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SCIENCE FOR SUSTAINABLE DEVELOPMENT

Progress Report of the Secretary-General of the Conference

1. INTRODUCTION

The General Assembly in its resolution 44/228 of 22 December 1989 has emphasized the crucial role of science and technology and stressed the need for effective international cooperation in the field of sustainable and environmentally sound development. The Secretariat of the United Nations Conference on Environment and Development, recognizing the importance of the natural, engineering and social sciences both for the formulation and implementation of Agenda 21, herewith submits a Progress Report on Science for Sustainable Development.

In considering recommendations from the regional conferences and special needs of the developing countries, the UNCED Secretariat is working in close collaboration with the relevant United Nations agencies, including the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Center for Science and Technology for Development (UNCSTD), the World Bank, the Food and Agriculture Organization (FAO), the World Health Organization (WHO), the United Nations Environment Programme (UNEP), the World Meteorological Organization (WMO) and the UNESCO Intergovernmental Oceanographic Commission (IOC), as well as non-governmental organizations, including the International Council of Scientific Unions (ICSU), the International Social Science Council (ISSC), the International Union for Conservation of Nature and Natural Resources (IUCN), the Third World Academy of Sciences (TWAS), the International Institute for Applied Systems Analysis (IIASA) and the Union of International Technical Associations (UITA).

The UNCED Secretariat has received valuable advice from members of the Working Party on Science for Environmentally Sound and Sustainable Development and is indebted to ICSU and UNESCO for their assistance with the preparation of this report.

A necessary precondition for sustainable development is that it must be environmentally sound. But unprecedented environmental transformations will be needed to serve improved development in the coming decades. How will humanity achieve these without losing longer term sustainability? Solving this problem represents the greatest challenge for science and technology in the twenty-first century.

Our basic understanding and analysis of the sectoral and cross-sectoral issues articulated in the General Assembly's resolution 44/228 are founded upon international scientific knowledge. This already forms an integral part of the treatment of every sector covered in the various progress reports which also include the specific monitoring/research/training/institution building requirements for dealing with these environment and development issues. However, there are broader questions involving development and science that need special attention. For example, how can existing knowledge be applied and new knowledge generated to meet the needs of development? How can the scientific community be more effectively brought into the process? And how can priorities for scientific research be determined and facilitated?

2. THE CONTENT AND NATURE OF SCIENCE

2.1 The Content of Science

Science is conventionally divided into the natural sciences (biology, physics, chemistry, etc.), the health sciences (medicine, dentistry, public health, etc.), the engineering sciences (civil, chemical, nuclear, etc.) and the social sciences (economics, sociology, demography, political science, etc.).

These classical subdivisions into science disciplines are studied in the universities by faculties and departments. Historically, this system worked well but in recent years the boundaries between disciplines have become blurred; and in many cases, important contemporary research topics occur at interfaces between disciplines. In particular, the development-science nexus requires inputs from a wide range of sciences; and the inputs, and outputs, must be formulated in ways that permit everybody involved to understand one another. To meet this need, numerous interdisciplinary environmental and natural resource institutes were established in the 1970s and 1980s. Similarly, many Governments created Departments of the Environment, the United Nations established UNEP, and ICSU created the Scientific Committee on Problems of the Environment (SCOPE). Many of these initiatives have been highly productive, and some new disciplines have emerged, e.g., environmental toxicology, environmental economics, risk assessment and environmental ethics. Nevertheless, communication problems between disciplines and with non-specialists still remain.

The crucial symbiotic relationship between science and society has still not been widely appreciated. Science can contribute to societal development but, in turn, society must nurture science. Scientific inquiry is often conducted purely for intellectual satisfaction as a fundamental manifestation of human culture. Much of modern development draws on the results of this activity. For this reason, basic research should be supported by the developed as well as developing countries. The growing commercialization of basic research could pose a barrier to the exchange of knowledge between scientists and thereby hurt scientific creativity and the use of science for enhancing our understanding of environmental and developmental issues. Moreover, there is greater need for mission-orientated or goal directed research, and in this report the main interest will be in those scientific activities that will help in "Promoting socio-economic development without damaging the environmental resource base over the long term".

2.2 Changing Social Responsibility and Ethics in Science

Science, although traditionally "practised for its own sake", has gradually become so important to humanity that ethical questions have steadily pushed their way to prominence, especially in the last 40 years. These issues relate to the social responsibilities of not only the practitioners of science but also, the users of its findings.

The methods employed by scientists to elucidate the structure and functioning of the universe commonly involve some degree of interference with nature. To avoid harm being done, scientific codes of practice have traditionally been developed which were regarded as not compromising the objective pursuit of a "value free" science. Thus, animal and human experiments are officially controlled and any excesses condemned by all civilized nations.

But these problems are minor compared with those arising from the ways in which society uses the results of science, and scientists knowingly acquiesce.

Using the results of science can create greater health, comfort, wealth and power. All these can be procured to benefit a much wider constituency in society, but may often be obtained without much consideration for unintended but harmful side-effects, which usually fall on the poorer, weaker or less influential groups. Despite the laws and conventions controlling the civil and military misuse of science and the large body of ethics in medicine, there are still many gaps which allow unacceptable practices worldwide. It is no wonder that science may be viewed with suspicion by the disadvantaged groups.

