Chapter 35 Science for sustainable development

This chapter focuses on the role and the use of the sciences in supporting the prudent management of the environment and development for the daily survival and future development of humanity. The programme areas proposed herein are intended to be over-arching, in order to support the specific scientific requirements identified in the other Agenda 21 chapters. One role of the sciences should be to provide information to better enable formulation and selection of environment and development policies in the decision-making process. In order to fulfil this requirement, it will be essential to enhance scientific understanding, improve long-term scientific assessments, strengthen scientific capacities in all countries and ensure that the sciences are responsive to emerging needs.

Scientists are improving their understanding in areas such as climatic change, growth in rates of resource consumption, demographic trends, and environmental degradation. Changes in those and other areas need to be taken into account in working out long-term strategies for development. A first step towards improving the scientific basis for these strategies is a better understanding of land, oceans, atmosphere and their interlocking water, nutrient and biogeochemical cycles and energy flows which all form part of the Earth system. This is essential if a more accurate estimate is to be provided of the carrying capacity of the planet Earth and of its resilience under the many stresses placed upon it by human activities. The sciences can provide this understanding through increased research into the underlying ecological processes and through the application of modern, effective and efficient tools that are now available, such as remote-sensing devices, robotic monitoring instruments and computing and modelling capabilities. The sciences are playing an important role in linking the fundamental significance of the Earth system as life support to appropriate strategies for development which build on its continued functioning. The sciences should continue to play an increasing role in providing for an improvement in the efficiency of resource utilization and in finding new development practices, resources, and alternatives. There is a need for the sciences constantly to reassess and promote less intensive trends in resource utilization, including less intensive utilization of energy in industry, agriculture, and transportation. Thus, the sciences are increasingly being understood as an essential component in the search for feasible pathways towards sustainable development.

Scientific knowledge should be applied to articulate and support the goals of sustainable development, through scientific assessments of current conditions and future prospects for the Earth system. Such assessments, based on existing and emerging innovations within the sciences, should be used in the decision-making process and in the interactive processes between the sciences and policy-making. There needs to be an increased output from the sciences in order to enhance understanding and facilitate interaction between science and society. An increase in the scientific capacity and capability to achieve these goals will also be required, particularly in developing countries. Of crucial importance is the need for scientists in developing countries to participate fully in international scientific research programmes dealing with the global problems of environment and development so as to allow all countries to participate on equal footing in negotiations on global environmental and developmental issues. In the face of threats of irreversible environmental damage, lack of full scientific understanding should not be an excuse for postponing actions which are justified in their own right. The precautionary approach could provide a basis for policies relating to complex systems that are not yet fully understood and whose consequences of disturbances cannot yet be predicted.

The programme areas are in harmony with the conclusions and recommendations of the International Conference on an Agenda of Science for Environment and Development into the 21st Century (ASCEND/21)

