Environmental Monitoring and Data Analysis in China--Evaluation of Its Present State and Improvement and Recommendations to CCICED by Working Group on Environmental Monitoring and Data Analysis

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1. FORWARD

At the first plenary session of CCICED it was decided to conduct priority research in five fields (later adjusted to six) in the light of the pressing issues of the coordinated development of the economy and environment in China today. Monitoring and data analysis is one such field. The expert working group on this subject held its first meeting, from 15 to 16 April 1993, in Beijing. This report has been written on the basis of the discussion of three background reports presented by the Chinese experts. Considerable attention was given during the discussion to financial guarantees and international cooperation. The report also provides an evaluation of the present state of the monitoring system, the decision support system and the environmental indicator system. It then lists the preliminary recommendations and gives a future work plan.

2. EVALUATION OF THE PRESENT STATE OF ENVIRONMENTAL MONITORING AND DATA ANALYSIS

2.1 Improving China’s Environmental Monitoring Network

2.1.1 Status of Environmental Monitoring

Being the basis of environmental management, environmental monitoring stations of different levels were established in the mid 1970s when China set up its environmental management institutions. During the Sixth Five-Year Plan (1981 - 1985), sixty-three key monitoring stations, including the China National Environmental Monitoring Center and some stations in major cities, were set up under the leadership of the administrative departments of different levels. At the same time, some of the seriously polluted counties also established monitoring stations. An environmental monitoring system at four levels (state, provincial, municipal and country) thus gradually came into being.

During the Sixth Five-Year Plan period, other authorities under the State Council that are responsible for the protection of natural resources also began to establish their own monitoring systems. Industrial sectors also began to set up their own monitoring systems at the national and provincial levels, and at large enterprises.

After the Seventh Five-Year Plan, environmental protection departments, resource protection departments and industrial sectors had all established their monitoring networks. The total number of monitoring stations has reached 4,000, with nearly 70,000 professional monitoring technicians. The number of stations of the environmental protection system is increasing at a rate of 13 % annually. By the end of 1991, the monitoring stations at four different levels totalled 2131 and professional staff increased to 32,000.

2. 1. 2 Status of environmental monitoring techniques and management

a. Objectives of environmental monitoring

Monitoring environmental quality; monitoring and supervision of pollution sources; monitoring the implementation of environmental monitoring.

b. Technical support
In order to fulfil the above-mentioned tasks, the National Environmental Protection Agency (NEPA) has stipulated methods for the ambient monitoring and pollution source monitoring. NEPA also formulated four technical specifications concerning air and waste gas, surface water, biological substance and noise, providing a favorable condition for the editing of the national environmental quality report. Quality control between the stations of different levels has started using more than 50 standards and samples of calibration materials to support the assessment of laboratory and instrumentation performances.

c. Establishment of the preliminary management basis of environmental monitoring

In recent decades, the administrative organization of environmental monitoring at different levels has been organized. All environmental protection bureaus (agencies) at the state, provincial and municipal level have and administrative organization and full-time staff. The National Environmental Monitoring Administrative Act came into force in 1983.

d. Existing problems in management

Harmonized organization and administration are lacking for national environmental monitoring centers. There is no adequate coordination and cooperation between different departments, and monitoring is not standardized.

There is not enough crosswise contact between environmental protection, resource protection and industrial centers. So they neither exchange monitoring date and information nor comprehensively report on environment status and pollutants discharge status.

The technical basis for monitoring is very weak. The development of methods and instruments cannot meet the demand.

a. Justification of the establishment of an environmental monitoring network

One of the basic tasks of environmental monitoring is to give information on existing environmental quality. It needs the cooperation of meteorological departments to determine that air quality, and it needs the cooperation of the water conservancy departments to determine the quality of surface water. We need, in general, close cooperation among the various departments to form an environmental monitoring network of surface water, air, ocean, radioactive substances and ecological systems, so that we can have an integrated environmental monitoring system.

