

DEPARTMENT OF WATER AFFAIRS

DIVISION OF HYDROLOGY

TECHNICAL NOTE NO. 38

PROPOSED PROGRAMME FOR MONITORING POLLUTANTS
IN THE WATER ENVIRONMENT.

W.J.R. ALEXANDER.
October, 1972.

PROPOSED PROGRAMME FOR MONITORING POLLUTANTS
IN THE WATER ENVIRONMENT.

1. Environmental pollution has become an international problem. However, trends in the effects of this pollution and advance warning of the approach of dangerous and possibly irreversible situations, will have to be based on a sound national monitoring programme. It is in our own interest, as well as being an international obligation, that we should establish this as soon as possible. A background to the international developments in this field is given in the notes below.
2. Summaries of the SCOPE report on global environmental monitoring, and the recommendations of the United Nations Conference on the Human Environment (Stockholm, June 1972) are attached.
3. The main objectives of the monitoring programme are:-
 - (i) The development of an environmental monitoring system to provide the co-ordinated collection, analysis and publication of data on the physical, chemical and biological parameters of pollutants in the water environment.
 - (ii) The development of the capability of providing advance warning of adverse situations. This would require a knowledge of the pathways of pollutants through the environment; the transfer mechanisms at the air/water/soil interfaces; the accumulation of pollutants in aquatic biota which could then serve as indicators; and the development of mathematical simulation models.
4. The programme will have to be co-ordinated with programmes for monitoring the atmospheric and marine environments and in media other than water (air, soils and biota).
5. Baseline, regional, and high exposure sites will have to be selected, bearing in mind that as many variables as possible should be collected at the same location (i.e. both causal and effect variables, and other variables outside the water environment).
6. The preservation of samples for future re-examination should be considered (environmental archives).
7. Research should be undertaken in collaboration with the international organisations to develop standard procedures for the collection and analysis of samples.
8. Research should be encouraged to provide adequate knowledge of the inputs, movements, residence times and ecological effects of critical pollutants in the water environment.
9. Information should be obtained on the existing environmental monitoring networks.

10. Recommendations should be made on the extension of existing networks; the establishment of new networks; and on the organisations responsible for the collection of data, and the analyses and publication of results.
11. The entire programme will have to be co-ordinated; co-operation with statutory monitoring authorities will have to be sought; co-ordination with other environmental monitoring bodies will have to be obtained; and international co-ordination and co-operation should be fostered.

W.J.R. ALEXANDER
Pretoria
September, 1972.

GLOBAL ENVIRONMENTAL MONITORING.

A: SUMMARY OF SCOPE REPORT TO STOCKHOLM CONFERENCE.

1. Terms of reference.

- 1.1 In terms of a 1968 resolution of the International Council of Scientific Unions (ICSU), the International Union of Biological Sciences (IUBS), and the International Union of Geodesy and Geophysics (IUGG) in consultation with the Special Committee for the International Biological Programme (SCIBP) recommended the creation of a Scientific Committee on Problems of the Environment (SCOPE). This committee first met in Madrid in 1970.
- 1.2 SCOPE's main objective was to advance the knowledge of the influence of man upon his environment and provide a source of advice to governments on environmental problems. Its functions included advanced studies of environmental processes, devising techniques for environmental measurements, designing a co-operative environmental monitoring system, evaluating global trends and projecting these into the future, and devising measures to minimise the adverse effects of the interaction of man on his environment.
- 1.3 SCOPE initiated four working groups, one of which was a Commission to Monitor the Environment. In 1970 the Secretary-General of the UN Conference on the Human Environment requested that this SCOPE Commission "..... prepare a report recommending the design, the parameters and technical organisation needed for a coherent global environmental monitoring system making maximum use of available capabilities of existing and planned national, regional and international networks, together with such data collection and processing centres as may be required".

