Keystone International Dialogue Series on Plant Genetic Resources

OSLO PLENARY SESSION

FINAL CONSENSUS REPORT: GLOBAL INITIATIVE FOR THE SECURITY AND SUSTAINABLE USE OF PLANT GENETIC RESOURCES

Third Plenary Session
31 May - 4 June, 1991
Oslo, Norway

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The Keystone International Dialogue Series on Plant Genetic Resources

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The Keystone Center, founded in 1975, is located in the Colorado Rocky Mountains, USA. The Center is a non-profit organization comprised of three divisions: 1) the Science and Public Policy Program, which facilitates the resolution of public policy conflicts through the use of a consensus dialogue approach; 2) the Science School, which provides residential natural science education programs for students of all ages; and 3) the Symposia on Molecular and Cellular Biology, which offers an annual series of colloquies addressing critical developments in science and research.

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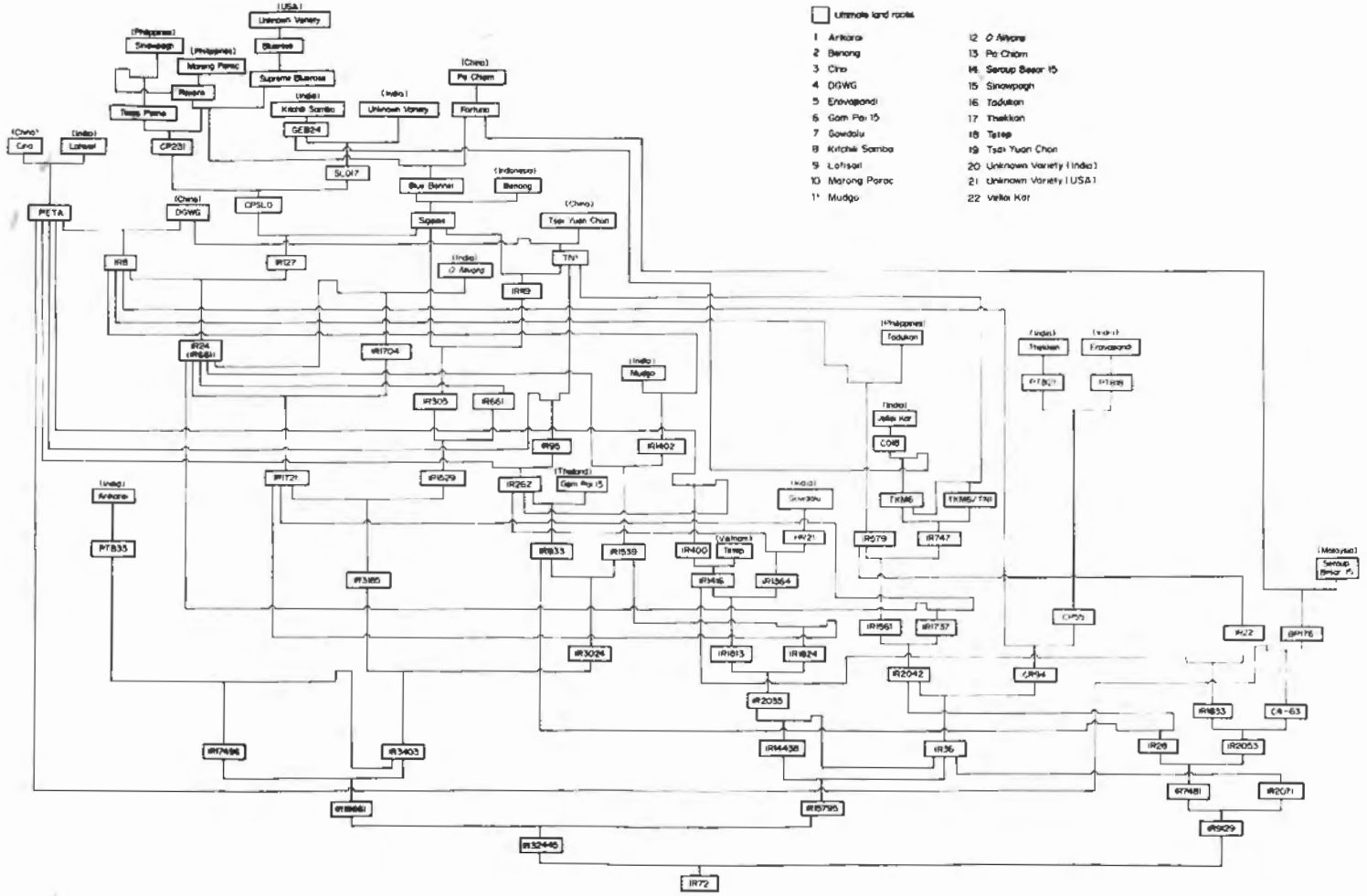
Pedigree of IR-72



Dialogue participants believe that the pedigree for IR-72 symbolizes the interdependent nature and importance of the conservation and utilization of the world's plant genetic resources. The pedigree of this modern variety of rice demonstrates the critical role that landraces from all over the world play in contributing to the range of genetic characteristics necessary to meet the world's future food requirements. As indicated in the chart above, twenty-two landraces contributed to the development of IR-72.

EXECUTIVE SUMMARY

Overview

In the third and final report of The Keystone International Dialogue Series on Plant Genetic Resources, the participants from the Oslo plenary session unanimously agreed on the need to alert the international community to the threat of genetic erosion. If the loss of plant genetic resources (PGR) continues unabated at the present rate, genetic options for needed changes in agricultural production in the future will be lost forever.

The Dialogue participants firmly believe that the current situation calls for a **Global Initiative for the Security and Sustainable Use of Plant Genetic Resources.** To be successful, the Global Initiative set forth in the report will require the joint efforts and involvement of all affected parties and institutions from all levels and from all parts of the world—including those who are contributors of germplasm, information, technology, funds, and systems of innovation.

The report represents a consensus of 41 individuals with a diversity of backgrounds and interests from 22 countries. The group was able to reach consensus on the content of the report, which is a summary of their discussions, findings and recommendations. The participants of the Oslo session, noting the urgency of the situation, stated affirmatively their commitment to take immediate and sustained action to make the Global PGR Initiative a reality.

The Dialogue group strongly recommends that the upcoming United Nations Conference on Environment and Development (UNCED 1992) consider plant genetic resources conservation as an important part of overall biological diversity conservation and as an integral component of "Agenda 21."

Gaps and Needs

Plant genetic resources provide the basic raw materials to adapt crops to: expanding biotic and abiotic stresses; changing consumer preferences; and possible changes in the environment, as may occur through global warming, rising sea levels, and depletion of the ozone layer. Crops will have to be adapted to sustainable forms of agriculture while maintaining increased productivity to feed a still growing world population.

The basic elements of an institutional framework for PGR conservation are in place at community, national, regional, and international levels. However, the system remains largely inadequate to provide the needed security of plant genetic resources due to a serious lack of funds and the need for improved institutional structures and implementation mechanisms at all levels.

The report identifies gaps in activity areas that must be addressed if the system is to cope with the urgency of the situation. Specifically, it will be necessary to improve and expand the current system in many areas, including:

- *ex situ* conservation, including collecting, storage and regeneration, documentation and information systems, germplasm evaluation and enhancement, and exchange;
- on-farm community conservation and utilization;
- *in situ* conservation;
- monitoring and early warning of genetic erosion in specific locations;
- development of techniques for sustainable advances in agricultural productivity; and
- research, training, and public education.

In all of these areas there is a necessity to enhance the linkages between the formal and informal sectors at the community, national, regional, and global levels.

Magnitude of the Funding Requirements to Meet the Needs

The centres of diversity of most crops important to world agriculture are located in the less developed regions of the tropics and the subtropics. Unfortunately, many of the countries in these areas cannot, by themselves, adequately meet the cost of conservation. Hence, preventing genetic erosion is an urgent international task that requires a sustained international commitment.

The Global PGR Initiative recommended in the Oslo Report will require substantial *additional* funding once the institutional framework discussed below is fully operational. It is estimated that the resources that will be required to strengthen existing programmes and institutions in the manner outlined above and described more fully in the report are on the order of US $300 million per annum on a sustainable basis. During the period of 1993-2000, which coincides with UNCED's "Agenda 21," it is estimated that US $1.5 billion will be required.

Ownership and Intellectual Property Rights

In addition to the gaps and needs associated directly with PGR conservation and utilization, the Dialogue group addressed issues related to ownership and intellectual property right (IPR) systems. The issue of IPR for plant genetic resources has fallen within the scope of wider discussions on IPR in the General Agreement on Trade and Tariffs (GATT) negotiations. If the GATT negotiations result in the strengthening of IPR within developing countries, this, in turn, might result in both the adoption of plant variety protection systems and the patenting of plants, animals, and the genetic materials that are contained in them. In previous Dialogue reports, the Dialogue group expressed strong concern about the imposition of IPR for plant genetic materials through the GATT or bilateral trade negotiations. Every country has the right to decide whether and to what extent they adopt IPR for PGR. No country should be pressed to do so. To date, the issue has received little attention and discussion by the GATT negotiators. The Dialogue group strongly recommends that the implications of IPR for PGR (as discussed in the Oslo Report) be given adequate discussion and evaluation by the negotiators, with input from national experts and other entities involved with PGR, before any GATT action is taken.

