programme (MED POL). In this, 83 marine science institutions from 16 Mediterranean countries and the European Economic Community participate in 8 pilot projects initiated in 1975 under the technical guidance of FAO, IAEA, IOC, WHO and WMO.

Monitoring is based on agreed sampling and analytical procedures with permanent intercalibration of the techniques used. It covers:

(a) the determination in marine organisms of levels of selected metals, particularly mercury and cadmium;

(b) the determination in marine organisms of selected organo-chlorine compounds such as DDT, PCB's dieldrin and their metabolites;

(c) the sanitary and health surveillance of recreational and shell-fish growing waters in selected coastal areas;

(d) petroleum hydrocarbons pollution, assessed by methods similar to those used in the IGOSS pilot project referred to above;

(e) changes in marine communities and ecosystems that might be the result of ocean pollution.

Additional activities are planned to start in 1979 to monitor the input of river-borne and airborne pollutants into the Mediterranean.

Similar monitoring programmes are due to start in 1979 in the Red Sea and the Kuwait Action Plan area. Other areas such as the Gulf of Guinea and the Caribbean region will be included shortly in the Regional Seas activities.

The assessment of the pollutants' load carried by major rivers has been initiated through the UNESCO project on the World Register of Rivers Discharging into the Oceans. The first completed phase of the project has estimated the water discharge into oceans of 260 major rivers, but only 25 per cent of these rivers are regularly monitored with regard to their water quality. Even in the rivers that are regularly monitored, concentrations of the most important pollutants are not generally measured on a routine basis and the present lack of agreement on the analytical techniques to be commonly used is a serious obstacle for a general evaluation of the results.

This short overview has only highlighted those activities in which the GEMS PAC is directly involved. These include most of the monitoring activities carried out under the aegis of the United Nations system. They have been either initiated or considerably boosted by UNEP's contribution but it is important to underline that UNEP's support to any of these activities is not open-ended and will inevitably be reduced or phased out altogether when the scope of the activities reaches its pre-assigned limits, when the expansion of the activities becomes largely self-sustaining, or when it is realized that the investment in a certain activity is not commensurate to the returns obtained. The time limits imposed on UNEP's support, which obviously vary from activity to activity, are dictated by the fact that UNEP's financial resources are assumed not to be growing thus placing limitations on the funds available for monitoring activities. In a non-growing budgetary situation, decreased commitments to certain activities imply the release of resources for new activities and therefore the continuation of UNEP's catalytic role.

No new activities are possible, however, without new ideas. It is precisely new ideas that UNEP expects to be aired at international conferences, ideas towards the implementation of which it will eventually have to decide whether to channel its limited resources.

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