A Strengthening the scientific basis for sustainable management

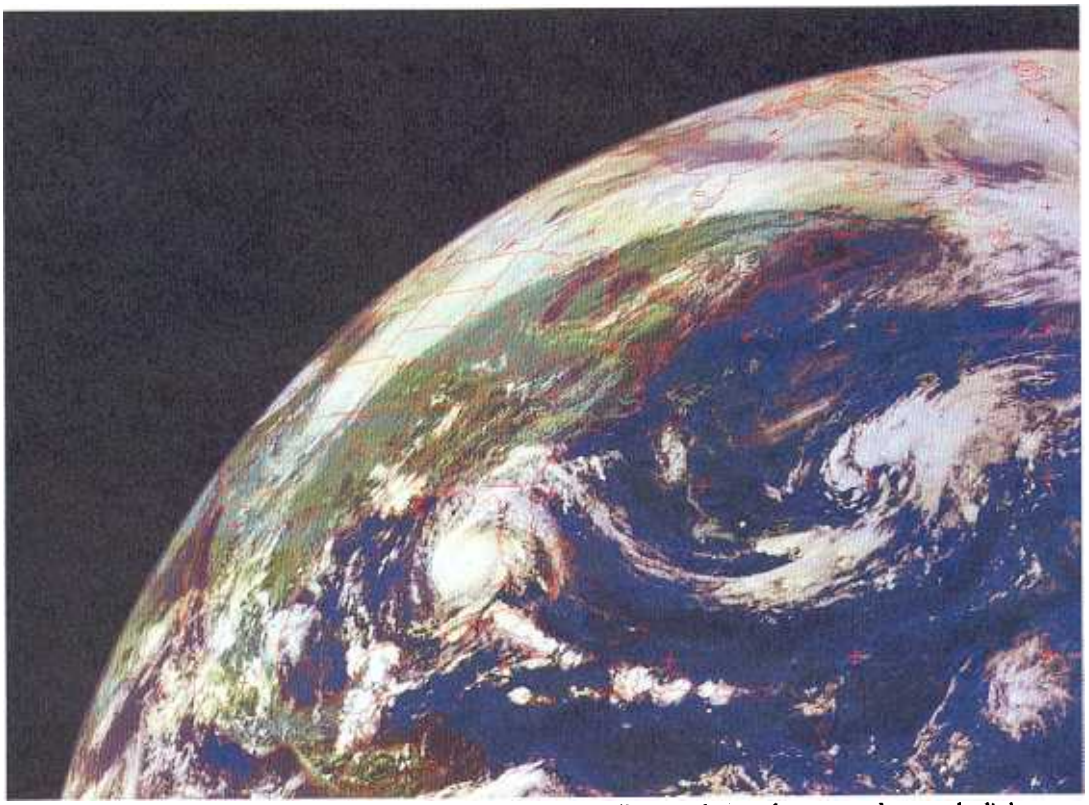
Basis for action Sustainable development requires taking longer-term perspectives, integrating local and regional effects of global change into the development process, and using the best scientific and traditional knowledge available. The development process should be constantly re-evaluated, in light of the findings of scientific research, to ensure that resource utilization has reduced impacts on the Earth system. Even so, the future is uncertain, and there will be surprises. Good environmental and developmental management policies must therefore be scientifically robust, seeking to keep open a range of options to ensure flexibility of response. The precautionary approach is important. Often, there is a communication gap among scientists, policy makers, and the public at large, whose interests are articulated by both governmental and non-governmental organizations. Better communication is required among scientists, decision makers, and the general public.

Objectives The primary objective is for each country with the support of international organizations, as requested, to identify the state of its scientific knowledge and its research needs and priorities in order to achieve, as soon as possible, substantial improvements in:

a Large-scale widening of the scientific base and strengthening of scientific and research capacities and capabilities – in particular, those of developing countries – in areas relevant to environment and development;

b Environmental and developmental policy formulation, building upon the best scientific knowledge and assessments, and taking into account the need to enhance international cooperation and the relative uncertainties of the various processes and options involved;

c The interaction between the sciences and decision-



The development of satellite systems has resulted in accurate meterological prediction and monitoring. This satellite picture shows Hurricane Andrew as it moved across Florida.

making, using the precautionary approach, where appropriate, to change the existing patterns of production and consumption and to gain time for reducing uncertainty with respect to the selection of policy options;

d The generation and application of knowledge, especially indigenous and local knowledge, to the capacities of different environments and cultures, to achieve sustained levels of development, taking into account interrelations at the national, regional and international levels;

e Improving cooperation between scientists by promoting interdisciplinary research programmes and activities;

f Participation of people in setting priorities and in decision-making relating to sustainable development.

Activities Countries, with the assistance of international organizations, where required, should:

a Prepare an inventory of their natural and social science data holdings relevant to the promotion of sustainable development;

b Identify their research needs and priorities in the context of international research efforts;

c Strengthen and design appropriate institutional mechanisms at the highest appropriate local, national, subregional and regional levels and within the United Nations system for developing a stronger scientific basis for the improvement of environmental and developmental policy formulation consistent with long-term goals of sustainable development. Current research in this area should be broadened to include more involvement of the public in establishing long-term societal goals for formulating the sustainable development scenarios;

d Develop, apply and institute the necessary tools for sustainable development, with regard to:

i Quality-of-life indicators covering, for example, health, education, social welfare, state of the environment, and the economy;

ii Economic approaches to environmentally sound development and new and improved incentive structures for better resource management;

iii Long-term environmental policy formulation, risk management and environmentally sound technology assessment;

e Collect, analyse and integrate data on the linkages between the state of ecosystems and the health of human communities in order to improve knowledge of the cost and benefit of different development policies and strategies in relation to health and the environment, particularly in developing countries;

f Conduct scientific studies of national and regional pathways to sustainable development, using comparable and complementary methodologies. Such studies, coordinated by an international science effort, should to a large extent involve local expertise and be conducted by multidisciplinary teams from regional networks and/or research centres, as appropriate and according to national capacities and the available resources;

g Improve capabilities for determining scientific research priorities at the national, regional and global levels to meet the needs of sustainable development. This is a process that involves scientific judgements regarding short-term and long-term benefits and possible long-term costs and risks. It should be adaptive and responsive to perceived needs and be carried out via transparent, "user-friendly", risk-evaluation methodologies;

h Develop methods to link the findings of the established sciences with the indigenous knowledge of different cultures. The methods should be tested using pilot studies. They should be developed at the local level and should concentrate on the links between the traditional knowledge of indigenous groups and corresponding, current "advanced science", with particular focus on disseminating and applying the results to environmental protection and sustainable development.

Financing and cost evaluation $150 million, including about $30 million from the international community on grant or concessional terms.

B Enhancing scientific understanding

Basis for action In order to promote sustainable development, more extensive knowledge is required of the Earth's carrying capacity, including the processes that could either impair or enhance its ability to support life. The global environment is changing more rapidly than at any time in recent centuries; as a result, sur-

prises may be expected, and the next century could see significant environmental changes. At the same time, the human consumption of energy, water and non-renewable resources is increasing, on both a total and a per/capita basis, and shortages may ensue in many parts of the world even if environmental conditions were to remain unchanged. Social processes are subject to multiple variations across time and space, regions and culture. They both affect and are influenced by changing environmental conditions. Human factors are key driving forces in these intricate sets of relationships and exert their influence directly on global change. Therefore, study of the human dimensions of the causes and consequences of environmental change and of more sustainable development paths is essential.

Objectives One key objective is to improve and increase the fundamental understanding of the linkages between human and natural environmental systems and improve the analytical and predictive tools required to better understand the environmental impacts of development options by:

a Carrying out research programmes in order better to understand the carrying capacity of the Earth as conditioned by its natural systems, such as the biogeochemical cycles, the atmosphere/hydrosphere/lithosphere/cryosphere system, the biosphere and biodiversity, the agro-ecosystem and other terrestrial and aquatic ecosystems;

b Developing and applying new analytical and predictive tools in order to assess more accurately the ways in which the Earth's natural systems are being increasingly influenced by human actions, both deliberate and inadvertent, and demographic trends, and the impact and consequences of those actions and trends;

c Integrating physical, economic and social sciences in order better to understand the impacts of economic and social behaviour on the environment and of environmental degradation on local and global economies.

Activities

a Support development of an expanded monitoring network to describe cycles (for example, global, biogeochemical and hydrological cycles) and test hypotheses regarding their behaviour, and improve research into the interactions among the various global cycles and their consequences at national, subregional, regional and global levels as guides to tolerance and vulnerability;

b Support national, subregional, regional and international observation and research programmes in global atmospheric chemistry and the sources and sinks of greenhouse gases, and ensure that the results are presented in a publicly accessible and understandable form;

c Support national, subregional, regional and international research programmes on marine and terrestrial systems, strengthen global terrestrial databases of their components, expand corresponding systems for monitoring their changing states and enhance predictive modelling of the Earth system and its subsystems, including modelling of the functoning of these systems assuming different intensities of human impact. The research programmes should include the programmes mentioned in other Agenda 21 chapters which support mechanisms for cooperation and coherence of research programmes on global change;

d Encourage coordination of satellite missions, the networks, systems and procedures for processing and disseminating their data; and develop the interface with the research users of Earth observation data and with the United Nations EARTHWATCH system;

