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**UNITED NATIONS INTER-AGENCY CONSULTATION ON  
IMPLEMENTATION OF CHAPTER 16 OF AGENDA 21:  
ENVIRONMENTALLY SOUND MANAGEMENT OF BIOTECHNOLOGY**

**UNIDO, Vienna International Centre, Vienna, Austria**

**15 - 16 September 1994**

**BIOTECHNOLOGY AND SUSTAINABLE DEVELOPMENT:  
UNIDO'S EXPERIENCE AND NEW INITIATIVES\***

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\* This document has not been edited.

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## 1. Introduction

In the world today, changes in technology set the rate and pattern of industrial, and subsequent economic growth, and thus the development of society as a whole.

Technology is also a key to more effective utilization of the world's limited resources that can help to achieve sustainable development. Unfortunately, technologies do not interact with society and automatically improve standards of living, increase income, add to employment potential or improve the lot of poor and rural communities, especially in developing countries. Developing countries require appropriate structures to acquire, absorb and develop technology, to manage it properly and systematically, and to build up local scientific and technological competence. The resultant ability to discern, choose and adapt technology is a measurement of a country's self-reliance. How developing countries and enterprises can manage technological change is, therefore, of central concern to UNIDO.

In the 1980s, the need to manage technological change emerged as a major issue, in response to the new intensity and speed of technology development, especially the development of new and advanced technologies, including specifically genetic engineering and biotechnology. Advanced technologies, being a major driving force of global change, have a significant impact on the socio-economic development. In addition to having a direct effect on industry itself - in changing the way limited raw materials become value-added and are manufactured into goods - their indirect impact is on world markets and on the ability of developing countries to compete in them.

Recognizing that several approaches are needed to ensure ecologically sustainable industrial development, UNIDO keeps advanced technologies under review, and also gives direct special attention to five generic technologies that have far-reaching effects on industrial development. These technologies are microelectronics and information technology, new materials, manufacturing technology, marine industrial technology and *genetic engineering and biotechnology*. This document summarizes UNIDO's perspectives and its programmes in the applications and uses of biotechnology for sustainable industrial development.

## 2. Technology Monitoring

- ***Genetic Engineering and Biotechnology Monitor***

Monitoring, forecasting and assessments of technology are the essence of a management approach to technological change and to technology management in general. With their limited resources and susceptibility to the negative impacts of technology-led change, they are especially important to developing countries.

Much of developing country industry lacks easy access to publications, to professional and technical meetings, to trade fairs and other contact mechanisms by which its developed country counterparts keep abreast of technological change. Moreover, at the government level, policy decisions are often made without the benefit of in-depth consideration of the technological alternatives and of the longer term environmental and social impacts of the technologies being acquired and of those selected for endogenous development. In addition, least developed countries lack a critical mass of technological gatekeepers as well as the techniques and methodologies of monitoring and assessment.

The concept of monitoring technological advances as such stems from the Vienna Conference on Science and Technology for Development held in the summer of 1979. It was further considered that year by the General Conference and the Industrial Development Board, the governing body of UNIDO. UNIDO began this task in first issuing the *Microelectronics Monitor* in 1981, followed by the *Genetic Engineering and Biotechnology Monitor* in 1982 and later by the *Advances in Materials Monitor* and the *Marine Industrial Technology Monitor*. The quarterly *Genetic Engineering and Biotechnology Monitor* was brought out in response to a recommendation by a group of experts that met in Vienna in February 1981 to review the implications of genetic engineering for developing countries. The experts were of the view that genetic engineering and biotechnology hold significant potential for developing countries and requested UNIDO to collect and disseminate information on technological developments and institutions in this field for the benefit of developing countries.

Over the ensuing years, the *Monitor* has continuously reported on various aspects of genetic engineering and biotechnology, ranging from new developments to applications, regulations, patenting and legislation, bio-informatics and news of institutional activities. A special feature article on a relevant topic of interest is an important part of each issue. The *Monitors* also provide information on various biotechnology projects UNIDO promotes for the benefit of developing countries. Important feedback from readers on progress and on developments considerably assist in UNIDO's formulation of technical cooperation projects. Contacts through various networks launched and maintained by UNIDO are strengthened and broadened.

In order to speed up the distribution of copies to readers in developing countries, UNIDO negotiates with regional focal points to print and distribute the *Monitors* locally. It intends, in addition, to make them available over the Internet network.