The group agreed that the impact of intellectual property rights on plant genetic resources must be reviewed locally before IPR is extended to plant genetic resources. Although IPR may have important value to stimulate innovation in certain market conditions, when applied to PGR it could have a negative impact on the farmer-breeders who still actively maintain important genetic diversity as part of their traditional activities. Developing countries choosing to implement a Plant Breeder's Rights (PBR) system should retain provisions allowing Farmer Plantback of protected varieties. This is especially important in developing countries where farmers cannot afford to buy seed every year or are not consistently reached by a seed distribution infrastructure and must therefore rely on seed saved from the previous season.

Institutional Structures and Implementation Mechanisms

In order to effectively implement the Global PGR Initiative it will be necessary to utilize, build upon, and improve existing institutional structures at the community, national, regional, and global levels. For certain critical components of this Initiative, especially the creation and maintenance of *ex situ* gene banks, there should be an especially heavy reliance on national level institutional structures and implementation mechanisms. The precise nature of these structures will undoubtedly vary. There is also a critical need for more effective linkages between the formal and informal systems at all levels.

The Dialogue group reached consensus regarding the need for a global mechanism designed to promote political and policy oversight, mobilization and distribution of funds, and implementation of well-defined tasks that fulfills the following basic criteria:

- It should have the confidence of all countries which are important repositories of PGR;

- It should inspire support from contributors of germplasm, information, funds, technology, and systems of innovation; and
- It should be capable of ensuring effective, economical, and timely implementation of approved programmes.

To achieve the above tasks the group believes that four major instruments will be needed. These are:

1. An **Intergovernmental Council** (IGC), based on the principle of one country, one vote, to discuss and decide on policies and priorities, and approve a biannual plan of action, programme of work, and budget. The IGC will include **Associate Members** to ensure inputs from the broader PGR community;
2. An **Executive Board** (EB) of the IGC that is authorized to take action on the implementation of the priorities specified in the approved plan of action;
3. A **Scientific and Technical Advisory Committee** (STAC) of independent professionals to provide the necessary scientific and technical advice and support to both IGC and its EB; and
4. A **PGR Trust Fund** operated as a special trust fund through a designated fiduciary agency.

An appropriate location that allows operational autonomy of the IGC/EB/STAC organizational structure will be essential to ensure the successful implementation of the Global PGR Initiative. With this and other criteria in mind, the Dialogue group concluded that at present there does not exist any ideal organization that completely fulfills all of the identified criteria. Several options are possible: FAO, due to its longstanding experience in this field and its existing intergovernmental Commission on PGR; an intergovernmental body that may emerge from the Biological Diversity Convention negotiations; an intergovernmental body that may emerge from the UNCED process; and the Consultative Group on International Agricultural Research (CGIAR), if it is able, as with the other options, to develop a policy-making structure along the lines of the Intergovernmental Council, Executive Board, and Science and Technology Advisory Committee which are described in more detail in the report.

Call for Immediate Action

The new Global PGR Initiative is designed to create the basis for a general cooperative venture based on mutual benefit. The Global PGR Initiative, taken as a whole, will inevitably create a new environment of trust and exchange. The purpose of the Global PGR Initiative is to act now to ensure conservation and use forever.

It is acknowledged that it may take some time for the PGR Initiative to become operational. Meanwhile, the tasks needing attention and financial support are urgent. These include: immediate assistance to existing gene banks located in Eastern Europe and Ethiopia; training of gene bank managers; infrastructure development for PGR conservation in developing countries which are centres of genetic diversity; and the development of a broader public awareness for PGR conservation. Given the immediate needs outlined above, the Dialogue group recommends that a suitable project proposal be prepared and submitted for consideration for support under the recently created Global Environment Facility (GEF) in view of the high priority accorded by GEF to the protection of biological diversity. The GEF is under the joint co-sponsorship of the International Bank for Reconstruction and Development (IBRD/World Bank), United Nations Environment Programme (UNEP), and the United Nations Development Programme (UNDP).

Every day's delay in pursuing this programme of action may result in a considerable loss of genetic variability in plants of current and potential use.

PREFACE

Dialogue, Purpose, Background, and Groundrules

The Keystone International Dialogue Series on Plant Genetic Resources was initiated in 1988 to bring together diverse interests to engage in a structured, off-the-record consensus-building dialogue to promote a strong international commitment to plant genetic resources (PGR) at the community, national, regional, and global levels. The first plenary session of the Dialogue Series was held in Keystone, Colorado, USA, in August 1988, and the second plenary session took place in Madras, India in January 1990. This report is the summary from the third and final plenary session held in Oslo, Norway, 31 May to 4 June, 1991. The Series involved participants from international and intergovernmental organizations, national government organizations, non-governmental organizations, corporations, and research institutions from developed and developing countries. In total 92 people from 30 countries participated in the three plenary sessions and associated working groups.

The Dialogue Series was given direction from its inception by an International Steering Committee chaired by Dr. M.S. Swaminathan, India and included: Dr. Donald Duvick, United States; Dr. Dalmo Giacometti, Brazil; Dr. Jaap Hardon, The Netherlands; Mr. Pat Mooney, Canada; Dr. John Pino, United States; Dr. Setijati Sastrapradja, Indonesia; and Dr. Melaku Worede, Ethiopia. The specific goal of the Dialogue Series was to increase mutual understanding and develop consensus recommendations on the availability, use, exchange, and protection of plant genetic resources. The Steering Committee, the participants, and The Keystone Center found that the Dialogue discussions and relationships, as well as the consensus recommendations, have and hopefully will continue to serve as a catalyst for new ideas to be considered by key organizations and individuals concerned with plant genetic resources and biological diversity at all levels.

The first plenary session in 1988 resulted in a widely distributed consensus report covering a number of critical issues including refinements to the understanding of Farmers' Rights and Breeders' Rights, and recommendations regarding: the development of a biennial report on the State of Genetic Resources of the World; the formation of national and regional committees on plant genetic resources; strong consideration of global funding mechanisms; and better coordination of institutions concerned with these issues. An equally significant outcome was the agreement to continue the Dialogue in Madras, India in 1990. At that session, the Dialogue further refined recommendations formulated at the first plenary session regarding needed actions to continue to improve the PGR system at the community, national, regional, and global levels. In addition, the group added specific recommendations on intellectual property rights, recognition of the role of informal innovation systems, and the need for funding and institutional mechanisms which address plant genetic resources as a critical aspect of overall concerns regarding biological diversity. The report from the Madras Plenary received wide international circulation and attention.

Following the Madras Plenary, the Steering Committee designated several topics to be addressed by preparatory work groups to help the Dialogue progress as far as possible prior to the Oslo plenary session. In keeping with this request, working sessions on: Intellectual Property Rights issues were held in Ottawa, Canada and Rome, Italy; Sharing the Benefits of Plant Genetic Resources, in Rome; and International Funding, Legal, and Institutional Mechanisms, in Uppsala, Sweden.

In developing Dialogue consensus reports, the participants agreed to three groundrules to govern their discussions:

- Participants attend as individuals;
- All conversations are off-the-record and not for attribution; and
- No documents are made public without the consensus of all participants.

The Dialogue group for the Oslo session consisted of 41 people from 22 countries. They agree that their report is a summary of their discussions, findings, and recommendations. The group understood that consensus meant that each person could accept and "live with" the report as written.

The Oslo group is unanimous, however, in agreeing that plant genetic resources constitute an invaluable asset, currently at risk, that the world *cannot live without*

INTRODUCTION

We, the participants in the Keystone International Dialogue Series on Plant Genetic Resources, choose to speak now in a loud and clear voice, realizing that while the world already has too many crises, it must take heed of yet another. Therefore, we call for a **Global Initiative for the Security and Sustainable Use of Plant Genetic Resources**. Why? Because we fear that the world's capacity to respond to change is being lost—all too quietly and all too quickly. We can hardly imagine a greater threat to the future well-being of the people of the world than the loss of genetic variability of plants.

The critical significance of plant genetic resources (PGR) to global food security as well as to the security of the livelihood of millions of rural families was underlined at the first U.N. Conference on the Human Environment held at Stockholm in 1972. The Conference called for concerted efforts to conserve and utilize naturally occurring genetic variability in all plants, ranging from microflora to giant trees, keeping in view the interests of both present and future generations.

PGR activities are a distinct part of the total efforts on biological diversity or "biodiversity." Biodiversity is the total variability within all living organisms and the ecological complexes in which they exist. Plant genetic resources are a critical portion of global biodiversity. In the public debate on loss of diversity most attention has been drawn to loss of species, where a single well-known species, such as the panda, is threatened with extinction or where a species-rich ecosystem such as a tropical rainforest is under threat of destruction. The problem of loss of biodiversity is more than this; the loss occurs at every level of biological organization. The survival of a species receives more public attention than the protection of diversity within a species, but it is diversity within species that is the key to their survival in nature in the long term, and the main concern of genetic resources programmes for crop species.