2. Summary of recommendations of SCOPE report.

- 2.1 The Monitoring Commission of SCOPE made 18 recommendations:-
1. That the UN take immediate steps to foster and co-ordinate a permanent global environmental monitoring system.
 2. That the most efficient means for co-ordinating the existing activities into a global monitoring system be studied.
 3. That the UN request ICSU to establish permanent arrangements to provide scientific assistance in the evolution and design of the global environmental monitoring system, and the analysis and interpretation of data on environmental changes and their effects.
 4. That the UN invite each government to designate an appropriate Monitoring Office, and that the programmes be evolved to obtain maximum integration between monitoring activities in the different media.
 5. That an international integrated network of baseline (low exposure) and regional (medium exposure) stations be established immediately for minimum priority monitoring and pilot research programmes. This to be followed by a development period of additional stations and the inclusion of additional variables.

6. That at least ten terrestrial (including freshwater) global baseline stations be established immediately. Baseline stations in the marine environment should be established after pilot studies (see 15).
7. That the following first priority physical and chemical data be collected as a minimum programme at the baseline stations in all relevant media of air, water, soils and biota from the beginning of the establishment period.
 - (a) For assessing secular changes of the global climate: atmospheric turbidity, carbon dioxide, solar radiation, standard meteorological data.
 - (b) For assessing the degree of pollution in all media: Mercury, lead cadmium, DDT, polychlorinated biphenyls.
- And that the following additional variables be seriously considered.
 - (a) For assessing secular changes of the global climate: Vertical and size distribution of aerosols, carbon dioxide fluxes; ozone, water vapour and trace gases in the stratosphere; global albedo.
 - (b) For assessing the degree of pollution of the biosphere: Petroleum products, persistent organochlorine compounds other than DDT; chlorinated aliphatic hydrocarbons; chlorinated phenoxy acetic acid derivatives; relevant compounds in the cycles of S, N, P, and C; certain metals (As, V, Zn, Se, Cr, Cu, Be, Ni, Mn); organo-phosphorous compounds; oxygen in water.
- And also that other potentially harmful substances be continuously reviewed for possible inclusion in the routine programme (e.g. antibiotics, hormones, carcinogens, teratogens, mutagens).
- That the possibilities of using biological accumulators and indicators be investigated by pilot studies.
- That all the measurements be standardised and co-ordinated in space and time so that the resulting data together with appropriate information about sources and flux rates in the environment can be used to construct global dynamic budgets of pertinent substances.
8. That nations be invited to nominate one or more regional stations for inclusion in the global network of reference stations.
9. That the programme of the regional stations be correlated with the baseline stations and that the following variables be measured for the establishment period:

Atmospheric turbidity
Solar radiation
Standard meteorological data
Mercury
Lead
Cadmium
DDT, its metabolates and degradation products
Polychlorinated biphenyls

- And/.....

- And that the variables to be included in the baseline stations during the development period also be considered for possible inclusion at the regional stations.
10. That nations be invited to establish stations in high exposure areas to investigate the correlation between high levels of contaminants and the possible effects on human health and the performance of biological systems.
 11. That a coherent programme be developed to monitor those aspects of human health known or suspected to be environmentally produced.
 12. That at least two International Research Reference Stations be established for developing standard methods and for training.
 13. That biome studies be started immediately in association with the reference stations to provide information on the structure and functioning of representative ecosystems and for monitoring the effects on biota of environmental change.
 14. That pilot programmes be designed for the following monitoring activities that cannot be confined to the networks of stations:-
 - (a) Repetitive surveys (satellite sensing of gross vegetation, land use patterns, erosion and soil cover of the continents).
 - (b) Monitoring of vanishing or endangered species of mammals, birds, ecosystems or biocoenoses.
 - (c) Monitoring selected significant aspects of soil organisms in suitable areas.
 15. That action be taken immediately to implement research activities and pilot studies to define and develop efficient monitoring programmes in the following areas:-
 - (a) The design of a programme for monitoring variables in the marine environment.
 - (b) The isolation and development of biological parameters pertinent to the monitoring of effects on biota of environmental changes.
 - (c) The development of a programme for continuous registration of short lived phenomena as early indicators of potential future global problems.
 - (d) The design of a system for preserving samples from air, water, soils and biota in order to make future re-examinations of past environmental conditions possible (environmental archives).
 - (e) Analyse the needs and possibilities of aerobiology as a method for global environmental monitoring.
 16. That operations manuals be prepared.