In support of these activities, UNIDO has a number of computerized information systems, networks, services and products operating under the umbrella of the Industrial and Technological Information Bank (INTIB). These deal with various aspects of industrial development for the benefit of developing countries.

### **3. Technological Infrastructure and Human Development**

- **The International Centre for Genetic Engineering and Biotechnology (ICGEB) and its Affiliated Centres**

Many developing countries do not have technological resources or the scientific competence to take up bioscience research and development, or the technical capability to develop scale-up and down-stream industrial processes. Educational systems often are not geared to the teaching of biotechnology and training of required high quality, multidisciplinary researchers. In many developing countries, a lack of critical mass of scientists and engineers also prevents R and D institutions from undertaking the multidisciplinary research that can bring technology to fruitful results.

Recognizing that the major impact of genetic engineering and modern biotechnology is on industry, UNIDO invited representatives of more than 40 governments to consider its implications at a meeting in Belgrade, Yugoslavia, in 1982. They agreed in principle to establish the International Centre for Genetic Engineering and Biotechnology (ICGEB). The Centre was to devote itself to training and research and development in genetic engineering and biotechnology, with the long-term view toward enhancing human health, food and nutrition levels, and promoting advancement of bio-industries in developing countries.

In 1987 ICGEB became operational, a unique inter-governmental centre engaged in research, development and training in biotechnology and genetic engineering, reaching a high level of scientific competence within a short time.

Having attained the required number of ratifications of its Statutes by Member States, ICGEB became autonomous in 1994. The ICGEB has 32 Member States and a total of 49 signatories to its Statutes. Several UN agencies participate with observer status in the meetings of the ICGEB Board of Governors.

The ICGEB Board, made up of representatives of Member States, endorsed the 1994-98 work programme and a budget of \$13.6 million for 1994. Work at ICGEB's components - in New Delhi and in Trieste - includes R and D on diseases such as hepatitis, malaria, AIDS and human papilloma virus as well as pest- and stress-resistant crops, peptide antigens and lignin biodegradation. Some industrial applications have already been developed. ICGEB seeks to develop the results of research into products for use for the benefit of developing countries. A number of industrial enterprises are funding contract research at ICGEB or licensing its products for marketing.

The Centre's programme includes pre- and post-doctoral training of scientists and researchers from Member States to ensure that they have access to the latest genetic engineering techniques. It also supports collaborative research projects at 20 affiliated institutions around the world.

The establishment of ICGEB and the promotion of centres of excellence were part of UNIDO's integrated programme on capacity-building, involving *technology policy formulation, assessment, acquisition and applications* relating to other technologies and services complementary to biotechnology promotion. The programme includes, among other things, the following:

- **Regional Programme of Biotechnology for Latin America and the Caribbean**

Launched in 1987, UNDP, UNIDO and UNESCO jointly executed a programme providing a framework for the gestation of integrated policies for development in biotechnology and for the elaboration and implementation of collaborative actions aiming towards the solution of regional priority problems. It involved 17 countries in the region. 70 organizations and enterprises participated in the programme. Activities included R and D and human resource development in basic sciences and projects on identification and evaluation of technologies for industrial applications in the region. The first phase was successfully concluded in 1993, to be followed by the second phase within the framework of Biotechnology for Development. The second phase aims towards the practical commercial application of biotechnology for ecologically sustainable industrial development, the strengthening of electronic communications networks and human resource development in specific areas.

In this connection, it should be noted that an agriculture biotechnology network, the Technical Cooperation Network on Plant Biotechnology for Latin America and the Caribbean (REDBIO), was launched in 1990 by FAO in response to a regional request, thus providing the region with comprehensive coverage in the area of biotechnology.

- **Promoting Ecologically Sustainable Industrial Utilization of Medicinal and Aromatic Plants in Developing Countries**

In 1977, UNIDO joined other international bodies in working to promote the utilization of medicinal and aromatic plants, a subject of major interest to countries around the world. UNIDO's programme has reflected the emphasis derived from its mandate, to



promote and accelerate the industrialization of the developing countries. Beginning with the development of the "mobile unit" for roving demonstrations in least developed countries in Africa and Asia, the joint UNIDO/Romania Centre extensively promoted the technology. Because of its mobility, it was possible to gather a wealth of information and data on various aspects of numerous medicinal and aromatic plants in various regions of the world. After almost two decades of continuous promotion and technical assistance to developing countries, UNIDO has newly developed software for the establishment of comprehensive national databases on medicinal and aromatic plants. The UNIDO Database on Medicinal Plants (UNMPD) and UNIDO Medicinal Plant Data Evaluation (MPDE) include information ranging from ecology to composition and processing technology to their products. Micropropagation and genetic improvement techniques to produce high yielding varieties have been included in the technical assistance projects.