Should scientists work on a problem knowing that their findings are likely to be harmful or misused? And should they speak out when they see malpractice of which society at large is unaware? These old problems have been given a very serious, new twist by the growing realization that the products of science can be used in ways which may harm the environment more or less irreversibly, and this could mean harm to future development and hence, to future generations. And there are no codes of practice or ethical rules in force to protect the biosphere or our successors. Environmental scientists are the best able to calculate the risks of future harm although they may not always be the best placed to compute the societal costs. Such questions which involve decision-making under conditions of uncertainty are being encountered more and more. Just as the sustainability issue, squarely faced, forces us to look at the ethical issues of international and intergenerational equity, so the issue of uncertainty in environmental analyses makes such ethical questions as the "precautionary principle" matters of urgency, in order to avoid delays in making decisions.

In order to direct the global scientific effort more effectively towards the solution of environmental problems and the provision of guidance for sustainable development, the current processes of scientific inquiry need to be supported by a value-systems framework. Such a framework must be accorded international approval and receive acceptance from environmental scientists. This would make the work of the scientists much more usable by policy-makers who ultimately have to take the difficult environmental management decisions.

3. DEVELOPING A SCIENCE AGENDA 21

Developing and refining a long-term science agenda for environmentally sound and sustainable development is to become a major task for the scientific community, to be undertaken in close consultation with decision makers and planners in Governments and in the different economic sectors such as energy and transport, industry, and agriculture and forestry. New transdisciplinary and other types of approach to the large "systems" involved will be needed on a continuing basis.

3.1 Objectives and Goals

The objectives of Science Agenda 21 should aim at identifying the unknowns and uncertainties about major driving forces and perceived causes that are at the root of current major issues and concerns of environmentally sound and sustainable development. The research agenda is required to facilitate means and ways of addressing those issues properly and of building up a sound scientific basis for assessing the Earth's carrying capacity, ability to "assimilate" waste products, resistance to degradation, and resilience to environmental shocks.

Moreover, science for sustainable development needs to address major environment and development issues such as demographic pressures, unsustainable consumption patterns, poverty and sustainable development, atmospheric and ocean pollution, land degradation, deforestation, toxic chemicals and hazardous wastes, loss of biological diversity, and risk/benefit of biotechnology, etc.

Of paramount importance is to integrate the contributions of the natural, engineering and social sciences into the formulation of environment and development policy and the decision-making process and to provide guidance for planning and implementation of development programmes at national, regional and global levels.

3.2 Forming New Disciplinary Combinations

As the need to analyse and quantify the structure and functioning of larger, more complex systems has developed in recent years, there has been much success within the natural sciences in interdisciplinary research. However, the success rate has not been so favorable in the case of collaboration between the natural, engineering and social sciences in tackling problems of environment and development despite the growing need. Forming the new combinations required within and between the natural and social sciences is a matter of developing new processes of cooperation and partnerships, and features may not be realized until a common language of communication can be developed between very disparate specialisms. Meaningful communication requires four elements: a "larger" issue of common interest; an ability to speak clearly; the capacity to listen patiently; and a common language. Interdisciplinary cooperation requires the same four elements: a sharply focused definition of the problem to be solved; an ability to present knowledge in a form intelligible to individuals from other backgrounds; the capacity to make the conscious effort required to understand the concerns and contributions of others; and the realization that language, which may appear to be universal, in fact contains ambiguities and nuances depending on individual backgrounds.

This obstacle to fruitful interdisciplinary cooperation is exemplified in the case of the application of scientific and engineering knowledge to the control of communicable diseases. The classical dialogue, which used a classification of water-related diseases based on the nature and life cycle of the causative organisms (bacterium, virus, worm, etc.), failed to produce significant results. The situation was transformed when a new classification was introduced, based on the mode of dissemination of the disease (water-borne, water-washed, water-related vectors). Concentration on these differences in dissemination greatly facilitated both the discussion of the causative factors responsible for outbreaks and appropriate preventive and control measures. Again the development of "systems analysis" and modelling has enabled shared perceptions of the larger issues to emerge.

3.3 Components of the Science Agenda 21

Science Agenda 21 could include, but not be limited to the following components: (1) the natural sciences; (2) the engineering sciences; (3) the social sciences; (4) the health sciences; (5) the linkages between the natural and social sciences, particularly with respect to policy; and (6) traditional knowledge in environment and development. These six components could function at all levels: national, regional and global. It is also important to emphasize that the allocation of human, physical and financial resources needs to be divided in a balanced manner so as to cover all components.

As the underlying science programmes of the specific issues or sectors will be covered in each of the appropriate issue/sector documents, a general science agenda could deal with broader initiatives that cut across issues/sectors. A brief review of selected cross-sectoral programmes by some United Nations agencies and international non-governmental organizations is attached herewith as an Annex. This report is presented for the purpose of discussion and an integrated agenda (after the ICSU Conference, see Section 3.4) will be submitted to the next session of the Preparatory Committee in March 1992.

(1) Natural Sciences

The natural sciences can enlarge our understanding of the structure and functioning of the universe and its components.