It is very difficult to strengthen and further the management and control of polluting sources without a strong monitoring network, including the participation and cooperation of the monitoring stations of industrial sectors.

We must start within two years large-scale monitoring work for mankind’s common cause of global environmental protection; for example, the monitoring of the ozone layer, greenhouse gases, acid rain and other ecological function zones. These monitoring works call for an inter-departmental and inter-sectoral monitoring network.

b. Objectives

- Select stations to establish a meaningful environmental monitoring network. We will chose enough monitoring stations from the existing ones of the four levels to form a national environmental quality monitoring network of enough substance to write a National Environmental Quality Report.

- Optimize stations and establish a three-level monitoring network that cuts across departments and special regions. It should be based on the three major monitoring approaches (environmental protection system, resources management system and industrial system).

- Comparative study of foreign environmental monitoring networks by reviewing the type, structure and operation of the networks in America, Britain, Germany, Japan and other European countries.

- Study and compile information on unified network techniques. Compile a national scheme of unified monitoring methods, technical specifications and management of quality control.

- Study and draw up necessary network operation; management regulations and establish prediction models for typical cities.

2.1.4 Suggestions on the realization of an improved monitoring network
In order to build a solid base for the improved monitoring network, a definition study should be carried out. This study should first of all define the objectives that have to be reached with the results of the monitoring activities. It should describe the structure of the network, including the number of stations in the different media (air, soil, water, vegetation, etc.) and their geographical distribution (urban, rural, industrial area, resource area, background, etc.).

The study should also describe the parameters to be monitored in general and the specific components for each station.

Apart from the monitoring site and its equipment, the local and central data handling functions that have to be carried out should be specified.

In order to define the policy actions to be taken at a later date, a study should be made of the fate of pollutants from their sources to the receptors. A transport and deposition modelling facility therefore has to be established together with the data handling center.

To promote harmonization and standardization between the monitoring stations of the national network and to encourage close cooperation between relevant ministries and agencies, and extensive training and education network should be set up in the coming years.

Along side the training, a permanent Quality Control Procedure should be developed and maintained for the measurements, the observation, the data handling activities as well as for the professional, technical and administrative personnel.

Last but not least, a plan should be developed and carried out to link the Chinese monitoring and data analysis activities with ongoing international programs. Apart from support for the international information data base this will also promote the realization of training and the optimal use of Chinese expertise.

A guideline for a possible selection could be, at present, the selected range of existing stations.

2.2 Development of a Decision Support System for Harmonization of Development and Environment

2.2.1 Background and objectives

China's environmental information systems achieved much progress during the Seventh Five-Year Plan period. A considerable gap, however, still exists compared with those of the developed countries. No sufficient information systems in collecting and processing information related to economic development have been structured, especially with respect to the impact of the market economy on environmental quality and industrial pollution; communication between the central government and local departments is not smooth enough; information is collected repeatedly and left unused; information cannot be utilized again if these are not improved.

Establishment of a decision support system (DSS) in China is essential. For once the useful information is put into the system properly, managers and decision makers can utilize the information in assessment, prediction and planning. The system will serve sound industrial development, the strategic study of pollution control and effective environmental management, as well as for a reporting system and the establishment of long-term strategy.

2.2.2 Current situation of China's environmental information system

a. General situation

During the Seventh Five-Year Plan period, the Chinese Research Academy of Environmental Sciences (CRAES) was engaged intensively in study of the subjects, successful feasibility studies and program design for some design support systems.

At present the Environmental Management Institute of CRAES is developing an urban environment decision support system, which has five functions:

- analysis of historical environmental statistics and monitoring data;
- analysis of present environmental quality;
- environmental impact assessment;
- optimal pollution control plan;
- decision support for sustainable development of environment and economy.