The mobile unit technology has evolved through the years, leading to a new design for a polyvalent pilot plant that is adaptable to local fabrication and small-scale industrial application.

In addition, UNIDO is currently pursuing projects aimed at the conservation and utilization of medicinal and aromatic plants in developing countries.

#### **4. Promotion of Safe Application of Biotechnology: Voluntary Code of Conduct on the Release of Genetically Modified Organisms into the Environment**

Although biotechnology holds great potential for meeting basic needs and enhancing global competitiveness, the challenge remains in how to maximize the benefits of biotechnology while reducing its risks.

Under the broad heading of environmental biotechnology, UNIDO works to create greater understanding and appreciation of the need for the applications of biotechnology consistent with safety. UNIDO works with UNEP, WHO and FAO in an informal

working group that seeks to promote environmental applications of genetically modified organisms (GMOs) for industrial development in a safe and ecologically sustainable manner. On behalf of the UNEP/UNIDO/WHO/FAO Ad Hoc Working Group on Biotechnology Safety, UNIDO prepared a volume under the title *GMOs: a biosafety manual*. Furthermore, it undertook a project to evolve a set of internationally agreed-upon biosafety guidelines for the sound management and uses of biotechnology. Two meetings of experts on biosafety and regulatory issues were convened at which a Voluntary Code of Conduct for the Release of Organisms (GMOs) into the Environment was developed. The final meeting of experts in formulating the Code was held in Trieste, Italy in 1991 by UNIDO in cooperation with the International Centre for Genetic Engineering and Biotechnology (ICGEB).

The Voluntary Code of Conduct was intended not to introduce new safety considerations, but to distil the common denominator of guidelines and regulations already adopted. It is a generic document. UNIDO's approach was intended to depoliticize the issues and to develop a consensus document which could serve as the basis of formulating national guidelines in countries in the developing world. Such guidelines are urgently needed. Without them, industry operates in a vacuum. Moreover, without proper institutional safeguards, public opinion might be adverse to technology transfer.

However, it has become obvious with experience that the assurance of biosafety in developing countries is not simply a matter of the formulation of guidelines. It is also a matter of implementation. UNIDO considered several options to address the problem of how best to implement guidelines in developing countries, the two most obvious appearing to be capability building in setting up and implementing biotechnology regulations, and outside expert advice. Both approaches have merits, but disadvantages as well.

In the vast majority of developing countries neither biosafety regulatory infrastructure nor procedures are in place. With the exception of a few countries, biosafety regulatory infrastructure is non-existent or, at best, underdeveloped and unable to cope with the monetary and enforcement requirements necessary to establish and implement policy. It should also be recognized that validated systems for risk assessment,

risk/benefit analysis, and data on approved testing are not generally available. The provision of such services is quite beyond the financial and technical capabilities of most developing countries eager to develop and receive new biotechnology products. Lack of personnel trained in risk assessment, environmental impact analysis and modelling is an additional impediment to monitoring and ensuring compliance with a regulatory policy.

Consequently, and as part of the development of the Voluntary Code of Conduct, a recommendation for an enabling mechanism was made in the form of the establishment of an international biosafety information network and advisory service (BINAS). Realizing that as a UN agency with a mandate to promote industrial development, and recognizing that industry is the major producer as well as the major user of biotechnology, UNIDO, in close cooperation with ICGEB and the Organization for Economic Cooperation and Development (OECD), took steps to strengthen the Organization's capacity in preparation for the anticipated task of implementing the BINAS programme.

## **5. UNIDO's Contribution towards UNCED**

In 1991, at a meeting of the United Nations ACC Task Force on Science and Technology for Development, it was agreed that the Task Force should concentrate on the area of the contribution of biotechnology to sustainable development, and that a paper should be prepared to cover the national, regional and international system/levels, with particular reference to issues such as socio-economic and legal implications, ethics, safety, impact on employment, and the international division of labour. At a subsequent meeting, it was agreed that the development of trends in intellectual property rights in relation to biotechnology should also be monitored.

UNIDO acted as the lead agency for preparation of a report on the activities of the UN system in the field of biotechnology. The report was entitled *Contribution of Biotechnology to Sustainable Development within the Framework of the United Nations System*, and authored by Dr. M.S. Swaminathan (1992).