The movement launched by the Russian geneticist, N.I. Vavilov in the late 1920s, for collecting, evaluating, conserving, and utilizing genetic resources from the major centres *of diversity* of crop plants, gained momentum following the Stockholm Conference. The International Board for Plant Genetic Resources (IBPGR) was established in 1974 by the Consultative Group on International Agricultural Research (CGIAR) in collaboration with the Food and Agriculture Organization of the United Nations (FAO). FAO further strengthened its PGR work by mobilizing international political commitment through a Commission on PGR established in 1983. Efforts in *ex situ* conservation of PGR grew worldwide and the number of national and regional Genetic Resources Conservation Centres increased. Public interest in PGR grew as a result of the striking yield improvement brought about in the 1960s in wheat and rice through the introduction of the Norin dwarfing genes and the Dee-gee-woo-gen gene for new plant architecture derived from material from Japan and China respectively. Naturally occurring genetic male sterility led to opportunities for deriving advantage

from hybrid vigor in many horticultural crops as well as in crops yielding food, fodder, and fibre. China increased rice production substantially by developing hybrid rice using a male sterile strain collected from Hainan Island. The opportunities opened up by molecular biology for moving genes across sexual barriers during the 1980s enhanced the interest of plant breeders and biotechnologists in work related to the collection and utilization of diverse genetic materials.

Access to a wide range of genetic variability enhanced the capacity of plant breeders to develop new strains possessing a combination of characteristics. These strains, when grown under conditions of good land and water management, yielded two to three times more than the earlier varieties. They thus helped to keep food production above the rate of population growth in most parts of the world. In addition, they helped to avoid the diversion of more forest land to crop farming. Farmers in India, for example harvested 12 million tonnes of wheat from 14 million hectares in 1965. In 1990, they harvested 55 million tonnes from 23 million hectares. Forty million hec-tares of additional land would have been needed to harvest 55 million tonnes of wheat at the 1965 yield level. More forest land would have been lost to annual cropping had the yield improvement not taken place. The growing importance of the seed industry is illustrative of the importance of plant breeding in general and the need to conserve the raw material upon which it depends.

Threats to the security of PGR also grew along with an interest in preservation. Two important sources of threat could be cited.

First, disease and pest epidemics in monoculture areas with the same genetic strain of maize, wheat, or rice have indicated that genetic vulnerability to biotic and abiotic stresses can be significant but can best be overcome through genetic diversity in plants, a feature which has been fundamental to farmers' seed selection practices since the beginning of agriculture. The experience with the corn blight epidemic in the southern United States in 1970 underlined the importance of avoiding genetic homogeneity in crop varieties. Also, the replacement of large numbers of local cultivars with a few high yielding strains resulted in genetic erosion, since in many countries timely efforts were not made to collect and preserve seeds of a representative sample of naturally occurring genetic variability. Even where efforts have been made to save seeds in gene banks, inadequate financial support has led to genetic erosion. The urgency of stepping up efforts in PGR conservation is thus obvious.

Second, demographic pressures have started to take a toll on natural ecosystems. Even now, globally, hardly three percent of terrestrial and one percent of marine ecosystems have been designated "protected areas" for *in situ* conservation of biological wealth. According to the International Union for the Conservation of Nature and Natural Resources (IUCN), already 91 areas in 57 countries (in both developing and industrialized countries) are threatened due to unsustainable development and anthropogenic pressures. Often efforts in *in situ* conservation, in the form of Biosphere Reserves and National Parks, are perceived by local communities as being in conflict with their economic survival. This emphasizes the critical importance of developing partnerships with the people living in the centres of biological diversity. Such partnerships are even more vital in PGR work since farm women and men have been engaged in the domestication, conservation, and genetic enhancement of economic plants since the dawn of settled cultivation over 10,000 years ago.

In recent years another area of conflict with potential adverse effects on the management of PGR as a common human blessing is the growing privatization of plant breeding linked to breeders' and patent rights in industrialized countries. This has highlighted the need for equity in the relative recognition and reward accorded to formal and informal innovation systems. In the Madras Plenary Report, the participants warned that a continuous expansion of the scope of formal patent rights on the one hand, and nonrecognition of informal innovation on the other, will lead to a widening of the economic gap between industrialized and poor nations.

In spite of advances in improving crop productivity and production, the World Bank concluded in 1990 that over one billion people are struggling to survive on an annual income lower than US $370 per capita. The 1990 World Development

Report concluded that "progress in raising average incomes, however welcome, must not distract attention from this massive and continuing burden of poverty." Considering the fact that between 60 to 80 percent of the population of developing countries depends on agriculture for their household food and livelihood security, the critical importance of ecologically sustainable advances in the productivity and profitability of major farming systems in developing countries is obvious.

It has been estimated that by the year 2020, the global population may reach a level of 8 billion with 83 percent living in developing countries. Annual food production will have to go up to over 3,000 million metric tonnes from the current 1,800 million metric tonnes. At the same time productive farm land is being increasingly diverted to nonfarm uses. Even now the per capita arable land availability is only 0.1 hectares in China and 0.15 hectares in India. There is thus no option except to produce more food from less land to meet the needs of the growing global population.

FAO and the United Nations Environment Programme (UNEP) estimate that a major cause of deforestation is the extension of cultivated areas. In addition, soil erosion, salinization, water logging, and similar factors are reducing the biological potential of soil in many parched areas of the world. Increase in productivity per unit area thus becomes an ecological and economic necessity. The pathway of yield improvement should, however, not result in any depreciation of environmental capital stocks like land, water, flora, and fauna. Such a pathway is now referred to as sustainable or ecological agriculture. The vital need for accelerated economic development based on ecological groundrules was stressed by the 1987 report of the World Commission on Environment and Development chaired by Mrs. Gro Harlem Brundtland.

The pathways of linking ecological security with economic development will be discussed at the UN Conference on Environment and Development (UNCED) scheduled to be held in Brazil in June, 1992. The Preparatory Committee for UNCED has accorded priority to addressing major environment and development issues for the initial period 1993-2000 and leading into the 21st century. This programme, referred to as "Agenda 21," will consist of specific action proposals which will help integrate environment and development.

It is against this background that the participants of the Keystone International Dialogue Series on Plant Genetic Resources considered issues relating to the security and sustainable use of PGR at the Third Plenary Session held in Oslo, Norway from 31 May to 4 June, 1991.

The timing of the Oslo Dialogue and its precise recommendations should help the UNCED process in developing an agenda for action which would ensure a better common future for all the inhabitants of our planet. The Dialogue participants therefore hope that their labour will lead to lasting benefits to both the present generation and to generations yet to be born.

PROBLEM STATEMENT AND RATIONALE

Threats and Opportunities

Plant genetic resources are an essential resource for the benefit of humankind; a resource that can be neglected or squandered, or put to use and passed to future generations. This is the message of this report of the Oslo Plenary Session.

Since the dawn of agriculture some 10,000 years ago, women and men have developed crops and modified them to better suit their needs. Crops adapted to a range of new environments as agriculture and crops spread out from their original centres of origins. From that process an enormous amount of genetic diversity was released and distributed over traditional cultivars (landraces). The original diversity allowed some

crops to spread globally and adapt to environments that greatly differed from their original habitats. Rice is now farmed from sea level to high altitudes in the mountains; wheat is grown from the hot dry plains of Northern India to the humid and cool regions of Northwest Europe. Other crops remained in more restricted geographical regions.

Under the care and influence of our ancestors, crops were selected for genetic resistance to pests and diseases. Some developed drought resistance and some, like deep water rice, flood tolerance. Others were selected by our ancestors for their taste, nutrition, or cooking qualities. This process continues today in farmers' fields around the world. In a sense, the total genetic diversity possessed by a crop represents a list of options for future development of that crop. Losing diversity, we lose options.

The future success of world agriculture will depend on its ability to adapt to change. But this success is conditional on our adopting a constructive approach to environmental matters.

The development of plant breeding provided more efficient tools to select and manipulate diversity to tailor crops to human needs. In farmers' fields, mechanization, fertilizers, irrigation, and control of pests and diseases reduced the need to utilize genetic variability as the means of adaptation and defense. As a result, plant breeding emphasis was shifted to raising yield potential and obtaining more efficient use of external inputs. Modern varieties became increasingly uniform. They began to be grown over ever larger geographical areas because of their broad adaptability. In the process, landraces began to be replaced, leading to genetic erosion, which continues today. Wild relatives of crops are also lost through habitat destruction.

An ever-growing world population must be fed. Significant yield improvements have been and are being made through the use of modern yield varieties. Alternative strategies are needed and used, especially in areas that are disadvantaged for economic or resource endowment reasons. Dramatic improvements have been realized; rice production rose from an average annual growth rate of 2.2 percent during 1955-1965 to 3.1 percent during 1965-1980. The additional rice feeds more than 500 million people. Wheat production in South Asia tripled over a twenty year period. This was not achieved however, without costs, both socio-economic and environmental.

As the new varieties were introduced across the landscape, many farmers ceased to grow their traditional landraces. When they did so, these landraces became extinct and valuable genetic characteristics were often lost completely and forever.

As this process was taking place, the Food and Agriculture Organization of the United Nations (FAO), the Consultative Group on International Agricultural Research (CGIAR) system, and various national governments initiated conservation efforts. Plant collectors were dispatched, returning with thousands of genetically distinct varieties, particularly of the world's most important crops. This genetic material was stored in gene banks. Also, some nongovernmental organizations (NGOs) developed collection and conservation activities in different parts of the world and tried to alert local communities.