Already the main functions of system have been realized and computerized. An integrated environmental plan for water, air and solid waste for the city of Huhhot, Inner Mongolia Autonomous Region, has been set up using the system. A graphical display function will be added when the system is connected to a geographical information system (CIS). Data collection for the city of Changzhou, Jiangsu Province, is also completed. The urban environment decision support system developed by the Environmental Management Institute will soon be applied to the city of Changzhou, and to the city of Qingdao, Shandong Province, is restricted, being composed of seven parts. It includes indices of natural resources, degree of protection, ecological damage, regional environmental quality assessment, regional pollution levels and their prevention and control, environmental industry data, environmental management considerations and relevant global environmental issues. It is a huge index group of numerous indices. Its features are:

a. Its components vary in quantity and quality. The existing environmental index is made up of many various components. It includes primary as well as secondary information and the distinction between high and low environmental quality is hard. The system involves many absolute values rather than relative ones. There are no direct interactions between the components and it is difficult to conduct comprehensive analysis and assessment. Overlapping occurs between different indices.

Most of the indices are only at the level of a description of material objects instead of a critical assessment. The practical application of such an index is difficult.

b. Quantification is poor. Due to the huge amount of the indices and limited quantitative data, many indices are not numeral or quantitative.

c. Lack of rationality. The existing system of classification is irrational. Some components contain several highly correlated features, and it is not easy to judge which aspects are primary and which secondary.

d. Limited applicability. The existing system is limited and not linked to economic and social systems. The national economic accounting has no indices to reflect environmental and resource elements. National economic indices and the relation ship between environmental and economic features are poorly covered and displayed.

2.2.3 Establishing an environmental indicator system

Any national economic indicator system which is linked with environmental indices plays a guiding role in economic and social development. The following principles should be considered. First, the indicators must be comprehensive and scientific, reflecting the intrinsic relationship between environment and economy. Second, the establishment of a framework of indicators must be scientific and rational. The indices may be obtained from monitoring of various environmental elements based on certain analytical processes and mathematical calculation. Indices should be set up on an objective basis. Third, the system should be comparable intrinsically and capable of being linked to external characteristics. There should be uniform measurement within a system. Interactions between the environmental system and other systems such as socio-economic ones must be reflected. Fourth, the system must be multi-functional and work at different levels. Environmental indicators should be able to be linked with indicators of economic development, in such a way development are obtainable. It should also be able to indicate the extent to which environmentally sound technologies are being implemented, replacing those that are more environmentally damaged. The indicators should also to reflect national resources accounts.

2.2.4 The elements of an environmental indicator system

The system will take the environmental, ecological and resource systems as reference values to be compared with grassroots-, intermediate-, and high-level indices as pillars to set up a complete and suitable indicator system.

The system may be divided into three series according to elements, which includes series of index, series of environmental, ecological, and resource system. The environmental system concerns indicators of climate, air, water, soil, noise, and solid wastes. The ecological system is composed of indexes of ecological structure, ecological functions, ecological efficiency, and ecological variations. The resource system includes indices of energy, mineral, water, land, forestry, grassland, and species resources and so on.

The system may be divided into three levels based on structures, which involves indices of grassroots-, intermediate-, and high-levels. The
grassroots-level indices refer to those which are descriptive of actual monitoring and measuring. They come from data based on various physical, chemical and biological analyses and monitoring, and are direct reflections of the environmental state. The intermediate-level indices are analytical and evaluating, based on fundamental and unified indices standardization of the grassroots-level indices. The high-level indices are of economic and social nature, which reflect, to the fullest possible extent, changes of environmental elements. They are mostly indicators of values of certain aspects, which may be used in economic accounting to show in it the environmental factors. It can thus link environment to economic development.