The experiences and lessons learned by UNIDO and ICGEB from having assisted Third World governments to build a scientific and technological base on which biotechnology could develop were of direct relevance to policy-makers participating in UNCED. Consequently, a report entitled *The ICGEB and Agenda 21: Biotechnology at the United Nations Conference on Environmental and Development* was prepared as a contribution towards UNCED.

## **6. Addressing the Challenge of Agenda 21: New Initiatives**

Agenda 21, a product of UNCED, proposes a number of interrelated programmes and actions for implementation, including, specifically, safe applications of biotechnology and its environmentally sound management. The global scientific and technological community is called to participate, along with all the agencies and bodies of the United Nations system, in implementing the actions proposed by Agenda 21. The intention is to assist governments to establish more effective patterns of balanced economic and social development with minimal negative impact on the environment.

Advanced biotechnologies can undoubtedly play an essential role in fostering the economic and social development of developing countries. New and powerful diagnostics, vaccines and drugs can be obtained through biotechnology for some diseases present in high proportion in developing countries, e.g. malaria, trypanosomiasis and hepatitis. As populations grow, biotechnology can help raise productivity of major food crops. In many countries where large quantities of biomass are under-utilized or wasted, biotechnology can provide a means for their conversion into useful value-added products. Furthermore, with proper planning and management, biotechnology lends itself to decentralized applications. It can, therefore, be used as a tool for rural, small-scale industrialization and micro-enterprises that can provide better opportunities for women to participate and benefit.

Unfortunately, the acquisition of new biotechnologies is highly dependent on the funding of research in bioscience. Consequently, development to date has been directed disproportionately to industrialized countries' needs. Some technologies required by

developing countries are not of immediate interest to industrialized countries. In these cases, developing countries themselves must explore various alternatives to achieve self-reliance.

- The Agenda 21 programme on biotechnology focuses upon the needs for
- (a) increasing the availability of food, feed and renewable raw materials;
  - (b) improving human health;
  - (c) enhancing the protection of the environment;
  - (d) biosafety and international cooperation; and
  - (e) facilitating the transfer and applications of biotechnology.

To meet the needs of developing countries, UNIDO has prepared a set of initiatives involving biotechnology applications and management that can positively impact important sectors and yet operate at a level appropriate to each country. Biotechnologies can play essential roles in fostering development in an environmentally sound and sustainable manner, giving competitive advantage to nations that harness its possibilities. UNIDO's programmes operate both vertically, by the step-wise fostering of development from simple to more sophisticated as countries develop infrastructural support in biotechnology expertise, and horizontally, or regionally, as networks are built and developed on themes of common interest among developing countries. UNIDO, in close cooperation with ICGEB, has responded to the challenge of Agenda 21 by strengthening a number of its ongoing activities as well as taking new initiatives, based on these new demands and on the two Organizations' comparative advantages. Major initiatives include the following:

- **Biosafety Information Network and Advisory Service (BINAS)**

UNIDO has recently put its electronic Biosafety Information Network and Advisory Service (BINAS) on-line, making information and advice on biosafety issues more accessible.

Stemming from the joint Informal UNIDO/FAO/WHO/UNEP Working Group's Voluntary Code of Conduct for the Release of Genetically Modified Organisms, BINAS contains a number of databases that include biotechnology guidelines, regulations and standards for release of transgenic organisms into the environment. UNIDO works closely with the Organization for Economic Co-operation and Development (OECD) in information and data sharing, thus providing a comprehensive coverage of developing and developed countries.

The new system contains global information on national regulatory authorities as well as a roster of experts involved in field releases of transgenic organisms. At the same time, BINAS provides an electronic gateway to other biosafety-related data banks. Access is currently through Internet; however BINAS will soon be accessible through X.25 Public Data Networks.

Comprehensive in its approach, BINAS is aimed at several categories of potential users. It will assist national biosafety authorities to formulate and implement biotechnology guidelines. To reinforce this aspect of its service, BINAS promotes the establishment of national and regional biosafety focal contact points that will provide decision support to government authorities and industry through ready access to data and expertise. A number of countries have already designated national focal points.

BINAS is designed for use by industry to identify regulatory trends worldwide, to reach competent regulatory authorities directly and to participate in the formulation of biotechnology guidelines and regulations. It can help industry determine what is required to obtain permits for field trials and commercialization of transgenic products.