- Long-term global research programmes for identifying the unknowns about major driving forces and conditioning factors:

  Stratosphere - Troposphere Interactions and the Biosphere (STIB);
  Land-Ocean Interactions in the Coastal Zone (LOICZ);
  Global Analysis, Interpretation and Modelling (GAIM);

- Ecological research programmes:

  Global Change and Ecological Complexity (GCEC);
  Biological diversity and ecological processes;
  Genetically engineered organisms and the environment;
  Sustainability of ecological systems, e.g. eco-agriculture and sustainable rural development, etc;

- Sustainable energy systems:

  Renewable energy resources including rural energy;
  High efficiency systems of fossil fuels;
  Alternative fuels including biofuels, hydrogen, etc.

(2) Engineering Sciences

The engineering sciences can provide structures, mechanisms and technologies useful to humanity.

Engineering for natural disaster reduction and land degradation control;

Development of new technologies involving low energy intensity;

New technology for pollution control and hazardous waste management;

Development of new biotechnology-based industrial technologies;

Efficiency improvements for the transmission and use of energy.

(3) Social Sciences

The social sciences can elucidate behavior and the conduct of social relations.

Environmental ethics;

Relationship between population trends, human development and the environment;

Environmental economics of global warming, ozone layer protection, biological diversity, ocean pollution, environmental health, etc;

Transition to a low-material, low energy consumption and low pollution economy;

Policy determinants of technological changes and environmentally sound actions.

(4) Health Sciences

The health sciences can clarify in greater depth the relationship between environmental conditions and human health.

Risk assessment of new and unknown environmental factors (non-ionizing radiation, new chemicals, new technologies for food production and processing);

Environmental epidemiology and environmental impact assessment;

Forecasting of health impacts of development policies and projects;

Public understanding of environmental risks (risk communication) and community action in protecting environmental health.

(5) Interactions Between the Natural Sciences and the Social Sciences

Policy-making with respect to long-term environment/development issues involves: (1) large space scales, requiring a global perspective, right down to small scales, requiring a local perspective; (2) increasing uncertainty as time is extended into the future; (3) transsectoral interactions and feedbacks. Energy consumption, agriculture, population, urbanization, health and a great many other factors, including human value systems, will change over time, so that an analysis of the effects of climate change on a single sector is interesting but incomplete. A main research agenda item is therefore to develop methods for widening the scope of such research studies.

Environmental impact assessment has evolved in many positive ways over the last 20 years. It now needs to take the next step forward as an instrument for assessing, and discussing publically, proposals to introduce new technologies and public policies.

Recent ecological literature is rich with ideas of uncertainty and chaos theory. Ecosystems evolve to meet changing environmental conditions (the idea of ecosystem integrity) and efforts to preserve them in their present state are likely to fail. This thinking should be introduced into development planning and programming and project appraisal, where externalities are often assumed to remain constant, or to change very slowly.

There is a great need to establish priorities amongst a range of environment and development issues. Current methods of policy-making are generally rather elitist, and there is a need to develop new methods which involve participation and consensus building, including those who would be affected by the proposed policies. Some of the newer approaches such as policy exercises and backcasting are promising. Much more work needs to be encouraged in this field. There is a considerable knowledge gap in the field of population-resources-development-environment interactions and closing this gap should be one of the priority areas for research and action.

(6) Traditional Environmental Knowledge in the Development Process

Traditional communities possess unique knowledge of their environment including information on plants, animals, land and water resources, and ways and methods of their use. These communities, including tribal populations and/or spatially isolated groups usually live in socially, ecologically and geographically marginal situations. Consequently, they are often threatened by massive unexpected incursions into their habitats or by major development projects which tend to displace themselves and sometimes even to destroy them along with their habitats. Destruction of their habitats often takes place also. A constructive use of traditional knowledge by itself and in combination with modern knowledge could open new options for sustainable development in many areas.

In the interest of these communities and of society at large, the knowledge that local people have acquired over many generations should be appreciated, recorded, analyzed and used; this knowledge needs to be treated as an intellectual property. Consequently, efforts could be made to ensure that any profits, financial or otherwise, which may result are not appropriated by outside interests. Appropriate mechanisms are needed to channel these profits back to the communities involved, but at the same time avoiding the disruptive effects of the overwhelming windfall gains.

3.4 International Conference on an Agenda of Science for Environment and Development (ASCEND 21)

In order to provide an input to the development of Science Agenda 21, ICSU, in cooperation with TWAS and in partnership with several other non-governmental organizations, is convening the ASCEND 21 Conference in Vienna in November 1991. The Conference will seek to bring together the understanding and judgement of the world's scientific community on issues of highest priority for the future of environment and development. The Conference will cover the issues, specified in Section 3.1, which were discussed at a meeting of the authors of ASCEND papers in July 1991. The UNCED Secretariat expects that the major outputs of ASCEND 21 will serve a valuable contribution to the UNCED preparatory process in this regard.

4. COMMUNICATING THE RESULTS

4.1. The Communication Issue

Scientists are skilled at communicating with their colleagues through publications and professional meetings, an approach which is familiar, efficient and accessible. Traditionally, scientists have never felt the need for anything that went beyond this. However, nowadays, in the era of more socially relevant science, this has had the unfortunate and largely unintended consequence of limiting scientists' influence to the confines of their peers. Also, the carefully cultivated objectivity of scientific inquiry has produced a scientific culture collectively reluctant to draw policy conclusions and give advice.

Today, scientists are being called upon more and more to interpret their results to political decision-makers, governmental administrators, legislators, leaders in business, industry and religion, and women and children. To communicate means first to identify the likely audience group, and, secondly, designing the most effective way of reaching each such group, because this varies with the group involved. This issue is in itself a suitable subject for systematic study. There is a need for scientific translators, communicators and educators, whose training merits attention.