17. That discussions be instituted to formulate, define and assign responsibility for contributions to a practical and unitary monitoring programme, and that these discussions include:

- (a) Territorial monitoring activities which are the sole concern of each national government.
- (b) Regional programmes which are collaboratively monitored.
- (c) Global programmes for climatic change, human health and toxicology, marine conditions, radioactivity, education and training.

18. That the UN establish an appropriate unit for co-ordinating all global environmental activities.

3. Other matters mentioned in the report.

3.1 The report emphasised the need for a global environmental monitoring system to include co-ordinated measurements of physical, chemical and biological parameters in the atmosphere, the hydrosphere, the pedosphere and in biota. Thus the budget, or pathways of a substance through the environment from start to finish, can be determined.

3.2 The need to develop mathematical simulation models of environmental interactions that can predict the results of remedial action was emphasised. The capability of advance-warning before an adverse situation becomes irreversible is absolutely essential.

3.3 The problems considered most relevant for early implementation by a global monitoring system are:-

- (a) Potentially adverse climatic changes.
- (b) Potentially adverse changes in biota and man from contamination by toxic substances.
- (c) Potentially adverse changes in biological activity caused by improper land use.

3.4 Other important problems which are important locally but which have not been included in the global programme are eutrophication of waters and decreasing freshwater resources.

3.5 The air/water/soil transfer mechanisms and interfaces deserve particular attention.

3.6 Substances released into rivers find their way into aquatic biota and bottom sediments which may often irreversibly accumulate many substances and thus act as a valuable historical record of previous changes and trends.

3.7 The two major groups of parameters of potential importance in water monitoring are the biological stimulants and the biological toxins. The stimulants result in flourishing aquatic growth which on decay de-oxygenate the aquatic environment and disturb the normal biological equilibrium. The toxins include almost all heavy metals and many organic compounds.

- 3.8 For reasons of economy, a variable should not be measured at more sites than are necessary to establish global trends. On the other hand, as many variables as possible should be measured at the same location. The monitoring system should be designed to measure both causal and effect variables, such as DDT and species reproductivity.
- 3.9 To accomplish the global survey, a minimum of 100 areas should be established. Every country should participate, the largest might each offer ten or more areas. The siting criterion is simply that it be representative of an integrated region, which may be defined on the basis of geography, biota, climate, land use, etc. The initial list of variables to be monitored will be similar to that of baseline stations but not as comprehensive and requiring less sophisticated instrumentation.
- 3.10 Sites should be dedicated to monitoring in perpetuity and should be located in natural areas at least 100 km from any significant human settlements and large-scale agricultural activities.
- 3.11 The final stage will be the transfer of the programme from being the joint efforts of both research and governmental institutions to governmental institutions only, it being obvious that the execution of routine monitoring programmes is not the task for research institutes.
-

B: SUMMARY OF REPORT OF THIRD COMMITTEE
(POLLUTION AND ORGANISATION ARRANGEMENTS) OF
STOCKHOLM CONFERENCE.

1. Terms of reference.

The Third Committee considered the following items on the agenda of the Conference:

12. Identification and control of pollutants of broad international significance.
15. International organisational implications of action proposals.