Academic and research institutions constitute another body of BINAS users that stands to gain from the network's close ties with the International Centre for Genetic Engineering and Biotechnology (ICGEB). A repository of information from the 49 countries that have signed its Statutes, the Centre provides a channel for state-of-the-art bioinformatics through the ICGEBNet. In its annual courses on biosafety designed to bring regulatory expertise to developing countries, ICGEB offers training to staff of

national and regional BINAS contact points and at the same time offers them ongoing technical support.

- **Biotechnology and Biodiversity Management Development**

Although it is reasonable to hold that conventional methods of conservation and utilization of genetic resources have largely been effective and should continue to be the main approach in developing countries, genetic engineering and biotechnology offer new tools and new approaches to germplasm conservation and utilization. UNIDO's programme operates on the principle that it is desirable to apply genetic engineering tools and techniques, whenever feasible, as adjuncts to conventional approaches.

The effective protection and preservation of *in situ* biodiversity requires the active participation of local people, communities and non-profit organizations. In addition, the private business sector has an important role to play in the rational and equitable use of genetic resources. In the past decade, commercial interests have become increasingly involved in the scientific development and targeting of biotechnology applications for genetic improvement of plants, animals and micro-organisms. In many cases, new and useful genetic varieties have been developed through research. The private sector has intensified efforts not only to create new variability, especially in micro-organisms and plants, but also to improve methods of collecting, assessing and conserving natural genetic resources. An innovative type of commercial venture has emerged to meet the growing demand for commercially viable genes and their products that can be of potential use to humans; it has come to be known as biodiversity or genetic resources prospecting. Developing countries, individually or within regions, can equitably benefit from collaborative efforts in such ventures with the private sector through negotiating favourable technology transfer agreements.

At the UNIDO/ICGEB-sponsored Scientists Forum in Trieste, Italy in October 1992, the participants resolved that a very special effort should be made to use modern biotechnologies to increase efficiency of conservation and utilization of the biodiversity of flora, fauna and microbial species. Specifically, UNIDO and ICGEB were requested to

give special priority to programmes that will strengthen the capacity of member states to study the biodiversity of their endogenous natural resources at the molecular level. A resulting database that catalogues genetic characteristics of valuable species and includes medicinal plants will complement existing UNIDO databases on medicinal plants and their evaluation (UNMPD and MPDE).

In this context, UNIDO has been working in close collaboration with a number of developing countries to develop an institutional capacity in two developing regions of the world to serve as models and as ICGEB Affiliated Regional Centres for other developing countries. The technological and the management capacity and capability of the regions' infrastructural and human resources will be strengthened. This capacity will enable nations to systematically catalogue plants and microbial species, basing the work on local needs, and to direct their potential development into commercially viable products. The private sector and NGOs are also included in this new initiative.

Recently, UNIDO joined UNDP and FAO in launching the Bioinformatics Network on Biotechnology and Biodiversity. It is designed to facilitate information dissemination to developing countries and to share information among network members.

- **Biotechnology and Bioremediation**

Bioremediation is the technological use of biological processes to clean contaminated environments, such as oil spill sites. Micro-organisms added from outside, or micro-organisms present *in situ* in a contaminated environment, are stimulated to grow by the addition of appropriate nutrients affecting the naturally-occurring bioremediation process. Applications of bioremediation technologies include, in addition to the treatment of oil spills, treatment of toxic or hazardous wastes, treatment of contaminated soils and ground waters, and grease decomposition. In particular, microbial remediation is increasingly gaining importance as a valuable environmentally sound, non-toxic, and economical tool that effectively removes oil contamination.



Applications of modern biotechnology for bioremediation of contaminated land and water has created increasing global interest and, subsequently, increasing demand by developing countries for technical advice and assistance from UNIDO. Research and development capabilities in these technologies should be strengthened in developing countries to facilitate sustainable development and pollution abatement.

Within the larger overall UNIDO Programme on Clean Industry, UNIDO has increased its promotional and technical assistance in the area of bioremediation. It has ongoing activities on waste minimization and industrial effluent treatment. A series of regional workshops are being planned and organized. These workshops are aimed towards disseminating information on strategies for the development of appropriate technologies for treatment of contaminated soil and water as well as the development of technologies for the treatment of industrial effluents.