With the increasing collaboration taking place amongst disciplines, publication of multi-authored scientific syntheses is becoming a vehicle for communication between disciplines. Funding for such endeavors can usually be found; however, proposals to produce popular versions of these syntheses, written by competent science writers, are almost always unsuccessful.

Popular magazine articles, film, video and radio are appropriate for particular audiences. School curricula and even teaching methods warrant attention. Graphic and other visual packaging of results will make science more intelligible to more people. In this connection, some people can be most effectively influenced through traditional art forms-theater, painting, literature, song and dance. These forms are eschewed by "modern" scientists but are used effectively in traditional cultures.

Finally, various non-specialist groups are interested in environment/ development data. State-of-the-environment and other reports need to be mindful of these special needs. For example, the acidity of a lake is not of much interest to citizens' groups; rather it is the number of species of fish that have gone extinct in that lake. As another illustration, there are sophisticated technologies including satellite-based techniques, for measuring wind, vegetative cover, precipitation, and other variables.

In summary, effective communication requires:

Packaging information in appropriate formats and making it accessible to the various people interested;

Undertaking assessments and analyses guided by the requirements of these constituencies;

Processing data in formats and systems determined in part by this needs-driven approach;

Collecting data of type, scale, frequency and reliability specified by the logic of user needs;

Training of scientific communicators, translators and educators;

Securing of funds to permit preparation by science writers of popular versions of technical syntheses of important topics in the environment/development field.

4.2 The Information Explosion: A Major Problem for Developing Countries

Science is moving forward very quickly, which brings both benefits and risks with respect to the development process. More than 2 million papers are published in science and medicine every year, and the number is increasing. At the same time, supporting technical facilities (computer capabilities, telecommunications, remote sensing from satellites, etc.) have evolved remarkably in recent years. Although of great benefit to industrialized nations, this has disadvantaged scientists in the developing countries, whose libraries and laboratories are falling farther and farther behind those in the developed countries. Several bodies are combining forces in efforts to solve these problems. ICSU, along with TWAS, UNESCO, the American Association for the Advancement of Science (AAAS) have recently begun a serious study on how to reduce the North-South inequities in the availability of scientific information.

A related problem concerns the selection, analysis and synthesis of the published literature. Electronic information systems will soon be able to transmit collections of journal articles almost instantaneously to almost anywhere in the world while teleconferencing is also becoming a global reality. However, these tools are of little use to a scientist working "on the ground" in a remote part of the world, who needs synthesized information specifically related to the environmental riddles with which he is struggling. In this connection, many of the United Nations bodies publish excellent technical working papers of immediate relevance in developing countries. But the distribution system is far from perfect in many cases, particularly when a topic is in a cross-sectoral research area. An efficient information clearing house would require national, regional and global funding commitments. Some international agencies are already funding information dissemination initiatives at the national and regional levels but the efforts so far have fallen short of the considerable demand in developing countries. In this connection, developing countries could play a major role in designing a clearing-house. Without the availability of relevant information and its dissemination to scientists working "on the ground", these countries will not develop.

5. SCIENCE EDUCATION

5.1 The Broad Issue of the Role of Science in a Country

In the contemporary world, a country's comparative advantage often depends greatly on the number and quality of its scientists and scientific institutions. It also depends on how science feeds into societal and technological development (R & D). For science to be able to play this role, it needs to be embedded in a society at the highest possible level of general education. Science and technology must be given a special focus not only in general education but also in decision-making processes at all levels. A political and cultural atmosphere conducive to scientific inquiry and intellectual freedom is also important.

In summary, one of the fundamental prerequisites for development in general, and sustainable development in particular, is a "scientific culture" and a full and continuing contribution of science to national, regional and global policies and agendas.

5.2 Linkages between Education and Research Institutes and Development

Universities, research institutions and development agencies constitute the main scientific/technological development system of a nation. However, linkages among these groups are often weak, particularly in developing countries. In developing countries, a critical mass for effective teaching, research, technology generation and transfer, policy formulation and development is usually lacking. Sometimes the total resources available for environment/development studies are sufficient but they are not deployed in the most effective way. In many developing countries, the universities are not turning out graduates adequately trained for the tasks that they are expected to undertake. This is particularly true in the case of environment/development matters. University curricula often lag behind the latest scientific findings and development trends, leading to a critical shortage of specialists in environment management and related fields. Methods of improving the current situation should be considered by assisting universities to develop policies, infrastructures and programmes to produce environmentally literate specialists with an interdisciplinary outlook in the natural and social sciences. Some of the ideas that might help include:

Appointment and promotion criteria could be changed to reward interdisciplinary work on environment/development issues;

Interdisciplinary centres of excellence might be established within universities - to promote education, research and policy development;

Additional interdisciplinary training in environment/development issues needs to be provided to existing academic staff;

Professionals from government and private-sector laboratories are better to be cross-appointed to the universities, e.g., for joint supervision of graduate student's research;

More North-South linkages and cooperation should be developed between universities, science libraries, national institutes and other appropriate bodies.