These efforts were underfunded and understaffed. In many cases, they simply came too late and much diversity was lost. Losses continue today at a rapid rate. As we do not know how much total diversity once existed, it is impossible to quantify the losses. But if we wish to save what is left of the world's priceless heritage of genetic diversity, we must act now. To preserve options for the future, especially to ensure that agriculture can meet the needs of the next century and those to follow, we have no alternative but to conserve plant genetic diversity now.

To cite one example, a sizeable percentage of the human population now lives in coastal areas within 60 kilometers of the seashore. Many of these areas are prone to damage by storms and cyclones. Trees like mangroves, palms, and casuarina provide some insulation against such damage, but coastal trees are being destroyed due to industrialization, pollution, tourism, ex-

pansion of coastal aquaculture, and human settlements. The loss of such plant genetic resources adversely affects both the ecological security of coastal areas and the livelihood security of coastal communities. The recent loss of life in Bangladesh as a result of storm surges is a grim reminder of the possible shape of things to come.

Now we are faced with the difficult task of reconciling the short-term imperative to increase food production with the long-term imperative to conserve natural resources for agriculture, especially plant genetic resources, to sustain our food supply in the future.

Climate change, depletion of water resources, sea land rise, over exploitation of our lands and pollution of our environment threaten the sustainability of modern agriculture. To safeguard the world's environment and develop sustainable forms of agriculture while maintaining increased productivity is an enormous task. Conservation and utilization of plant genetic resources is essential to achieve such a task.

Today, many gene banks cannot provide adequate security. In some cases, we may be losing as much diversity in the gene banks as we are in the fields. Poor equipment and equipment failures have taken their toll. Much diversity is being lost due to the inability (usually for financial reasons) to regenerate samples as they lose germinability. Some collections have been lost completely. Important collections of our most significant crops are stored under conditions which are inadequate to insure their long-term survival or full usefulness.

The Keystone Dialogue involves people intimately familiar with this situation—directors of some of the world's most prominent gene banks and largest national and international genetic conservation programmes, as well as people intimately involved with conservation in farmers' fields. We have chosen not to sing the praises of existing conservation systems, not because praise and appreciation is undeserved, but because we are convinced that it is urgent to sound the alarm that deficiencies in these systems threaten the future of agriculture.

Not all problems concerning plant genetic resources relate to the way we are attempting to conserve them. Growing controversies over ownership and control, and over who will benefit from the use of these resources, threaten to affect their availability and effective use. These controversies should be solved by ensuring that all can share the benefits of our rich legacy of plant genetic diversity. Sharing the benefits will produce important new incentives for conservation.

In fashioning solutions, our sense of urgency has helped us overcome many of the significant differences of viewpoint represented among participants. Outside observers would have thought this impossible a few years ago. In honesty, we ourselves had doubts that we could reach substantive agreement. We hope that the consensus we have achieved lends power to our message and recommendations. The programme of work and structure for the Global Initiative for the Security and Sustainable Use of Plant Genetic Resources we propose is not perfect. It will need adjusting and reworking as we work and learn together. But it is a programme we endorse, a programme we pledge ourselves to work for, a programme we hope is not too late.

Overview of Past and Current PGR Activities

Within the last two decades, attempts have been made to develop a global plant genetic resources system, but a fully articulated global system has yet to emerge. The system that is being built depends on actors and actions at four levels: community, national, regional, and global.

Community Level

Community efforts have only recently begun to be recognized by the formal sector. At the farmer level, we are beginning to learn of and appreciate the plant breeding and conservation efforts being made by farmers and gardeners.

Farmers have been found to: employ their own taxonomic systems; encourage introgression; use selection; occasionally hybridize; make efforts to see that varieties are adapted; multiply seeds; employ simple cell/tissue culture techniques to produce new plants; field test; record data; and name their varieties. In the course of this innovative activity (which is usually aimed at production, not conservation), they also conserve genetic diversity and encourage new genetic combinations and adaptations.

In the Philippines, Thailand, Nicaragua, Ethiopia, parts of Latin America, and other parts of the world, farmers are trying to maintain diversity in fields dominated by uniform varieties—often with the assistance of formal sector scientists. Community conservation efforts also play a major role in conserving diversity in times of civil strife and natural disasters.

Increasingly, farmers are involved in purposeful conservation projects. In Ethiopia, landraces are being preserved on farms in a programme coordinated by the Plant Genetic Resources Centre of Ethiopia. In the United States, organizations of farmers and gardeners actively conserve thousands of old cultivars, a significant number of which are not found in government collections.

The informal sector is also active in research on indigenous farming systems and promotion of sustainable forms of agriculture based on diversity. NGOs offer training and education tailored to community-level conservation and utilization. Fostering public awareness of the importance of genetic diversity is a prime component of many NGO programmes. And a number of organizations actively advocate for increased conservation—often to the direct benefit of the formal sector.

National Level

National programmes have now emerged, together with the International Agricultural Research Centres (IARCs) as the major operational elements of the international plant genetic resources effort.

A fully functional national programme in PGR might consist of: a national coordinator; gene bank holdings; base and active collections of plant genetic resources of the country's most important crops; facilities and staff for collecting, multiplying, characterizing and documenting the material; and effective contacts with national crop improvement activities. In addition, there may be a formal coordinating mechanism, such as a national genetic resources committee, through which personnel not within the formal agricultural infrastructure (such as representatives of farmers groups, NGOs, seed-producing companies) may be linked with the mainstream of activity (see Institutional Structures and Implementation Mechanisms discussion below). Each programme is unique in that it seeks to meet national needs; their common desire is to be self-reliant, but not isolated from international level activities.

Investment in storage facilities, training, and collecting has increased in the last two decades or so, but much more needs to be done. Today, some 50 countries have long term PGR storage facilities for conservation; 29 of these are in developing countries. Despite some impressive growth in interest and participation, much needs to be done to make national efforts more effective. Some important or rare collections are threatened by indifference and/or *neglect* by national authorities or by fundamental political changes, as in Eastern Europe. Many national systems are not well linked to existing efforts, either internally or externally. Some modern plant genetic resources storage facilities are not functioning because of a *lack* of operating funds or trained personnel. Important or rare collections are at times threatened by poor storage conditions, a lack of duplication in other collections, or difficulties in regeneration.

Regional Level

Original plans drawn up by an FAO panel of experts in the late 1960s, called for regional gene banks to be located in major centres of diversity—the so-called Vavilov Centres—but these proved generally unworkable because most nations preferred to support national gene banks rather than regional gene banks.

Centres of genetic diversity do not respect political boundaries and are often shared by more

than one country. Regional cooperation in various PGR activities, such as joint collecting, characterization, evaluation, documentation, research, and training may be socially and culturally relevant as well as cost effective.

Crop research networks have been set up in many regions, and most of them include components of PGR networks that can facilitate regional cooperation between national systems. There is support among and between regional NGO PGR networks and formal regional PGR networks through joint projects, training, and technical advice. In addition, there are independent NGO efforts.

Global Level

FAO has constitutional responsibility to promote and, where appropriate, to recommend national and international action with respect to agricultural research, methods of improvement of agricultural production, and the conservation of natural resources, including plant genetic resources.

Its involvement and activities in this area since the early 1950s have led to the establishment of the FAO Global System for the Conservation and Utilization of PGR described in the International Legal Context section found below.

At the international technical level, probably the most important single development was the establishment in 1974 of the International Board for PGR (IBPGR) by the Consultative Group on International Agricultural Research (CGIAR). Its objective is to stimulate and support coordinated research on all aspects of crop genetic resources.

The administration of IBPGR is currently provided by FAO. IBPGR will soon change its name to the "International Plant Genetic Resources Institute" (IPGRI) after its formal administrative separation from FAO. IPGRI's and FAO's programmes will, however, continue to be developed in close consultation with each other. For that purpose, FAO and IBPGR have developed and signed a Memorandum of Understanding (MOU) on Programme Cooperation. Among other issues this MOU addresses the development of a Global Information and Early Warning System and the preparation of the State of the World Report on PGR.

Out of the current 16 IARCs of the CGIAR, 12 are heavily involved in the conservation and use of plant genetic resources. Each commodity centre assembles and maintains plant genetic resource collections of its mandate crops. IBPGR plays a coordinating role in the CGIAR and also deals with the technical and scientific efforts on crops outside of the mandates of the commodity centres. The expansion of the CGIAR focus to include forestry will further widen the scope of CGIAR's involvement in the conservation and use of plant genetic resources.

The plant genetic resources of a single crop are now of interest to numerous institutions and a wide variety of workers. Crop networks were initiated in the late 1980s. Crop networks, composed of institutes, scientists, farmers, and their representatives operate on a crop-by-crop basis. Each network encompasses all genetic resources activities, including collecting, documentation, active and base storage, and preparation for utilization. The networks have the responsibility for developing policies and priorities for action for their respective crops. This includes establishing and managing databases and fostering collaboration among national programmes. These networks should become a major working element of a reorganized global genetic resources programme.

A significant recent initiative is the organization of a Global Environment Facility (GEF) by UNEP, United Nations Development Programme (UNDP), and the World Bank. This is a three-year pilot programme supported by a Core Trust Fund together with various co-financing arrangements. UNEP has established a Scientific and Technical Advisory Panel (STAP) to provide the necessary professional support to GEF. The three major objectives of GEF are (a) protection of biodiversity, (b) limiting emissions of greenhouse gases, (c) protection of the ozone layer, and (d) protection of international waters. From the beginning, GEF has associated NGOs

with both project formulation and implementation. The Core Trust Fund is lodged in the World Bank.

