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The Global Environmental Monitoring System of the United Nations Environment Programme

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and sodium salts (other than sodium chloride) can also be economically recovered from bitterns.

53. Metallic magnesium is currently extracted from sea water in substantial quantities by processing salt bitterns with calcium carbonate from sea shells and then reacting the material with electricity (electrolysis).

54. Bromine gas, an important component for the production of leaded gasoline, is recovered from the ocean by simple treatment with sulfuric acid and chlorine gas. The bulk of the world's requirements for bromine is produced from sea-water. Deuterium (heavy water) is obtainable from sea-water and is important in nuclear engineering applications. Compared to other sources, the natural concentration of uranium compounds in sea water is sufficiently great that the continuing demand for the material may allow economic recovery in the foreseeable future.

6. Desalination of sea water

55. Growth in world population and expansion of agricultural and industrial activity will certainly increase the need for fresh water. It has been estimated that world consumption of fresh water may double in a matter of two decades. Desalination has been proposed as a partial solution to increasing demands for fresh water. Recent technological developments in desalination processes have been incorporated and tested in numerous facilities around the world. Nearly all of the plants have been of comparatively small capacity (several million gallons of fresh water produced per day), and the construction of much larger systems has been held in abeyance because of the expected costs of desalination compared to other water sources or practices.

56. The need for fresh water in specialized applications in remote or arid coastal locations will continue despite the

production cost of up to several dollars (U.S.) per thousand gallons (for smaller scale facilities). However, more general usage of desalinated sea water will be predicated on a delivery cost of approximately \$0.30 (U.S.) per thousand gallons. Agricultural use of water may be limited to costs as low as \$0.10 to \$0.15 per thousand gallons.

57. The most efficient technology in current use produces desalinated sea water at costs of slightly less than \$1 (U.S.) per thousand gallons. Four general types of processing have evolved: distillation; membrane action (reverse osmosis); crystallization (freezing); and chemical reaction (ion exchange). Of the four processes, distillation by the so-called "flash" or "multistage flash" systems appears to be the most practical from the viewpoint of production cost and quantities of sustained production.

58. The economic operation of all of the processes is constrained by several major factors: first, all of the systems require large quantities of energy (heat or electricity) and fuel costs are very significant; secondly, corrosion may limit sustained plant operation; thirdly, in the case of distillation, "scaling" (chemical deposits) in piping reduces the heat transfer properties and thereby increases fuel requirements.

59. Plans for very large flash distillation systems have emerged with estimated production costs of less than \$0.40 (U.S.) per thousand gallons that are intended to profit from further technological innovation and economies of scale. Because the energy costs form such a substantial portion of operating expenses of desalination, multipurpose systems have been proposed in conjunction with industries that produce large quantities of heat as a waste product (i.e., nuclear or fossil-fueled power generators). Reliable cost of information from large-scale desalination or multipurpose facilities must await more detailed investigations of pilot plant operations.

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The Global Environmental Monitoring System of the United Nations Environment Programme^{7 5}

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1. The Global Environmental Monitoring System (GEMS) project was established upon a decision of the Governing Council of UNEP at its first session held at Geneva from 12 to 22 June 1973. Following that decision, the Executive Director convened an International Meeting on Monitoring in February 1974 which outlined the objectives, principles, programmes, goals and general guidelines of GEMS (see Annex) and listed the environmental variables that it recommended should be monitored as a matter of priority.

2. At its second session, by decision 8 (II), the Governing Council decided, among other things, to consider as a matter of priority the report of the Intergovernmental Meeting on Monitoring that was held at Nairobi in February 1974 (UNEP/GC/24) and a report to be prepared by the Executive Director on the result of his studies and analyses

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^{7 5} Submitted by the United Nations Environment Programme (UNEP) at the request of the Third Committee of the Third United Nations Conference on the Law of the Sea.

of the report of the Inter-governmental Meeting and on the progress in the implementation of GEMS. The Executive Director is accordingly submitting its report to the Governing Council in document UNEP/GC/31/Add.2 under the title "The Global Environmental Monitoring System". The present document is largely based on that report and on other documents prepared for the Governing Council.

3. GEMS is a co-ordinated effort of Member States, United Nations agencies and UNEP to ensure that data on environmental variables (such as pollutant levels and the state of living resources) are collected in an orderly and adequate manner for the purpose of providing Governments with a quantitative picture of the state of the environment and of the natural and man-made global and regional trends undergone by critical environmental variables. It will thus provide one of the tools that decision-makers require at the national and at the international level. Because of its regional and global nature, the main concern of GEMS will be with programmes whose results may lead to concerted action by more than one country, or with those that can only yield results, even of local import, if more than one country is involved in them.

4. Local programmes, on the other hand, are those in which results are collected by the countries concerned primarily for their own benefit rather than for that of the international community. All countries and certain agencies are, and will continue, devoting much of their monitoring resources to these programmes in order to meet local needs rather than to satisfy internationally established priorities.