5.3 Environmental and developmental education

Environmental and developmental education will need to become an integral part of science education and of basic education for all. At the international level the UNESCO/UNEP International Environmental Education Programme (IEEP) has been active since 1975 in curriculum development, teacher training, networking and promotion of information exchange. The main emphasis for the future will need to be in the production of innovative educational materials, on training of specialized educational planners at country level and on the environment and development links as a basis for informed action involving the stakeholders of sustainable development (e.g. educators, industrialists, scientists, Governments). Special attention needs to be paid to ensuring that the best available scientific information is fed into the materials and activities of environmental and developmental education. Major scientific endeavors should specifically address this question of how best to pass on results to those responsible for environmental and developmental education.

6. SCIENTIFIC CAPACITY BUILDING

6.1 National Institutional Needs

The ability of a country or state to use science and technology for environmentally sound and sustainable development is determined to a large extent by its endogenous capacity. The cost of developing such endogenous capacity will often be less than the cost of expatriate expertise. Therefore, it is imperative for developing countries to build up their own capacity: (1) to study their ecological systems and manage them better; (2) to promote the development and diffusion of environmentally sound technologies; and (3) to meet the regional and global challenges. In order to assist them in building up this national scientific capacity, the international support for respective training programmes offered within and outside the United Nations system could be stepped up considerably. National institutions have a responsibility to enhance scientific cooperation with other relevant national counterparts in regional and international programmes and thus form a close link between policy and scientific needs.

Among other recommendations, an efficient information clearing-house is required to be established timely and developed successfully so that information packages covering the proper utilization of national resources, energy, health and sanitation should be available. Necessary technical, infrastructural and manpower training supports need to be provided to developing countries to strengthen their capacity in informatics.

6.2 Regional Institutional Needs

Higher level institutions can conduct basic and applied research through bilateral and multilateral support. Regional institutions would facilitate the scientific and technological needs in developing countries at the regional level. Such institutions would be able to link and coordinate regional programmes through technical and financial assistance that national institutions might be unable to secure effectively. It would then be easier for regional institutions to communicate the successes or failures of scientific research.

Regional institutions would be more effective in coordinating academic needs in those issues or sectors as specified in Section 3.1 that are regional and global in scope. They might also be able to encourage active involvement of less developed countries in regional programmes.

Regional research networks have been established for a number of environment and development issues. Most of them are promoted within the scientific programmes of UNESCO, WMO, FAO, WHO, UNEP, etc. However, due to lack of financial resources many of these research networks do not function fully satisfactorily. Moreover, a number of regional research centres dealing with the environment, natural resources management and related development issues have been established or their establishment is in advanced stage. Among them, are the International Centre for Integrated Mountain Development (ICIMOD) in the Hindu-Kush Himalayas region, the Centre for Environment and Development for the Arab Region and Europe (CEDARE) sponsored by UNDP, in cooperation with UNESCO and other United Nations organizations, and a recent initiative, known as the System for Analysis, Research and Training (START) created within the IGBP.

The regional development banks and other principal regional institutions have been encouraged to join in developing proposals for the establishment in each region of a sustainable development and technology support system (SDTSS). The establishment of such networks is the principal purpose of the UNDP's Sustainable Development Network's (SDN) initiative (please see A/CONF.151/PC/53). The concept of a regional research center (RRC) has potential merit and is well worthwhile for study and development. The overarching function of the RRC is the core of the SDTSS or SDN under which RRC plays a decisive role in conducting interdisciplinary and/or multidisciplinary research; promoting the development and diffusion of environmentally sound technologies; organizing science education and technical/managerial training; establishing and maintaining an information system, and coordinating scientific cooperation among all nations in the region.

Certain aspects of capacity building at national and regional level may need to be supplemented at a global level. This question will be discussed at ASCEND 21 in November 1991.

7. CONCLUSION

The basic facilitating means and mechanisms that can give operational reality to the process of environmentally sound and sustainable development, as identified in the General Assembly's resolution 44/228, will need to include a comprehensive package of scientific backstopping activities, including improved application of knowledge, generation of new knowledge, scientific capacity building, environmental and socio-economic monitoring, assessment and information exchange. As presented in this Progress Report, work is in progress to better define the role and needs of science for sustainable development. The UNCED Secretariat will submit the results of this work to the next session of the Preparatory Committee together with more elaborate proposals concerning potential areas for action related to the programmes of Science Agenda 21 and scientific capacity building to be included in Agenda 21. At this session the Preparatory Committee may wish to discuss the following preliminary conclusions concerning strengthening the contribution of science to environment and development. In this way the Preparatory Committee would guide the continuation of the work organized by the Secretariat in this field.

1. Science for sustainable development needs to address both systemic changes that operate globally through the major systems of the geosphere-biosphere (e.g. climate change) and cumulative changes that represent the global accumulation of localized changes (e.g. desertification and land degradation). There is a need to strengthen and provide additional support to innovative collaborative studies involving both the natural and the social sciences on global change issues, on issues relating to ecological and socio-economic linkages and harmonization, and on adapting scientific knowledge by developing countries for their own betterment.

2. The Earth system is threatened with unprecented environmental changes over the next 50 years, which will seriously impair the sustainability of human development unless major corrective actions are taken. As a basis for such actions, it is imperative to carry out the interdisciplinary research necessary to understand better the total Earth system. Thus the ongoing and planned global change research programmes should continue to have high priority on the international research agenda.

3. Whereas there are observational networks for many of the environmental indicators relating to global changes, no similar monitoring programmes in the social sciences with respect to indicators of sustainable development (global or regional). Designing such programmes may need to be given high priority.