NGOs such as the Rural Advancement Foundation International (RAFI) and Genetic Resources Action International (GRAIN) function at the global level in an effort to have an impact on policies and the implementation of programmes within the formal and informal sectors. Interactions with the formal sector include working liaisons with organizations such as FAO and the European Community (EC).

International Legal Context

FAO Global System for the Conservation and Utilization of PGR

In the late 1970s, as national and international activities increased substantially to collect and conserve plant genetic resources in gene banks, questions regarding the safety of the material, the ownership of collections, the development of national laws restricting the availability of germplasm, and intellectual property rights over new varieties became the subject of continuing debate. As the number of activities related to PGR increased, the need to establish a mechanism to coordinate intergovernmental action at a global level became apparent.

As a result of these discussions, FAO established in 1983 a Global System for the Conservation and Utilization of PGR which includes a non-binding legal framework, the International Undertaking on Plant Genetic Resources and an intergovernmental forum, the Commission on PGR. As an indication of interest, to date, 128 countries are part of the global system, of which 110 are members of the Commission and 102 have adhered to the Undertaking. These and other legal elements developed in this framework are described below.

The Commission on PGR functions on the basis of "one country, one vote." IBPGR and other relevant professional organizations, as well as representatives of other UN agencies, regional development banks, and NGOs, attend the meetings of the Commission as observers. The Commission serves as a forum for discussing matters related to PGR and to recommend measures necessary or desirable to ensure the comprehensiveness and efficiency of the Global PGR System, and monitors the implementation of the Undertaking. In 1993, the Commission is planning to convene the Fourth International Technical Conference on PGR that will examine and review the first State of the World Report and Plan of Action on PGR. The Dialogue participants welcome this initiative.

The International Undertaking on PGR is a non-binding legal instrument, the objective of which is to ensure that plant genetic resources, especially species of present or future economic or social importance, are explored, collected, conserved, evaluated, utilized, and made available, without restriction for plant breeding and other scientific purposes. The Undertaking is based on the principle that PGR is part of the heritage of humankind and, therefore, should be conserved for future generations. This principle, which is subject to the overriding sovereign rights of nations over the genetic resources within their territory, has been qualified by the FAO Conference and the Commission on PGR in two resolutions that are now annexes to the Undertaking. These resolutions recognized that Plant Breeders Rights are not incompatible with the Undertaking and that the owners of germplasm, through the concept of Farmers' Rights,[1] should be compensated for their contributions to the enhancement of PGR. These resolutions have enabled a number of countries to remove their original reservations to the Undertaking.

At both the Keystone and Madras Plenary Sessions of the Dialogue Series, considerable time was spent carefully clarifying an operational understanding of the classifications of plant genetic resources addressed by the International Undertaking on PGR. We are pleased that these discussions have contributed to improved

[1]Farmers' Rights, as defined in the text of the International Undertaking means "rights arising from the past, present and future contributions of farmers in conserving, improving and making available plant genetic resources, particularly those in the centres of origin/diversity. These rights are vested in the International Community, as trustee for present and future generations of farmers, and supporting the continuation of their contributions, as well as the attainment of overall purposes of the International Undertaking."

understanding elsewhere and have enabled the membership of the FAO Commission to be expanded, as well as the adherence to the International Undertaking.

Since the Madras session, the FAO Commission has taken several important steps that compliment the Undertaking. One such step is the development of a network of *ex situ* germplasm collections that are subject to varying degrees of commitment to the safe conservation and unrestricted availability of the plant genetic resources that are conserved at these gene banks. These voluntary commitments are effectuated through bilateral agreements between FAO and national governments or the IARCs. Both FAO and IBPGR have recognized the necessity of achieving maximum complementarity between the FAO network of base collections and the already existing IBPGR register of base collections and to merge them to the greatest degree possible.

In addition, consistent with Keystone Dialogue recommendations made in Madras, a voluntary International Code of Conduct for Plant Germplasm Collecting and Transfer, separate from but complementary to the Undertaking, has been developed by the Commission and will be submitted to the FAO Conference in November 1991 for approval. The Code will form an important tool for guiding the collection and transfer of plant genetic resources, with the aim of facilitating collection and access to these resources and promoting their utilization and development.

UNEP Negotiations Related to a Convention on Biological Diversity

The United Nations Environment Programme (UNEP), established in 1973 on the basis of a recommendation of the UN Conference on the Human Environment held in Stockholm in 1972, has been active in promoting the conservation of habitats and critical ecosystems right from its inception. UNEP is currently negotiating a Global Framework Convention on Biological Diversity. It is possible that this Convention may receive intergovernmental approval prior to the UNCED, scheduled to be held in Brazil in June of 1992. Such a convention will likely deal with biological diversity at the ecosystem, species and subspecies levels.

UNESCO World Heritage Convention

During the last two decades, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) has promoted the Man and the Biosphere Programme (MAB). In addition, it administers the World Heritage Convention which accords recognition to both natural and cultural sites of eternal heritage value all over the world.

Other Legal Issues

In the Ownership and Intellectual Property Rights section of this report, other legal issues related to plant genetic resources are discussed including Plant Breeders' Rights (International Union for the Protection of New Varieties Convention), patents, and related intellectual property rights legislation.

SUBSTANTIVE ISSUES, FINDINGS, AND RECOMMENDATIONS

Introduction

The Dialogue group believes that there is a clear need for action in response to the critical situation facing the world's plant genetic resources. The group recognizes the fact that plant genetic resources encompass both agricultural and environmental considerations. As such, the concerns just highlighted cannot be effectively addressed without consideration of the unique linkage between environment and development.

The Keystone and Madras Dialogue reports ex-

plored these linkages and formulated specific recommendations regarding plant genetic resources conservation and use at the community, national, regional, and global levels.

The Oslo Dialogue group urges that these previous findings and recommendations be carefully considered and implemented. At the same time, however, the group strongly desired to focus this report on recommendations for a Global PGR Initiative that will be critical in the implementation of the consensus recommendations made in earlier Dialogue reports.

Building upon the previous Dialogue sessions, several very important issues were identified because they contribute significantly to the problems facing plant genetic resources including: ownership and intellectual property issues; weaknesses in the current plant genetic resources system; and serious lack of financial resources. The remainder of this report addresses the Oslo session's findings and recommendations regarding these critical issues.

Ownership and Intellectual Property

Role and Issues Concerning PGR Conservation and Use

Introduction. The sphere of plant genetic resources preservation, conservation, and use cannot be discussed without considering the issues of intellectual property rights, plant germplasm ownership, and the control of plant germplasm accessions in gene banks. These issues have been the focus of substantial debate and publication in numerous international fora for nearly two decades.

Recently, the interest and rhetoric surrounding these issues have increased, at least in part, as the public and private sectors, principally in the developed countries, pursue heavily-funded biotechnology research programmes. PGR will be the principal source of genes and related genetic sequences for biotechnology-based plant improvement and the production of valuable biochemicals. Developing countries are suggesting that some form of compensation is warranted for the role their peoples have played in the primary development of PGR.

Concerns have been expressed that the application of intellectual property rights to the successes from biotechnology research in developed countries could have negative consequences for developing countries. The Dialogue group discussed the question what will be the net impact in economic terms of extending IPR to biological materials and of privatizing resources that were previously freely available?

Evolving International IPR Activities. Legislative activities at the international level will have a significant influence on the availability of intellectual property rights in developing countries. These activities include the ongoing General Agreement on Tariffs and Trade (GATT) negotiations, the recently concluded revision of the International Union for the Protection of New Varieties (UPOV) Convention, and the patenting of plant-related biotechnological inventions.

In the absence of the GATT negotiations, the revision of UPOV and plant biotechnology patents might assume less significance for the developing countries and the survival of their plant genetic resources. However, as part of the Trade-Related Intellectual Property Issues (TRIPs) negotiations of the current Uruguay round of GATT, developed countries are pressing the developing countries to implement stronger intellectual property rights for a much broader range of materials.

If the GATT negotiations result in the strengthening of IPR within developing countries, this, in turn, might result in both the adoption of plant variety protection systems and the patenting of plants, animals, and the genetic materials that are contained in them. In previous Dialogue reports, the Dialogue group expressed strong concern about the imposition of IPR for plant genetic materials through the GATT or bilateral trade negotiations. Every country has the right to decide whether and to what extent they adopt IPR for PGR. No country should be pressed to do so. To date, the issue has received little attention and discussion by the GATT negotiators. The Dialogue group strongly rec-

ommends that the implications of IPR for PGR (as discussed in the Oslo Report) be given adequate discussion and evaluation by the negotiators, with input from national experts and other entities involved with PGR, such as FAO, UNEP, UNESCO, World Intellectual Property Organization (WIPO), UPOV, and several NGOs, before any GATT action is taken.

Intellectual property right (IPR) systems have been instituted by many countries to varying degrees in order to stimulate innovation throughout all sectors of society and especially to promote investment by and secure rewards for the private sector. They are meant to provide an incentive to create innovation and to disclose its details.