e Develop the capacity for predicting the responses of terrestrial, freshwater, coastal and marine ecosystems and biodiversity to short- and long-term perturbations of the environment, and develop further restoration ecology;

f Study the role of biodiversity and the loss of species in the functioning of ecosystems and the global life-support system;

g Initiate a global observing system of parameters needed for the rational management of coastal and mountain zones and significantly expand freshwater quantity/quality monitoring systems, particularly in developing countries;

h In order to understand the Earth as a system, develop Earth observation systems from space which will provide integrated, continuous and long-term measurements of the interactions of the atmosphere, hydrosphere and lithosphere, and develop a distribution system for data which will facilitate the utilization of data obtained through observation;

i Develop and apply systems and technology that automatically collect, record and transmit data and information to data and analysis centres, in order to monitor marine, terrestrial and atmospheric processes and provide advance warning of natural disasters;

j Enhance the contribution of the engineering sciences to multidisciplinary research programmes on the Earth system, in particular with regard to increasing emergency preparedness and reducing the negative effects of major natural disasters;

k Intensify research to integrate the physical, economic and social sciences to better understand the impacts of economic and social behaviour on the environment and of environmental degradation on local and global economies and, in particular:

i Develop research on human attitudes and behaviour as driving forces central to an understanding of the causes and consequences of environmental change and resource use;

ii Promote research on human, economic and social responses to global change;

l Support development of new user-friendly technologies and systems that facilitate the integration of multidisciplinary, physical, chemical, biological and social/human processes which, in turn, provide information and knowledge for decision makers and the general public.

Financing and cost evaluation $2 billion, including about $1.5 billion from the international community on grant or concessional terms.

C Improving long-term scientific assessment

Basis for action Meeting scientific research needs in the environment/development field is only the first step in the support that the sciences can provide for the sustainable development process. The knowledge acquired may then be used to provide scientific assessments (audits) of the current status and for a range of possible future conditions. This implies that the biosphere must be maintained in a healthy state and that losses in biodiversity must be slowed down. Although many of the long-term environmental changes that are likely to affect people and the biosphere are global in scale, key changes can often be made at the national and local levels. At the same time, human activities at the local and regional levels often contribute to global threats, e.g., stratospheric ozone depletion. Thus scientific assessments and projections are required at the global, regional and local levels. Many countries and organizations already prepare reports on the environment and development which review current conditions and indicate future trends. Regional and global assessments could make full use of such reports but should be broader in scope and include the results of detailed studies of future

Socio-economic development is accompanied by a justified anxiety brought about by the discrepancies existing in the world between the rich and the poor countries. It is a conflict between two systems with their own different laws and rhythms. Demographic growth, urban development, technological progress, accompanied by environmental degradation become ever growing problems. The global dimension of the issues leads to contradictory interests which confront both the developed countries and the poor countries. We consider the Earth Summit to be an example of the major responsibility of people in approaching joint problems and in reaching those solutions and recommendations that should allow everybody's lasting development, associated with the permanent responsibility for environment protection.

Ion Iliescu
President
Romania

conditions for a range of assumptions about possible future human responses, using the best available models. Such assessments should be designed to map out manageable development pathways within the environmental and socio-economic carrying capacity of each region. Full use should be made of traditional knowledge of the local environment.

Objectives The primary objective is to provide assessments of the current status and trends in major developmental and environmental issues at the national, subregional, regional and global levels on the basis of the best available scientific knowledge in order to develop alternative strategies, including indigenous approaches, for the different scales of time and space required for long-term policy formulation.

Activities

a Coordinate existing data- and statistics-gathering systems relevant to developmental and environmental issues so as to support preparation of long-term scientific assessments, e.g., data on resource depletion, import/export flows, energy use, health impacts, demographic trends, etc.; apply the data obtained through the activities identified in programme area B to environment/development assessments at the global, regional and local levels; and promote the wide distribution of the assessments in a form that is responsive to public needs and can be widely understood;

b Develop a methodology to carry out national and regional audits and a five-year global audit on an integrated basis. The standardized audits should help to refine the pattern and character of development, examining in particular the capacities of global and regional life-supporting systems to meet the needs of human and non-human life forms and identifying areas and resources vulnerable to further degradation. This task would involve the integration of all relevant sciences at the national, regional, and global levels, and would be organized by governmental agencies, non-governmental organizations, universities and research institutions, assisted by international governmental and non-governmental organizations and United Nations bodies, when necessary and as appropriate. These audits should then be made available to the general public.