4. Scientific analyses of the issues involved with environment and development are closely linked in many important ways with economic, legal, institutional and particularly ethical consideration. This is especially the case when the analysis is being carried out for management purposes. In order to ensure global sustainability, scientists and others need to develop principles which would focus on how decisions are to be made under conditions of uncertainty about potential risks to regional and global ecosystems.

5. The knowledge that traditional communities have acquired over many generations should be appreciated, recorded, analysed and used, treating them as intellectual property. Some of the principles and methods central to traditional knowledge may contribute significantly to sustainable development at all levels. A project on compilation analysis and codification of information on traditional practices could be initiated.

6. Endogenous scientific research capacity in the environment and development field is necessary to be strengthened in developing countries. At the same time, there is a need for higher level and more sustained funding for international scientific bodies - e.g. ICSU, IUCN, ISSC, etc.

7. Agreements and conventions should be based on sound scientific knowledge and analysis. Developed and developing countries alike need to participate as full partners in reaching these agreements. Scientific resources are necessary to be deployed, particularly in developing countries, to this end. Without such resources it will be impossible to achieve these goals.

8. The recent scientific publication explosion is greatly increasing the inequities between scientists in developing and developed countries. Scientists in developing countries are greatly in need of syntheses of the most recent research studies in the field of environment/development. Programmes could be established: (1) to support the publication and improved distribution of update and authoritative reviews of selected topics in this field; and (2) an action plan might be developed that would provide the basis for regional information clearing houses that could provide technical assistance with respect to environment/development issues.

9. It is important that the role of science in human affairs be more widely known and better understood, both by decision makers who help determine public policy, and by the general public. There is a special need for a new commitment worldwide to scientific education, and to the creation of scientific literacy among the global citizenry.

10. Technology transfer will be an important consideration to help bridging the gap between the scientific capabilities of developing and developed countries. A series of measures should be taken in order to promote the development and diffusion of environmentally sound technologies, and to ensure that all countries, and particularly developing countries, have access to them on an equitable and affordable basis (see A/CONF.151/PC/53).

ANNEX

Review of Selected Major Science Programmes by Some United Nations Agencies and International Non-Governmental Organizations

Some of the major United Nations agency and NGO programmes whose outputs contribute to the resolution of environment/development issues are described in the following sections. In general, these programmes are cross-sectoral, and quite naturally have resulted in increased collaboration amongst intergovernmental and non-governmental bodies. Sometimes these programmes have not had as much financial support as they could wisely use (other activities may have had higher priority), but it is hoped that the UNCED process will provide a catalyst for further support, and a re-direction of current resources in some cases.

1. SELECTED MAJOR CROSS-SECTORAL PROGRAMMES BY SOME UNITED NATIONS AGENCIES

1.1 The United Nations Educational, Scientific and Cultural Organization (UNESCO)

UNESCO, at the crossroads of education, science, culture and communication, offers a special institutional setting for dealing with the multidisciplinary facets of science in relation to the long-term problems of development.

(1) The Man and the Biosphere (MAB) Programme was launched in 1971 to encourage interdisciplinary research, demonstration and training in natural resource management. MAB thus contributes not only to better understanding of the many factors that affect environment-development interactions but to a greater involvement of scientists in deciding how resources can be used more wisely. As it enters its third decade, MAB is focusing on new approaches for facilitating sustainable development. Emphasis is placed on problem-oriented research, involving both natural and social sciences. The ecosystem approach is used throughout, and effective collaboration is with ICSU bodies.

(2) The Intergovernmental Oceanographic Commission (IOC) plays a leading role in a strengthened and effective ocean partnership among UNESCO and IOC Member States and the United Nations System, stressing interdisciplinary and cross-sectoral approaches, mainly through:

Contributing to better understanding of the ocean and coastal zone environments, their state of health, biodiversity, role in climate and global change;

Collaborating with UNEP and WMO in pilot activities for monitoring coastal and near-shore phenomena related to global climate change and enhanced societal use of coastline regions;

Contributing to training, education and mutual assistance in marine sciences.

(3) The International Hydrological Program (IHP) is in its fourth phase (1990-95) and has a main theme Hydrology and Water Resources for Sustainable Development in a Changing Environment. With increasing freshwater consumption, and declining replenishment (in a warmer Earth), water supply is likely to be the major factor limiting development in many parts of the world in coming decades.

Activities within UNESCO are also of considerable relevance to UNCED goals.

One of the main endeavors is the organization of an International Forum on Sustainable Development;

A joint programme is being undertaken with the International Institute for Applied Systems Analysis (IIASA) addressing the specific attributes of environmental negotiation processes, based on recent experiences drawn from river and water-right negotiations.

Finally, mention should be made of UNESCO capabilities with respect to the science-education interface, which is a crucial component in environment-development issues.

1.2 The United Nations Center for Science and Technology for Development (UNCSTD)

UNCSTD is engaged in the substantive theme: "ways and means of ensuring the participation of developing countries in international cooperation for research on and development of environmentally sound technologies, and the rapid and effective transfer of such technologies to the developing countries".

Its major current activities are:

(1) National policy dialogues. The Projects will be implemented through a number of studies on subjects of priority concern to selected developing countries supported by, in principle, three rounds of dialogues in each participating country discussing the results of their studies in the light of identifying a concrete set of initiatives.