There is little doubt that IPR systems under certain economic conditions are capable of encouraging innovations which may contribute to improvements in productivity. However, it is not possible to predict how those productivity gains might be distributed. If IPR systems are extended to plant genetic resources, depending on the precise nature of subject matter that qualifies for intellectual property protection and the scope of protection ultimately granted, some parties will be limited in their access to the protected germplasm. Developing countries have been the principal sources for PGR, but the poor farmers in those countries are most likely to be at a disadvantage without construction of proper safeguards.

The Keystone Dialogue group has reviewed these issues and the status of certain international activities in these areas. This review has proven especially complex for several reasons. There are significant differences in structure and complexity among the agricultural systems in developed and developing countries, the definition of protected subject matter as it applies to biological material is still evolving and far from fixed even in developed countries, and specific legal provisions in the area of intellectual property rights for biological content are currently under consideration.

Physical Property and Intellectual Property. In the context of our discussion on PGR ownership, we think it is important to distinguish between property in the physical plant genetic resource (e.g., seed) and intellectual property. A seed is a tangible asset or resource which can be sold. Intellectual property is an intangible asset, such as a patent or Plant Breeders' Right (PBR), recognized by society which grants certain rights for its exclusive exploitation. There are significant differences in the strategies used to control and manage each and in the nature of their impact on access to the plant genetic resources.

Plant Germplasm Ownership and Accessibility. Based on past events and current policy, most countries have serious concerns about guaranteed access to plant germplasm collections, especially those that originate in their country and are stored in another. It has been formally recognized by the FAO Undertaking on Plant Genetic Resources that the world's plant genetic resources are part of a global heritage which should be accessible to anyone who has need of it for plant breeding and scientific purposes.

The Dialogue group again confirms that every effort should be made to minimize all restrictions on the access to germplasm, from any quarter. Nevertheless, it is recognized that breeders' lines can remain outside the full exchange relationship in order to allow breeders to complete their work and make a formal varietal release. In the same way, there exist other genetic resources, improved or unimproved, for which there may be a reason for temporary constraint to exchange. In such cases, the world community must yield to the judgement of the holder of the germplasm. This situation should be monitored on an ongoing basis, preferably by the Scientific and Technical Advisory Committee of the proposed Global PGR Initiative (see below).

At the November 1989 FAO Conference, all member countries endorsed an agreed to interpretation of the Undertaking that recognizes both Plant Breeders' Rights and Farmers' Rights. Plant Breeders' Rights are a formal system for rewarding developers of plant varieties (see Appendix A). The principle of Farmers' Rights

recognizes the fact that farmers and rural communities have contributed greatly to the creation, conservation, exchange, and knowledge of genetic and species utilization of genetic diversity. This interpretation aims at reconciling the view of the "technology-rich" and the "gene-rich" countries in order to ensure the availability of PGR within an equitable system.

The concept of Farmers' Rights was considered in the Dialogue's Madras Report. This concept emphasizes the importance of the contribution of farmers and rural communities to "...the creation, conservation, exchange, and knowledge of genetic and species utilization of genetic diversity; that this contribution is ongoing and not simply something of the past; and that this diversity is extremely valuable."

Currently, no formal recognition and reward system exists to encourage and enhance the continued role of farmers and rural communities in the conservation and use of plant genetic resources. This concern should be considered within the context of the Dialogue group's recommendation regarding a Global Initiative for the Security and Sustainable Use of Plant Genetic Resources, which includes the establishment of a PGR Trust Fund (see below). Also, below, the Dialogue group suggests a series of additional measures to help support informal innovation.

Biotechnological Exploitation of PGR. The call for equitable compensation for biotechnologists and other scientists use of plant-derived genes is likely to increase as improved plant varieties and other products developed by the new biotechnologies reach the marketplace within the next five years.

Although compensation usually is discussed in financial terms, there are other ways that developing countries may obtain a reciprocal benefit for their contribution. Access to genetically engineered germplasm for local breeding, or to gene constructs for transfer into indigenous crops, are two mechanisms of compensation.

The Keystone Dialogue group supports industry efforts, like the recent position taken by members of the Green Industry Biotechnology Platform (an association active in Europe) to make some of their proprietary improvements available through bilateral agreements and/or technology transfer services. The Dialogue group also stresses that ultimately, such efforts should fit into a multilaterally agreed-to mechanism.

An Assessment of Current IPR Systems[2]

Since the Madras session, the Keystone Dialogue has explored the implications of the current IPR system on the conservation and use of PGR in both the formal and informal systems of innovation. The "formal system" refers to plant breeding, selection, and conservation as developed and practiced in public and private institutions, especially in the western world during the past century. The "informal system" refers to plant breeding, selection, and conservation in local communities and on small farms, especially in developing countries.

Both systems respond to appropriate incentives, often in different ways, and to differing degrees, depending on the context.

It was agreed that improved varieties—no matter whether they come from the public or private sector and are or are not protected by Plant Breeders' Rights—have the tendency to displace landraces and lead to a loss of genetic diversity. To the extent that PBR is intended as an incentive to develop improved varieties, it contributes indirectly to the loss of landrace genetic diversity. On the other hand, PBR may lead to an increase in the number and source of such varieties.

The Dialogue group further agrees that current IPR systems may not be equally appropriate or effective in all developing countries. Finally, the Dialogue group agrees that there is an in-

[2]A technical discussion of formal IPR systems, specifically PBR and patents, is found in Appendix A.

complete understanding of the impact of IPR on the maintenance and conservation of plant genetic resources.

It was necessary to identify some of the operational or agronomic mechanisms by which germplasm diversity is maintained or enhanced. As part of this evaluation, the Keystone Dialogue participants concluded that much of the plant genetic diversity still in active use in developing countries is maintained by small farmer-breeders as part of their livelihood and personal use. The expansion of the seed infrastructure will bring this farming sector under increasing economic pressure to adopt new varieties.

The Dialogue committed considerable time to an effort to understand the status of small farmer-breeders in evolving agricultural systems, to define the nature of their activities as they relate to germplasm conservation and utilization, and to understand the basis of their security (see Community Level section below under Institutional Structures and Implementation Mechanisms). We then sought to identify the potential impact of the IPR-related activities on small farmer-breeders who generally are beyond the reach of the seed distribution infrastructure and who actively maintain considerable genetic diversity in the context of their farming livelihood and preferences for personal use. Negative impacts on the activities of these farmer-breeders will challenge their security and the survival of the PGR they maintain.

We have sought to find new mechanisms and incentives that could function at the interface between IPR and PGR to ensure that plant genetic resources are available for the benefit of all. Our basic principle is that there must be widespread access to and use of PGR according to clear and well-defined rules.

Impact of PBR. As part of its evaluation, the Dialogue group has sought to determine the extent to which Plant Breeders' Rights may mitigate or exacerbate negative impacts on plant genetic resources. Also, a number of the key provisions of PBR have been reviewed to assess their potential impact on small farmer activities. The key provisions were uniformity, the Breeders' Exemption, and Farmer Plantback.

- *Uniformity*

To the extent that PBR promotes the development of new varieties and thereby the availability of new genetic combinations, commercial and public breeding research tend to focus on a limited number of crops with large acreage or with a high profitability of seed sales. Moreover, the existing uniformity requirement to obtain PBR ensures a high degree of genetic uniformity within a protected variety. The widespread introduction of new and uniform varieties will challenge the active utilization of locally adapted and genetically diverse landraces and less genetic variation would be, as a consequence, available to small farmers for local breeding and adaptation activity.

Although uniformity is a criterion for PBR, it may also be a consequence of modern breeding and market demands. It is encouraged by agricultural policies, such as seed registration and certification. This uniformity means that there is less genetic diversity available for the small farmer's breeding and selection efforts.

PBR systems and/or publicly administered programmes of breeding, seed certification, and varietal registration should utilize criteria that do not impose unnecessary uniformity in the newly released varieties, especially for those crops actively bred and exchanged by farmer-breeders.

- *Breeders' Exemption*

The Breeders' Exemption of PBR allows for the unrestricted use of protected varieties as a source of initial variation in breeding programmes. This applies to both the formal sector and small farmer-breeders. The Breeders' Exemption should be interpreted to ensure that market options for resulting varieties are never restricted.

The extension of Breeders' Rights under the recent revision of the UPOV Convention to essentially derived varieties should not be allowed to affect breeding and germplasm exchange by small farmers where it results in better adapted varieties. It should be noted that

private, noncommercial acts are also compulsorily excepted from the Breeders' Rights. Small farmer-breeders may be able to take advantage of this exemption.

•*Farmer Plantback*

Under the existing UPOV Convention, the Breeders' Right does not cover the reuse (plantback) of farm-saved seed although countries are free to extend the Breeders' Right if they choose to. The revised Convention now extends the Breeders' Right to cover such reuse and could be used to prevent farmers from replanting seed of a protected variety they have grown. Countries are free, however, to limit the Breeders' Right with regard to Farmer Plantback (e.g., to specify that farmers can replant seed of a protected variety that they have grown), and most countries are expected to do so.

The Dialogue group recommends that developing countries that choose to implement a PBR system adopt provisions for Farmer Plantback. This consideration is especially important in developing countries where farmers either cannot afford to buy seed every year or are not consistently reached by a seed distribution system and must therefore rely on seed saved from the previous season. A Farmer Plantback provision should exist to allow small farmer-breeders to continue their breeding and selection activities. However, it does not give them the right to sell seed of a protected variety.