3. RECOMMENDATIONS TO THE CCICED

3.1 Improving China’s National Monitoring System

3.1.1 Defining purposes and objectives of the system

a. In view of China’s national conditions, the system is to be composed of two parts: pollution monitoring and monitoring of damage to ecological systems (vegetation degradation, soil erosion, decrease of soil fertility, desertization etc.). Emphasis, however, will be placed on the former at present, and work on the latter will be carried out in a gradual manner.

b. The monitoring networks will be determined and optimized (number of stations, their distribution, and items of monitoring for each station).

c. Data collection-storage-retrieval-evaluation and specifications of data presentation will be defined.

d. A training system needed for optimal day-to-day operation of the monitoring system will be defined.

3.1.2 Developing an adequately financed quality control system

a. To improve the monitoring quality (sample analysis, modelling);

b. To improve the operational structure of China’s system (one should seek establishment of an interministerial and interagency steering group);

c. To improve the linkages of China’s monitoring system with existing international systems (e.g. GEMS, Bapruan, WHO, and monitoring systems in neighboring countries).

3.1.3 To establish teams of foreign and Chinese experts that have adequate mobile equipment

The establishing of such teams must be geared to support the production of the State of Environment documents that will serve rational policy designing and making.

3.2 Demonstration (Pilot) Projects for Networks of Air Pollution Monitoring and Data Analysis

China already has some large monitoring networks, which need urgently to be improved and updated to raise their efficiency. An early establishment of a medium-sized demonstration project will therefore be essential to that end.

3.2.1 In the beginning period of the project, a multi-functional mobile laboratory should be obtained, which can conduct sampling, analyzing and modelling of air pollution, and training of personnel.

3.2.2 The training of personnel should cover such subjects as sampling, analysis and modelling technologies as well as the operation and management of such laboratories. It should also cover quality insurance of data and research design and administration of overall quality.

3.2.3 Workshop training of a given subject should be held at least twice, in different parts of China.

3.2.4 Three to six foreign teachers who are experts in their respective fields should be invited to join the same number of Chinese experts in the training.

3.2.5 A network of multi-country cooperation should be established.

The implementation of the plan will generate data needed for further actions on optimizing the existing monitoring system. This will
contribute to decisions on risk management of the environment and to a data base.

3.3 Establishing Effective Environmental Information System

3.3.1 The responsibility of environmental protection must be shared by the government, industrial enterprises and the public so that tangible progress can be achieved in this respect. It is therefore imperative to set up an effective and easily accessible information system that will provide correct information to different levels of the public, and help the government to make decisions. A careful integration with environmental monitoring and all other information systems and with experiences within existing international operational information systems will greatly enhance the effective of the system.

3.3.2 China has accumulated large amounts of data, but the processing, analysis and dissemination thereof is inadequate. This makes it impossible for data to play their due role in assessment, policy-making and implementation of policies. The following things must thus be done:

- a. Strengthening the existing reporting system.
  
  The State of Environment reports by the central and local governments are an essential part of an environmental information system. Every effort in monitoring and data collection should be centered around the reports, for the information of the system will be disseminated to people at home and abroad.

- b. Structuring a long-term strategic planning model to evaluate policy to coordinate development and environmental protection at the national and regional levels.

- c. Developing a regional environmental information system.

  The system, consisting of computer, GIS' capital and forecasting models and environmental and development data, can be a powerful tool for regional planning and environmental assessment.

3.4 An Indicator System of Development and Environment in China

A broad consensus has been achieved on the interdependence of economic development and environment since the Rio Earth Summit in June 1992. It has now become a pressing task to link the economic development indicators and environmental indicators in a manner which reflects the close relationship of the two. China, in a process of rapid economic growth, should all the more formulate an uncomplicated system that combines the two kinds of indicators so as to reach a coordinated development of the two.

It is recommended that our group and the group of resource accounting and price policy jointly design an indicator system of development and environment for China. The following tasks may be accomplished through international cooperation:

- a. generation of economic development indices;

- b. development of environmental indicators;

- c. process-linkage of the two groups of indices.

Financial assistance therefore needs to be sought for establishment of an expert group consisting of two to three foreign experts and the same number of Chinese experts, who will meet regularly to exchange information and review progress.