(2) A register of research. UNCSTD and the United Nations University (UNU) are developing a database covering a United Nations systemwide inventory of research in progress for the use of the United Nations system in particular and the research community in general. This will facilitate the exchange of information among researchers so as to, inter alia, promote research cooperation and also avoid unnecessary duplication of efforts.

(3) Technology assessment. The initiative forms the basis for the advance technology assessment system bulletin entitled "Environmentally Sound Technology Assessment (ESTA)". The analysis is to focus on policy options with regard to transfer and management of environmentally sound technologies in developing countries as well as research cooperation on such technologies between developed and developing countries.

1.3 The WHO/FAO/UNEP Panel of Experts on Environmental Management of Vector Control (PEEM)

There are often dramatic increases in easily preventable vector-borne diseases such as malaria and schistosomiasis, following the introduction of irrigation, hydropower development and other water-related development projects in many parts of the tropics, which then require control measures with pesticides, drugs and/or vaccines. Arising from a concern about this serious problem, PEEM was established in 1981 as an advisory and policy-making body for WHO, FAO and UNEP. Its objectives are:

To promote collaboration among the different public sectors and international and national agencies concerned with health, water development and environmental protection;

To foster intersectoral collaboration in natural resource development, agriculture and health and in the application of environmental management techniques for the control of disease vectors and for the protection of human health and the environment;

To help solve vector-related scientific problems of water resources management;

To provide an institutional framework for collaboration in the application of environmental management measures for vector control: (1) at all levels - international, national and non-governmental; (2) between all involved disciplines and communities - health, agriculture, environment, development, science and technology, management, social science, political science and the donor community.

Since its inception, PEEM has been active through a network of 39 members and 10 collaborating centres world-wide in the promotion of multidisciplinary research, the development of curricula for the training of engineers and agricultural scientists in the principles of environmental management for vector control, the production of guidelines and training aids and the promotion of a continuous dialogue between sectors.

1.4 The UNDP/World Bank/WHO Special programme for Resear and Training in Tropical Diseases (TDR).

TDR was established in 1975 with two objectives:

To develop new methods of preventing, diagnosing and treating selected tropical diseases, methods that would be applicable, acceptable and affordable by developing countries, require minimal skills or supervision and be readily integrated into the health services of these countries;

To strengthen, through training in biomedical and social sciences and through support to institutions, the capability of developing endemic countries to undertake the research required to develop these new disease control technologies.

TDR's activities are targeted towards six disease groups: malaria, schistosomiasis, the filariases (including onchocerciasis or river blindness), the trypanosomiases (both African sleeping sickness and the American form, Chagas Disease), the leishmaniases and leprosy.

2. SELECTED MAJOR CROSS-SECTORAL PROGRAMMES BY SOME INTERNATIONAL NGOs

2.1 The International Council of Scientific Unions (ICSU)

ICSU was created in 1931 to promote international scientific activity in the different branches of science and their application and often cooperates with other international organizations, from the United Nations or the NGO sector, in carrying out its international programmes. The global environment has been the focus of several undertakings by ICSU over the past 20 years. Such studies have a common objective of strengthening the scientific basis for the prediction of impacts and the creation of policy options for prevention, mitigation and adaptation.

(1) The Scientific Committee on Problems of the Environment (SCOPE)

SCOPE is charged with assembling, reviewing and assessing the information on man-made environmental changes in order to synthesize the status of current knowledge and identify gaps and research priorities. SCOPE draws on a global network of specialists.

SCOPE focuses on major international scientific problems, selecting those that are both interdisciplinary and tractable. An example is the landmark SCOPE Study on the Environmental Consequences of Nuclear War. At the present time, SCOPE is concentrating on four interlocking themes: Sustainable Development; Global Change and Ecosystems; Health and Ecotoxicology; and Biogeochemical Cycles.

(2) The ICSU-WMO-IOC World Climate Research Programme (WCRP)

WCRP is focused on the physical aspects of the climate system, which is itself a sub-set of the Earth system. WCRP thus deals in particular with the atmosphere, the ocean, the terrestrial biosphere, ice and the hydrological cycle.

WCRP is divided into three Streams:

Stream 1, which is essentially extended-range forecasting;

Stream 2, which deals with inter-annual variations, and is aimed at taking advantage of predictability in the ocean arising from its "memory" and from understanding its dynamics;

Stream 3, which is aimed at understanding the sensitivity of the climate system to changes in external forcing.

The principal thrusts of WCRP are:

TOGA: the Tropical Ocean Global Atmosphere Study, which is essentially a Stream 2 activity;

WOCE: the World Ocean Circulation Experiment, directed toward better understanding of the behavior of the ocean;

GEWEX: the Global Energy and Water-cycle Experiment, which is directed toward gaining a better understanding of the hydrological cycle.

(3) The International Geosphere-Biosphere Programme (IGBP)

The IGBP was established by ICSU in 1986, to describe and understand the interacting physical, chemical and biological processes that regulate the total Earth system . While not seeking to be comprehensive, it concentrates on a limited number of focussed research projects, treating important aspects of the Earth system which are:

(a) The Global Atmospheric Chemistry Project (IGAC)

To develop a fundamental understanding of the processes that determine the chemical composition of the atmosphere;

To understand the interactions between atmospheric chemical composition and biospheric and climatic processes;

To predict the impact of natural and anthropogenic forcing on the chemical composition of the atmosphere.