It also is generally recognized that under certain market conditions Farmer Plantback particularly when abused (i.e., used to generate seed for resale in large quantities), may discourage commercial investment in the breeding of particular crops. This impact, in turn, has a detrimental effect on the degree of commercial inter-varietal variation, the encouragement of commercial small scale breeding, and breeding for specialized properties.

In order to mitigate the potential negative impact of Farmer Plantback on private sector investment in plant breeding, the developing country should consider the use of certain economic incentives to encourage breeding in low volume or minor crops, or in major crops, when Plantback threatens the economic viability of breeding.

Impact of Patents. The objective of the patent system is to stimulate innovation by rewarding the inventor and to encourage private sector technology to be published rather than kept secret. Major efforts currently are underway, under the auspices of WIPO, to assist developing countries with establishing appropriate intellectual property systems, and particularly to take advantage of the patent information system and facilitate the exchange of technology. Whether or not the current patent system fulfills the stated objective has been a matter of debate for several decades.

The Dialogue group did not agree on the relationship between patents and incentives for innovation. The group agreed that the introduction of a patent system might not be appropriate for every country. For a patent to offer optimum benefits to a country, the country must have a certain level of development and a suitable infrastructure. Many developed countries have only recently extended their patent systems to cover chemical and pharmaceutical products for example, while many developing countries do not allow patents on medicines, and chemical and food products. In some countries, the vast majority of patents are held by foreign companies and are not used in the local production process.

Whether living things and their genetic materials should be patentable is controversial. At one end of the spectrum, the United States holds that "everything...under the sun made by the hand of man[kind]" (*Diamond v. Chakrabarty*, 1980) should be patentable. Under current United States practice, patents are granted for novel DNA sequences, for constructs containing genes isolated from nature, for novel combinations of genes and regulator sequences, for plasmids, vectors, modified cells, and for new, altered animals and plants (including plant varieties).

In contrast, few developing countries permit patents for any forms of life or for genes. Between

the two extremes, European laws typically allow patenting DNA sequences, gene constructs, and microorganisms, but specifically forbid patenting essentially biological processes and plant and animal varieties. There is disagreement as to whether this provision excludes all patent rights over plants and animals. This question might be settled by legislation. For example, a European Community Directive on this matter is in preparation. Norway is adopting a solution which will permit patents on novel synthetic genes (excluding genes found in nature and natural microorganisms), but exclude all patents on plants and animals. Denmark is considering limiting patents on plants and a ban on the patenting of animals.

Some have the opinion that patenting higher lifeforms and the genetic materials they contain is unacceptable for ethical, social, and economic reasons. Others strongly contest this.

These different opinions about the role and effects of the patent system also were present within the Dialogue group. Certain misunderstandings or misinterpretations were acknowledged by the participants. It was made clear, for example, that the right and role of the private sector in the seed industry and in plant breeding in particular, was not a matter of fundamental dispute. There also was no dispute over the rights of breeders to profit from their work. Neither was there any fundamental disagreement over the concept of intellectual property rights itself.

However, concern was expressed by some participants about the implication of applying the patent system to living materials, including plants and animals and the genetic resources they contain. They felt that this would unduly restrict the exchange of these resources. They also felt that this would restrict free exchange that characterized public research before the advent of strong IPR on living material.

All participants agreed that applying the patent system to plant genetic resources would affect the exchange of germplasm, an exchange which is seen as the cornerstone of modern plant breeding and is the basis for the survival of indigenous farming systems. It also was agreed that complete lack of adequate incentive and reward mechanisms could reduce this exchange as researchers might use secrecy to protect their inventions. It also was fully agreed that the current patent system applied to genetic resources does not recognize the important role that farmers had, and continue to have, in the development and maintenance of germplasm.

It was strongly recommended that the implications of the patent system on the conservation, use, and availability of genetic resources should be further assessed, and that any policies relating to the extension of the patent system to plant genetic resources should take these implications into account. Any initiatives to devise patent systems for plant genetic resources should attempt to minimize potential negative impacts on the use and availability of these resources.

Accessibility of PGR Protected by Patents.
The Dialogue group also focused its attention especially on the implications of patents on the availability and exchange of genetic resources. A patent limits, by definition, access to patented products or techniques for use in the productive process, as the patentee can prevent others from using it commercially. However, the extent to which such restriction takes place depends on the nature of the patent claim, provisions in the patent law, and practice of the patentee.

While there was agreement on some of these issues, there also were several areas where it was impossible to reach consensus. Some participants expressed strong concern that the current patent system widely applied to genetic resources would be biased towards the interests of the already strong breeding sector in developed countries and to the detriment of national plant breeding programmes and companies in the developing world. They also were worried about the implications for the future of national and international public research as this sector is especially dependent on the free exchange of genetic materials and information. Overall, they stressed that the patent system was designed for inanimate matter and not suitable for living things and were of the opinion that rather than promoting in-

novation in biological sciences, it might reduce or even block it.

Other participants, however, were of the opinion that the patenting of genetic resources would generally lead to increased research in plant breeding and biotechnology, and stimulate the production of many new and useful plant varieties and characteristics, as well as the publication of technology and exchange of novel germplasm. They believed that ultimately these increased innovative activities would be beneficial also for resource-poor farmers in developing countries. They felt that without strong patent protection on genetic materials, the private sector would not invest in this area, and would target only areas where intellectual property protection is not necessary, such as hybrids.

These different perspectives on the usefulness and implications of the patenting of life forms reflect that the matter is far from resolved. In many countries, an intense policy debate on this matter is underway on all of the above mentioned areas. Also, several technical and legal problems related to the patenting of genetic materials remain unresolved.

However, where countries choose to apply the patent system to genes, the Keystone Dialogue group would encourage the plant biotechnology industry associations and individual companies commercializing plant varieties with patented genes to adopt the following policies:

- Provide clear notification when a patented gene is residing in an improved variety;
- Clearly state that derivative breeding with the varieties will not be restricted; and
- Offer to grant licenses for the patented gene for use in other varieties of the same crop in which the gene was commercialized at ten years from the date of first commercial sale.

Such actions by industry might also serve to diffuse some of the criticism about the patenting of genes, and could serve as an example to improve availability of germplasm for continued use within the framework of the patent system.

Incentives to Informal Innovation as a Means to Further Implement Farmers' Rights

A weakness of IPR systems in relation to plant genetic resources is their ineffectiveness in providing incentives to informal innovation.

Recognizing this shortcoming and the critical importance of informal innovation systems for the conservation of PGR, the group examined alternative strategies with potential to encourage informal innovation, and further implement Farmers' Rights.

Agricultural policy in many developing countries tends to provide major disincentives to both public and private sector investment in *input*-saving technologies. Policy mechanisms such as input subsidies, food price subsidies/ceilings, overvalued exchange rates, research policies biased toward high-input agriculture, and credit policies that discriminate against minor crops and traditional varieties, work in concert against the small-scale farmer and efforts to improve small-scale farming systems.

Certain of these policies are designed to provide incentives to improve productivity. Often this means subsidizing the use of modern varieties and high levels of inputs. The goal of increased and sustainable production is critical. However, in many cases the goal of increased production may be reached as well, and the criterion of sustainability will also be better satisfied through the utilization of locally-developed varieties.

Informal innovators can be encouraged to contribute to this goal through elimination of policy instruments which discriminate against useful varieties developed by this sector (e.g., credit tied to the use of particular varieties). Reforms in this area could stimulate the utilization of local PGR, reinforce conservation at the community level, and contribute to sustainable agricultural practices generally. The Dialogue group urges that appropriate policy changes be enacted.

Many of these policy mechanisms are dictated by politics and are unlikely to be changed purely

as a means of improving PGR conservation, utilization, and innovation. It is therefore desirable also to consider policy mechanisms which would provide incentives to informal innovation. In essence, these would encourage and/or reward farmers for their efforts to maintain and enhance crop diversity, and to develop varieties with better quality, improved yield, stress and disease resistance, and more efficient utilization of inputs.

As discussed elsewhere in this document, there is a great need for increased agronomic and economic research at the small farm level. There is a need to identify and describe constraints within the informal sector to enable better targeting of incentives. Research is needed to help solve technical constraints faced by informal innovation. One simple but potentially effective approach is the idea of a "Conservation Corps" which could include the provision of fellowships for young researchers interested in working at the farm level and training workshops for farmers interested in plant breeding, variety testing, and selection.

Improved market opportunities for a wider variety of produce and for better quality products also will serve as a direct reward to farmers for improvement of a diversity of varieties. Here again there is a role for different approaches such as improvements to market infrastructure (e.g., transportation of goods to markets, removing legal restrictions on local markets), information campaigns, varietal advertising, agricultural fairs to familiarize consumers, and market research.

Farmer cooperatives can support PGR work at the local level through the provision of germplasm, appropriate technologies, and training.

Unresolved Issues

The Dialogue group wishes to confirm its belief that the plant genetic resources community should continue to strive for greater transparency, mutual confidence and trust throughout the system, leading to a situation of increasing full access to plant genetic resources.

The following two concepts were received positively and with interest in holding further discussions from participants from industry and NGO backgrounds. Those participants more directly engaged in gene bank operations were less interested in pursuing discussions in these areas.

In the course of discussing the positive or negative impact of formal plant breeding in developing countries, participants saw value in encouraging an ongoing dialogue among various interest groups on the wider implications of the introduction of plant genetic resources in the form of advanced varieties. Such discussions could bring still greater trust and transparency to the community and allow the world to ensure the greatest benefit from PGR introductions.