5. GEMS will be concerned with the results of local monitoring programmes primarily for the purpose of ensuring that the information of regional and global significance that they yield is not ignored, and that problems at the interface between the local and other levels are handled with the requisite amount of technical consistency. However, GEMS will also provide a framework within which Member States can exchange information on the monitoring experience that each has gained at the local level and ensure that their data are comparable with those collected for the same purpose in other countries.

6. The main tasks of GEMS will be

(a) to select those variables which have been identified as falling within UNEP's programme of work, and that can and should be monitored as a matter of priority. Because monitoring is not an end in itself, the list of variables to be monitored will need to be reviewed periodically to ensure that it is consistent with the goals of UNEP's activities;

(b) to frame the questions that monitoring of each variable is expected to answer and to justify monitoring activities on the basis of the guidance for action that the results are expected to provide;

(c) to ensure that monitoring of any variable is carried out properly (namely that results are comparable, that sampling or observation frequencies are adequate to achieve the resolution required and that the results are made available according to a predetermined format) and on a scale commensurate with the urgency of the need for information and with the over-all resources for monitoring that are available internationally;

(d) to ensure that the individual readings are appropriately and uniformly processed and analysed so as to yield the information, rather than merely the data, that is required for environment management purposes.

7. In practice, the data that will be utilized by GEMS, even those that may require international arrangements, such as those collected in the high seas or from outer space, will all be collected by national institutions. GEMS will see to it that the collection of the data is properly co-ordinated, wherever necessary, through the intermediary of United Nations agencies or other appropriate organizations.

8. In its operation, GEMS will require:

(a) A standing advisory group of government experts or a steering committee of government representatives to recommend and set broad policies for GEMS within the UNEP programme as approved by the Governing Council, to review and analyse the results of monitoring operations and to report to the Governing Council. The Executive Director has suggested to the Governing Council that an *ad hoc* group of government experts should be asked, among other things, to make concrete proposals to the Governing Council at its fourth session (in 1976);

(b) A group of United Nations agencies' representatives to ensure the participation of the agencies in GEMS and to provide for exchange of information on, and for co-ordination of, planned and ongoing activities related to monitoring. Such a group is already in existence and is called the

GEMS sub-group of the Inter-Agency Working Group on Earthwatch, a subsidiary body of the Environment Co-ordination Board, established by resolution 2997 (XXVII) of the General Assembly;

(c) A small technical staff whose tasks will be

(i) to assemble the information that the Council requires;

(ii) to prepare, or request from appropriate sources, working documents that will enable the advisory group of experts or the steering committee (whichever is established) to report to the Governing Council;

(iii) to ensure that the views and decisions of the Governing Council, as interpreted by the advisory group or steering committee on monitoring that may be established, are followed in the implementation of GEMS;

(iv) to advise the Environment Fund on the financial support needed for monitoring projects; and

(v) to maintain contacts with national institutions and laboratories and with United Nations and other organizations.

9. The first task of the technical staff will only be performed successfully if Member States agree to make available the results of those measurements that will be required by GEMS. One of the principles (*annex, para. 3 (g)*) agreed by the states that "nations that agree to participate in a system of global or regional monitoring incur an obligation to exchange promptly appropriate data or evaluations of data, especially in relation to the early warning of natural disasters or disasters occurring as a result of human activities affecting regional or subregional resources".

10. Accordingly, no State is legally bound to participate in GEMS and therefore to exchange promptly data or evaluation of data unless and until it agrees to do so. Ultimately, therefore, GEMS can only rely on the voluntary co-operation of Member States.

11. Co-operation in generating and providing data needed for other than domestic purposes can only be ensured at a cost which some developing countries find difficult to bear. As underlined in the principles (*annex, para. 3 (h)*) agreed by the Intergovernmental Meeting provision of financial assistance for monitoring operations should be made to ensure effective involvement of the developing countries. Such assistance will depend on the nature of the operation. Thus, the Environment Fund would be expected to provide or arrange for the establishment of new stations or the purchase of equipment to be used for the collection of data of global relevance by developing countries that could not otherwise supply data of vital importance to GEMS. On the other hand, the Environment Fund, while it would not finance the establishment of national networks for domestic purposes, would make recommendations to funding institutions and provide some technical assistance to help establish such networks.

12. Measurements of critical variables in the marine environment will inevitably be one of the major activities co-ordinated by GEMS, with regard to both marine pollution and marine living resources. However, GEMS will need to broaden the scope of ocean monitoring in order to integrate it with the results of monitoring on land, in the atmosphere and in rivers and will aim at obtaining a comprehensive picture of the fate of priority pollutants (in this context, metals such as lead, mercury and cadmium,

chlorinated hydrocarbons and petroleum hydrocarbons) that can provide guidance for environment management purposes at both the national and the international levels.