- **Vaccine Self-Reliance Initiative**

UNIDO is to participate in the Children's Vaccine Initiative (CVI). CVI is a global coalition of governments, United Nations organizations, non-governmental and private organizations, industry and research groups focused on the goal of bringing new and improved vaccines into national immunization programmes. UNIDO has long recognized the need for a sustained and extended supply and development of quality vaccines in developing countries. Existing, improved and new vaccines, particularly against diseases prevalent in these countries, are urgently needed. At its meetings in Bogotá, Colombia in 1984 and in Dakar, Senegal in 1987, the Advisory Panel on Preventive Medicine of UNIDO recommended that regional vaccines of consistently high quality produced by traditional technologies be manufactured. UNIDO conducted studies in a number of countries of Asia, Africa and Latin America and reviewed their vaccine requirements and production facilities. Technical papers have been commissioned to evolve a long-term strategy for the development and transfer of vaccine technology and these papers were shared with other UN agencies and institutions engaged in the vaccine field. The first International Vaccine Institute (IVI) and network with regional focus will be established by UNDP in Seoul, Republic of Korea. Consequently, UNIDO has offered

to UNDP the facilities of ICGEB, which is already active in developing vaccines, to promote the objectives of the new International Vaccine Institute.

- **Commercialization of Biotechnologies**

Many developing countries recognize the many potential benefits that biotechnologies can bring to their economies, and most have on-going R and D programmes to develop indigenous and adaptive biotechnologies. However, to bear fruit, research results must be transferred and commercialized.

Working in collaboration with the Carl Duisberg Gesellschaft-South East Asia Program Office (CDG-SEAPO) in Thailand and the Philippines, UNIDO is working to establish Quality Control and Training Centres (QCTCs) in selected developing countries; the QCTCs will focus on training in biotechnologies, on business management skills, on entrepreneurship training, and on increasing opportunities for women to be actively involved in small-scale enterprise development. The QCTCs are expected to be self-sustaining through income generation from the private sector.

In addition, UNIDO's is using its comparative advantage in its close association with the ICGEB as the only operating laboratory in the field of genetic engineering and biotechnology established within the auspices of the United Nations system and an important, recognized resource for developing countries. Collaborative activities are aimed at the global, regional and national levels in an integrated programme approach involving biosafety, technology transfer, investment strategies, and management, including development, acquisition and commercialization of biotechnology products, services and industrial processes.

- **Bioinformatics and Biotechnology Networking**

Benefiting from the Organization's expertise and experience in telecommunication and information technology, as well as extensive computerized information systems that include the Industrial Technology Information Bank (INTIB), UNIDO promotes electronic

networking to strengthen technical cooperation among developing countries. Through regional network nodes, it is possible to provide developing countries (network members) with better access to other regional and international databases on biotechnology and related subjects.

In support to the biotechnology networks, UNIDO and ICGEB act as a repository of information by:

- gathering and collating information on R and D activities in Member States;
- hosting information on commercial products and technologies developed by institutes in Member States; and
- monitoring matters related to patent laws, release of genetically engineered micro-organisms/products and biosafety legislation.

UNIDO and ICGEB networks include the global bioinformatics network on molecular biotechnology (ICGEBNet), biosafety (BINASNet), lactic acid and food fermentation technology (LABNET) and bioconversion and mushroom technology (MUSHNET). In addition, UNIDO, in cooperation with UNDP and FAO, promotes regional bioinformatics networks in Asia and, with UNDP and UNESCO, a bioinformatics network in Latin America.

More recently, a regional networking system on bio-botanical pesticides has been set up in Asia to gather and disseminate information on biopesticides. In addition to information exchange, a North-South cooperation has been initiated, in cooperation with UNESCO and the International Union of Pure and Applied Chemistry (IUPAC), for training in safety and environmental protection in chemical, pharmaceutical and biotechnological research.

## **7. Future Partnerships: An Issue for Consideration**

The scope of Agenda 21 calls for a careful re-examination of the roles and responsibilities of the agencies in the United Nations system. Steps are already being taken to establish principles for defining those roles.

Recent international developments and their impact on the United Nations system as a whole, and the need for specialized agencies to consolidate complementary expertise in their respective fields, all require a global response; this applies equally to the new challenges and opportunities derived from closer economic interdependence and to development issues of a global nature.

Biotechnology is regarded as a cross-sectoral subject. It has been and is being promoted by a number of agencies, in relation to sectoral interests. Inter-agency cooperation has been initiated. Some examples have been elaborated in the various activities mentioned. More are needed to meet the global challenges outlined in Agenda 21.

Biotechnology development is closely associated with the private industrial sector, while consumer and public acceptance of new biotechnology processes and products are of increasing interest to the public and NGOs.

Future partnership initiatives will have to go beyond inter-agency coordination to involve industry, NGOs and, possibly, people's organizations.