2. Summary of recommendations.

2.1 Pollution generally:

- 218 That Governments carefully evaluate the likelihood and magnitude of climatic effects and consult other interested States when activities carrying a risk of such effects are being contemplated or implemented.
- 219 That Governments minimise the release to the environment of toxic or dangerous substances.
- 220 That Governments take into account the standards proposed by competent international organisations.
- 221 -
- 222 That Governments actively support international programmes to acquire knowledge for the assessment of pollutant sources, pathways, exposures and risks.
- 223 That the Secretary General with the active support of Governments and appropriate scientific and other international bodies:
 - (a) Increase the capability to provide awareness and advance warning of deleterious effects to human health and well-being from man-made pollutants.
 - (b) Improve the international acceptability of procedures for testing pollutants and contaminants.
 - (c) Develop plans for an International Registry of Data on Chemicals in the environment.
 - (d) Explore the feasibility of developing a registry of releases to the biosphere of significant quantities of radioactive materials.
 - (e) Expand international co-operation on radioactive waste problems.
- 224 That a major effort be undertaken to develop monitoring and research programmes providing data for early warning and prevention of the deleterious effects of the various environment agents. Programmes to be co-ordinated by the World Health Organisation (WHO).

- 225 That the WHO assist Governments in undertaking co-ordinated programmes of monitoring of air and water.
- 226 That internationally co-ordinated programmes of research and monitoring of food contamination by chemical and biological agents be established and developed jointly by the FAO and WHO.
- 227(a) That approximately ten baseline stations be set up in areas remote from all sources of pollution to monitor long-term global trends which may cause climatic changes.
- (b) That a larger network of not less than 100 stations be set up to monitor atmospheric constituents and changes in the distribution and concentration of contaminants on a regional basis.
- (c) That these programmes be co-ordinated by the World Meteorological Organisation (WMO).
- (d) That the WMO in co-operation with ICSV continue to carry out the Global Atmospheric Research Programme (GARP).
- 228(a) That research activities in terrestrial ecology be encouraged so as to provide adequate knowledge of the inputs, movements, residence times and ecological effects of critical pollutants.
- (b) That regional and global stations, research centres and biological reserves be established within the MAB programme in all major ecological regions.
- (c) That programmes such as MAB be used to monitor the accumulation of hazardous compounds in biological and abiotic material, and the effect of such accumulations.
- (d) That the WHO together with other organisations continue to establish primary standards for the human organism, especially from pollutants that are common to air, water and food.
- 229 That increased support be given to the Codex Alimentarius Commission to develop international standards for pollutants in food.
- 230 That UN agencies derive working limits for common air and water contaminants.
- 231 That Governments make information on their pollution research, control activities and cost-benefit methodology available.
- 232 That the functions of the body co-ordinating the UN organs in connection with environmental problems include:
- (a) The development of procedures for the identification of pollutants.
- (b) The appointment of expert bodies to assess the exposures, risks, pathways and sources of significant pollutants.
- (c) The review and co-ordination of international pollution control.
- (d) The establishment of consultation mechanisms.

2.2 Marine pollution.

- 233 That Governments with the assistance of UN bodies and the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) implement available instruments on the control of maritime sources of marine pollution, and strengthen national controls over land-based sources of marine pollution.
- 234 That Governments support national research and monitoring efforts of international programmes on the marine environment, particularly the Global Investigation of Pollution in the Marine Environment (GIPME) and the Integrated Global Ocean Station System (IGOSS).
- 235 That GESAMP re-examine annually its Review of Harmful Chemical Substances.
- 236 That mechanisms for combining world statistics on potential marine pollutants be developed.
- 237 That the Intergovernmental Oceanographic Commission (IOC), jointly with the WMO promote the monitoring of the marine environment.
- 238 That the IOC ensures the exchange and dissimulation of data and information on baselines and on marine pollution.
- 239 That Governments collectively endorse the objective that the marine environment and all the living organisms which it supports are of vital importance to humanity etc.

2.3 International organisational implications.

The conference recommended that the General Assembly establish a Governing Council for Environmental Programmes (GCEP) composed of 48 members on the basis of equitable geographical distribution.

The main functions and responsibilities of the GCEP would be the promotion of international environmental co-operation; the co-ordination of environmental programmes; the review of the world environmental situation; and the promotion of the acquisition and exchange of environmental information.

WJRA/
Pretoria
September, 1972.