13. Because the ocean is subdivided into basins and seas that in many cases communicate only slowly with each other, it is often convenient to consider it on a regional basis from the point of view of monitoring. Accordingly, the North Sea and the Baltic Sea are under continual monitoring by the coastal States under the International Council for the Exploration of the Sea (ICES) programme. Likewise, the participants in the Intergovernmental Meeting held at Barcelona in January and February this year (see UNEP/WG.2/5) have agreed to undertake co-ordinated monitoring activities in the Mediterranean under the aegis of UNEP. In the Indian Ocean a first survey of the monitoring capabilities of the coastal States is soon to be initiated under UNEP sponsorship and will eventually result in a co-operative marine monitoring and research effort in that area.

ANNEX

Definition of objectives and principles

1. On the basis of a draft prepared by a working group presided by the Vice-Chairman, Mr. Odhiambo (Kenya), the Intergovernmental Meeting, after considering certain amendments proposed to that draft, approved the objectives and principles set out below:

Objectives

2. The objectives of the Global Environmental Monitoring System (GEMS) are:

To provide information necessary to ensure, in conjunction with evaluation and research, the present and future protection of human health, well-being, safety and liberty and the wise management of the environment and its resources by:

- (a) (i) increasing quantitative knowledge of natural and man-made changes in the environment and of the impact of these on man's health and well-being;
- (ii) increasing understanding of the environment and, in particular, of how dynamic balance is maintained in ecosystems, as a basis for managing resources;
- (b) providing early warning of significant environmental changes (including natural disasters) in order that protective measures may be organized;
- (c) making it possible to check the effectiveness of established regulatory mechanisms and to plan optimal technological development.

Principles

3. The principles governing intergovernmental co-operation in monitoring are:

- (a) Intergovernmental co-operation in monitoring should build on the basis of existing national and international systems to the maximum possible extent, while making all useful arrangements for eliminating, as far as possible, the existing gaps;
- (b) Existing United Nations specialized agencies should be used to the maximum extent possible as the institutional base for co-ordinating and implementing monitoring programmes. It is essential to improve co-ordination mechanisms within the United Nations framework;
- (c) With regard to monitoring on an international basis, priority should be given to global and regional (multinational) problems;
- (d) The exchange of information about local problems that are of wide occurrence, and about the methods used to monitor them, is of high importance;
- (e) Special emphasis should be given global monitoring to the variables of most critical importance that are capable of adequate scientific measurement at the present time. Where the measurement

techniques for variables of critical importance are deficient, special attention should be given to their development and to arrangements that make it possible to ensure the comparison and homogeneity of measurements;

(f) Monitoring systems should be designed to meet clearly defined objectives, and arrangements for the evaluation of the data must be an integral part of the design of the system;

(g) Nations that agree to participate in a system of global or regional monitoring incur an obligation to exchange promptly appropriate data or evaluations of data, especially in relation to the early warning of natural disasters or disasters occurring as a result of human activities affecting regional or subregional resources;

(h) As international monitoring implies the participation of many nations without regard to their stage of economic development, assistance should be given, where necessary, especially in the field of training and equipment, to ensure effective involvement of the developing countries;

(i) Nations should share the responsibility for implementing international monitoring systems in areas outside national jurisdiction, such as oceans and space. Activities carried out on national territories will be the responsibility of the nations concerned.

Programme goals

4. Programme goals provide the focus for a global environmental monitoring system so that it can be responsive to priority subject areas of the United Nations Environment Programme. Programme goals are intended to ensure effective co-ordination and integration of the component monitoring systems, adaptation of the global system to all levels of development, and utilization of monitoring results to facilitate action. These programme goals, not listed in priority order, include:

- (a) An expanded human health warning system;
- (b) An assessment of global atmospheric pollution and its impact on climate;
- (c) An assessment of the extent and distribution of contaminants in biological systems, particularly food chains;
- (d) An assessment of critical environmental problems relating to agriculture and land and water use;
- (e) An assessment of the response of terrestrial ecosystems to pressures exerted on the environment;
- (f) An assessment of the state of ocean pollution and its impact on marine ecosystems;
- (g) An improved international system allowing the monitoring of the factors necessary for the understanding and forecasting of disasters and the implementation of an efficient warning system.

General guidelines

5. There is a need to co-ordinate the development of national, international and sectoral guidelines for each of the programme goals listed above and for the over-all objectives of GEMS. This is essential in order to elucidate pollutant pathways, sinks and impacts, to control existing pollution and its spread to hitherto clean areas and to optimize the use of natural resources.

6. These guidelines relate to:

- (a) The establishment of relevant national focal points required for co-ordinating, assessing and transmitting the results of monitoring;
- (b) The design and implementation of national, regional and global monitoring programmes including data collection, processing, reduction and assessment;
- (c) The improvement of data exchange and processing within and across sectors and at varying levels of detail;
- (d) The development of sound planning and an adequate scientific and technical basis before any new monitoring programme is established.

Recommendation

7. The Intergovernmental Meeting on Monitoring recommends that the Governing Council adopt the definition of objectives and principles, programme goals and general guidelines as presented above.