Finance and cost evaluation $35 million, including about $18 million from the international community on grant or concessional terms.

D Building up scientific capacity and capability

Basis for action In view of the increasing role the sciences have to play in dealing with the issues of environment and development, it is necessary to build up scientific capacity and strengthen such capacity in all countries – particularly in developing countries – to enable them to participate fully in the generation and application of the results of scientific research and development concerning sustainable development. There are many ways to build up scientific and technological capacity. Some of the most important of them are the following: education and training in science and technology; assistance to developing countries to improve infrastructures for research and development which could enable scientists to work more productively; development of incentives to encourage research and development; and greater utilization of their results in the productive sectors of the economy. Such capacity-building would also form the basis for improving public awareness and understanding of the sciences. Special emphasis must be put on the need to assist developing countries to strengthen their capacities to study their own resource bases and ecological systems and manage them better in order to meet national, regional and global challenges. Furthermore, in view of the size and complexity of global environmental problems, a need for more specialists in several disciplines has become evident world wide.

Objectives The primary objective is to improve the scientific capacities of all countries – in particular, those of developing countries – with specific regard to:

a Education, training and facilities for local research and development and human resource development in basic scientific disciplines and in environment-related sciences, utilizing where appropriate traditional and local knowledge of sustainability;

b A substantial increase by the year 2000 in the number of scientists – particularly women scientists – in those developing countries where their number is at present insufficient;

c Reducing significantly the exodus of scientists from developing countries and encouraging those who have left to return;

d Improving access to relevant information for scientists and decision makers, with the aim of improving public awareness and participation in decision-making;

e Involvement of scientists in national, regional and global environmental and developmental research programmes, including multidisciplinary research;

f Periodic academic update of scientists from developing countries in their respective fields of knowledge.

Activities

a Promote the education and training of scientists, not only in their disciplines but also in their ability to identify, manage and incorporate environmental considerations into research and development projects; ensure that a sound base in natural systems, ecology and resource management is provided; and develop specialists capable of working in interdisciplinary programmes related to environment and development, including the field of applied social sciences;

b Strengthen the scientific infrastructure in schools, universities and research institutions – particularly those in developing countries – by the provision of adequate scientific equipment and access to current scientific literature, for the purpose of achieving and sustaining a critical mass of highly qualified scientists in these countries;

c Develop and expand national scientific and technological databases, processing data in unified formats and systems, and allowing full and open access to the depository libraries of regional scientific and technological information networks. Promote submission of scientific and technological information and databases to global or regional data centres and network systems;

d Develop and expand regional and global scientific and technological information networks which are based on and linked to national scientific and technological databases; collect, process and disseminate information from regional and global scientific programmes; expand activities to reduce information barriers due to language differences. Increase the applications – particularly in developing countries – of computer-based retrieval systems in order to cope with the growth of scientific literature;

e Develop, strengthen and forge new partnerships among national, regional and global capacities to promote the full and open exchange of scientific and technological data and information and to facilitate technical assistance related to environmentally sound and sustainable development. This should be done through the development of mechanisms for the sharing of basic research, data and information, and the improvement and development of international

networks and centres, including regional linking with national scientific databases, for research, training and monitoring. Such mechanisms should be designed so as to enhance professional cooperation among scientists in all countries and to establish strong national and regional alliances between industry and research institutions;

f Improve and develop new links between existing networks of natural and social scientists and universities at the international level in order to strengthen national capacities in the formulation of policy options in the field of environment and development;

g Compile, analyse and publish information on indigenous environmental and developmental knowledge, and assist the communities that possess such knowledge to benefit from them.

Financing and cost evaluation $750 million, including about $470 million from the international community on grant or concessional terms.