(b) The Joint Global Ocean Flux Study (JGOFS)

To determine and understand on a global scale the processes controlling the time-varying fluxes of carbon and associated biogenic elements in the ocean, and to evaluate the related exchanges with the atmosphere, sea floor and continental boundaries;

To develop a capability to predict on a global scale the response of oceanic biogeochemical processes to anthropogenic perturbations, in particular those related to climate change.

(c) The Biospheric Aspects of the Hydrological Cycle (BAHC), which is planned in cooperation with GEWEX of WCRP. Its objective is to gain an understanding of the interactions between vegetation, land cover and the hydrological cycle.

(d) The Global Change and Terrestrial Ecosystems Project (GCTE), which is designed to develop a capability to predict the effects of changes in climate, atmospheric carbon dioxide and land use on terrestrial ecosystems, and how these effects can lead to feedbacks to the physical climate system.

(e) Past Global Changes (PAGES), which tries to draw from the past, inferences which have implications for the present and future. Its main objective is to construct the detailed history of climatic and environmental change for the entire globe for the last 2,000 years, and through a full glacial cycle, in order to improve our understanding of the natural processes that involve global climatic change.

(f) IGBP Office of Data and Information Systems (IGBP-DIS), which has been established to deal with the vast quantities of data that modern techniques make possible, and to provide methods to collate these data in various ways as required by different users.

The work of both IGBP and WCRP has been recognized by a resolution of the United Nations General Assembly in December 1989 and by the Intergovernmental Panel on Climate Change in 1990.

In addition to the work of SCOPE, IGBP and WCRP, at least 20 other ICSU bodies are undertaking activities relevant to the environment-development issue.

2.2 The International Social Science Council (ISSC)

ISSC has appointed a Standing Committee on Human Dimensions of Global Environmental Change (HDGEC) which will develop and coordinate scientific interdisciplinary on behalf of social sciences. It sets out to consider human activities both as they contribute to and as they are affected by global environmental change. These activities are driven by three factors: the large and rapidly increasing population and its distribution around the globe; human needs and expectations; and the cultural, social, economic and political structures and institutions that shape and mediate their behavior.

The following seven research topics are being undertaken under HDGEC:

Social dimension of resource use;

Perceptions and assessment of global environmental conditions and change;

Impacts of local, national and international, social, economic and political structures and institutions;

Land use;

Energy production and consumption;

Industrial growth;

Environmental security and sustainable development.

The Committee has established its permanent secretariat. First scientific symposium on HDGEC took place in 1990 and several working groups have already been appointed. In addition, other organizations such as the International Federation of Institutes for Advanced Studies (IFIAS), UNU and UNESCO have also initiated studies on human dimensions of global change.

ISSC is also involved in a major research project on Social Dimensions of Environmental Disorder in Amazonia. A liaison with the project is provided by the newly created (1990) ISSC Committee on Environmental and Development. Various ISSC bodies have initiated their own programmes of research on environment-development issues.

2.3 The International Union for Conservation of Nature and Natural Resources (IUCN)

IUCN's objectives are (1) to secure the conservation of nature, and especially of biological diversity; (2) to ensure that the earth's natural resources are used in a wise, equitable and sustainable way; and (3) to guide the development of human communities towards ways of life that are both of good quality and in enduring harmony with other components of the biosphere. The World Conservation Strategy (WCS) of 1980 (prepared in cooperation with UNEP and WWF) was a forerunner of the Brundtland Commission and a follow-up based on 10 years experience of implementing the WCS called Caring for the Earth: a Strategy for Sustainability, was launched in 1991.

IUCN's major programmes are:

Conservation of biological diversity;

Application of ecological science to conservation;

Habitat and protected area management;

Application of social science and demographics to conservation;

Formulation and application of conservation strategies, environmental law, education and training within the context of national and international conservation and development activities.

2.4 The Third World Academy of Sciences (TWAS)

TWAS was established in 1983 by distinguished scholars from the South. Among the major programmes of the Academy is scientific capacity building in the South in environmental sciences of major concern to developing countries, such as deforestation, desertification, floods, earthquakes, energy, and environmental pollution. For this purpose, TWAS is assisting a number of developing countries to establish a Network of Research and Training Centres of Excellence in these sciences. A Commission of Heads of States/Governments in the South has been established to follow through the institution of this important Network. In addition, the Third World Network of Scientific Organizations (TWNSO) has recently instituted a Committee on Environmental Hazards and Global Change whose purpose is to promote joint action by concerned institutions in the South in environmental problems of common interest.

2.5 The International Institute for Applied Systems Analysis (IIASA)

IIASA is a scientific research organization, created in 1972 to develop, disseminate, and apply the tools of systems analysis in relation to policy issues having transnational dimensions or interest. The Institute aims not only to advance the knowledge in the particular research fields, but also to inform decision-makers, through applied methodologies and advice.

IIASA's major interdisciplinary research programmes include:

Environmental changes - both global and regional;

Population development and impacts;

Economic transitions in formerly centrally-planned economies;

Methodological approaches to complex problems.

IIASA has been commissioned to provide scientific support to the UNCED Secretariat - especially as regards how systems analytical approaches can be used to synthesize information on environment and development interactions and provide more holistic understanding of key variables and linkages.