4. WORK PLAN FOR THE EXPERT WORKING GROUP

ON MONITORING AND DATA ANALYSIS

(FOR DISCUSSION)

According to the project "China Management System on Monitoring and Information Priority" selected by the Expert Working Group of monitoring and Data Analysis of the CCICED, the expert group will conduct its work in the next three years on three projects:

a. Improving China's environmental monitoring network;

b. Development of a decision support system for harmonization of development and environment.

c. Review of current state of development of an environmental indicator system for China.

The group will then submit a series of reports to the CCICED which will base its advice to the government in its decision making on such reports. The plan (for discussion) is as follows:

4.1 Improving China's Environmental Monitoring Network

4.1.1 Objectives

Environmental monitoring is an important part of risk assessment which provides a scientific basis for formulation of risk management. A timely and accurate statement of the environment quality in China is therefore a basis for formulating strategies of sustainable development.

The major objective is to introduce modern technology in environmental monitoring, data processing, and modelling, and to have sufficient quality assurance and quality control so as to raise the quality of the monitoring networks. It has been recommended in the report that a demonstration project be set up to that end. The demonstration project can conduct a test of the existing monitoring networks and train the monitoring staff and their supervisors.

4.1.2 Contents of the research

- Research on the present state of the existing monitoring networks and their problems;

- Research on organization and management of environmental monitoring institutions abroad;

- A feasibility study of the improvement of the environmental monitoring networks in China, standardization of monitoring technology, and analysis and management of data.

4.1.3 Achievement reports

a. The Present State of Environmental Monitoring Networks in China and Their Problems (to be submitted in 1993)

b. Recommendations on Improvement of China's Environmental Monitoring Networks (including improvement of organization and operational management, updating of equipment and technology) (to be submitted in 1994)

c. Final Report: Improving Structure and Quality of Monitoring Networks in China (to be submitted in 1995)

4.2 Development of Decision Support System for Harmonization of Development and Environment

4.2.1 Content of the research

Setting the standards on pollution emission standards concerning air, water, and soil for different economic sectors in China, proving a development plan for information system of environmental pollution control in China and the corresponding methodology.

4.2.2 Timetable

In 1993: The group will analyze existing data and materials in China, conduct a study of the decision support system on environmental pollution control abroad, train personnel for the system and organize study and research abroad.

In 1994: Foreign and Chinese experts will jointly develop a system and conduct a review of it.

In 1995: The group will wrap up its work and write a final report.

4.2.3 Achievement reports

Annual reports:
Decision Support Systems of Environmental Pollution Control Abroad (to be submitted in 1993)


Final report:

Plan of Development of Strategic Decision Support System of Pollution Control in China (to be submitted in 1996)

4.3 A Review of the Present State of the Indicator System of Environment in China

4.3.1 Content of research

grassroots-level indicators - descriptive indices and quantitative study of the environment;

intermediate-level-analytical and critical indices, and quantitative study of the environment;

high-level-socio-economic indicators of environment ad their quantitative study.

4.3.2 Timetable

In 1993: Chinese and foreign experts jointly design an indicator system for coordinated development of economy and environment; study the present state of the indicator systems for coordinated development of economy and environment in foreign countries; collect and process data in China, file them and establish a data base; conduct training of personnel and exchanges between each other.

In 1994: Operatability Identification, compiling reports.

In 1995: Experts will review and approve the system, revise and submit the final report.

4.3.3 achievement Reports

Annual reports:

A review of Indicator System of Economy and Environment (to be submitted in 1993)

A Compilation of Statistics of Indicator Systems of Coordinated Development of Economy and Environment in Relevant Provinces, Cities and Regions (to be submitted in 1995)

Final report:

Report on Research of Indicator System of Coordinated Development of Economy and Environment in China (to be submitted in 1995)

Annex: Namelist of Group Members

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