The Keystone Dialogue considered ways to recognize the contribution made by all countries through their accessions now held in gene banks worldwide. For example, it was suggested that in the long-term every gene bank in the international system might provide each country contributing germplasm with an inventory of the accessions known to have originated in the contributing country. A revised inventory could be prepared every five years or at the time new collections are added. Despite general agreement on the desirability of making such information available, this would require a much better funded, more efficient, and better functioning series of PGR data banks than presently exist.

A further idea would incorporate licensing agreements giving more favorable access to commercialized materials derived from gene bank accessions to those who contributed the germplasm. Although such a scheme would recognize and thus encourage more active participation by "gene-rich" countries, it would impose considerable burdens on the gene banks and raise many difficulties for implementation.

There were several broadly shared and serious reservations about the desirability of trying to implement such proposals.

An Analysis of Gaps and Needs

A global system for the security of the world's PGR is developing, but the existing institutional capacity, structures, and programmes are generally inadequate and underfunded at all levels. An effective and responsive system

must be sustainable and ensure conservation and availability of PGR to meet future global needs for formal and informal systems of PGR conservation and utilization. The Dialogue group identified current gaps and weaknesses which must be remedied if the system is to cope with the urgency of the situation.

Conservation Strategies

PGR conservation efforts can be carried out in various ways: (a) *in situ* conservation in natural or original habitat; (b) *ex situ* conservation in gene banks as seed, tissue, or pollen, in field gene banks, or in other live collections; and (c) on-farm/community conservation.

In situ conservation. *In situ* conservation of plant genetic resources depends on eco-geographic surveys to determine the amount of diversity present, its current status, and established measures to ensure future assessments.

In situ conservation should be seen as complementary to *ex situ* conservation. This is very often not recognized.

Ex situ conservation. *Ex situ* conservation involves collecting, storage, and regeneration, documentation and information systems, evaluation, enhancement, and exchange.

•*Collecting*

The inadequacy of most current collections is widely recognized. Even in major crops, there are important areas of diversity that remain to be sampled, and some areas where past sampling was inadequate or faulty may need to be revisited.

Minor crops have been neglected and are in serious need of further collection.

• *Storage and Regeneration*

Many existing facilities lack modern storage. Even some global base collections are stored under inadequate or insecure conditions.

Much of the genetic erosion taking place today occurs inside gene banks because of lack of regeneration, poor storage or handling conditions, inadequate funding to ensure proper operation, lack of trained personnel, or managerial inefficiency. Additionally, wars and civil unrest threaten the security of collections.

Field gene banks, often used for perennial species (fruits, cash and plantation crops, and forestry) require large areas and are expensive to operate and difficult to manage because of demanding maintenance requirements. Many tropical crops cannot be stored in regular gene banks and therefore must rely on field gene banks or *in vitro* conservation.

To maintain the genetic integrity of samples and to ensure the security of existing collections, more funding for long-term storage and effective regeneration are urgently required.

• *Documentation and Information Systems*

Much material currently in *ex situ* conservation lacks documentation. No national or regional programme has fully documented all of its material.

Without documentation, much of this material will never be used. Valuable characteristics preserved in gene banks may be unknown to potential users.

Information systems at both national and international levels are currently inadequate and many fail to take full advantage of the opportunities offered by modern computer technology. Information about accessions gathered from farmers and based on their practical experience is often lacking in collections. Considerable data stored in numerous locations but not computerized are essentially unavailable to researchers and gene bank curators.

• *Evaluation and Enhancement*

Many programmes lack the ability or resources to evaluate or enhance the materials they are conserving. This is particularly true with minor crops. The result is incomplete usage of valuable genetic materials.

Evaluation should be carried out in suitable environments where more traits can be assessed. To improve their effectiveness and to improve utilization of PGR, many gene banks may need to take on increased responsibility for PGR enhancement.

• *Exchange*

In some cases the exchange of plant genetic resources remains problematic. Exchange can be hampered by a lack of capacity or resources of gene banks to answer all requests for material. Sometimes government decisions may hamper exchange. The current system cannot solve these problems without addressing a wide range of administrative and political issues.

There is also a critical need for additional quarantine facilities. While seed exchange is vital and valuable, exchange without adequate quarantine precautions could lead to the introduction of new pests and diseases.

On-farm/community conservation. On-farm/community conservation includes aspects of collecting, storage, and regeneration, appropriate documentation and information systems, evaluation, monitoring, research, training, and advocacy. *In situ* conservation of landraces is also emerging as a viable method of PGR conservation. Mutual benefits could be obtained by closer ties between the formal and informal sectors. For example, this could result in training of grass roots conservationists and the development of more efficient conservation systems, storage technologies, breeding methods, etc. The informal sector could also benefit from the careful and coordinated introduction of new genetic materials to expand options for local breeding endeavors. A "Conservation Corps" of young professionals could help provide technical support to community organizations.

Involvement at all levels in the decision-making process within the formal sector would bring benefits to both sectors and possibly enhance the ability of NGOs to utilize the resources of the formal sector, and advocate for improvements and additional support for both sectors.

Community level work is chronically underfunded. Genetic losses could be prevented in these programmes through provision of modest funding tied to specific conservation/utilization objectives.

Other Concerns That Require Special Attention

Monitoring and Early Warning. Genetic erosion is a stealthy process that may often go unnoticed until it is too late. This is often caused by a lack of information about the existing range of genetic diversity, and no timely warning of events that may affect such diversity (introduction of new varieties, crop failure, etc.). Loss of habitats is often not systematically recorded.

Not all genetic erosion can be prevented. However, at present no comprehensive or coordinated system exists which would provide an early warning of impending genetic erosion.

Sustainability. Many developing countries, particularly in South and Southeast Asia, experience high population pressure on land and water. This is also the region where a majority of the world's poor people live. Therefore, accelerated economic development is a must in such countries for meeting the minimum needs of rural and urban families for food, water, clothing, shelter and work. Nearly 70 percent of the population in these countries depend upon crop and animal husbandry, fisheries, forestry and agro-processing for earning their livelihood. Therefore, the gains achieved in agricultural advancement must not be at the expense of basic environmental assets like land, water and biological diversity.

It is in the development of techniques for sustainable advances in productivity that PGR plays a pivotal role. Using the naturally occurring genetic variability for producing new crop strains carrying a wide range of genes from landraces and wild species, it is possible to reduce the use of chemical pesticides and fertilizers.

Plant breeding for sustainable agriculture will need special genetic enhancement centres to create novel genetic combinations for distribution to local breeders, including farmers groups.

Research.

A better scientific understanding is required to solve the problems that hamper PGR conservation. This can only be achieved by an intensification of integrated and systematic research on technical and socioeconomic aspects of PRG conservation.

More research will also be necessary to reduce costs and achieve greater managerial efficiency in the establishment and maintenance of *in situ* and *ex situ* collections. Research is also required on techniques involved in assessing genetic variation, maintaining genetic integrity during seed regeneration, all aspects of gene bank management, novel storage techniques, pathology, seed health and quarantine, among others. To ensure wider use of genetic diversity, gene banks should increasingly become involved in the enhancement of plant genetic resources. Research is needed to demonstrate and make more effective the essential role of PGR in achieving sustainable agriculture. Special research effort should be directed at on-farm/community conservation and utilization.

Training.

An expanded and more effective gene bank system will require additional and better trained staff to implement PGR research and conservation.

Core segments should be included in the curricula of formal undergraduate and postgraduate courses, with provision for specialization. There is also a need for more in-service training at research institutions for researchers, technicians, students, and farmers. To involve the informal sector more effectively, special training efforts are needed in: on-farm techniques; on-farm conservation; land use management; vegetative propagation; communication; and other skills.

Public Education and Awareness.

The long-term commitment of substantial financial resources to PGR conservation will require the widespread understanding and support of the public, governmental, and private sectors.

Enlisting support from these diverse elements of society will require a well-orchestrated programme of information and communication concerning the activities, issues, and successes of the plant genetic resources community.

Although there have been substantial efforts to produce and catalog technical information concerning plant genetic resources for the scientific community, clear and concise presentation materials for policymakers and for educational programmes have been rare or produced on limited funds largely by the NGO community.

A multifaceted awareness programme, directed at appropriate audiences, is a necessary and critical component of a Global Plant Genetic Resources Initiative. The objectives should be to attract more interest in PGR management as a career, to educate policymakers, to enlist the support of specialized groups within the public sector, and to heighten general public awareness.

Generation of public awareness of PGR and its importance for food and livelihood security should be given a very high priority in the action programme.

Magnitude of the Funding Requirements to Meet the Needs

Introduction

The participants of the Keystone Dialogue, representing programmes at all levels, used their collective experience and judgement in determining the funding needed to strengthen and sustain conservation and utilization of PGR. The proposed levels of additional fund-

Vavilov Centers of Plant Genetic Diversity

Areas of the World Where Food Crops Originated, and Where the Genetic Diversity of Those Crops Is Greatest

1. **Ethiopia**
   barley, coffee, sorghum
2. **Mediterranean**
   oats, olives, wheat
3. **Asia Minor**
   barley, lentil, oats, wheat
4. **Central Asia**
   apple, chickpeas, lentil
5. **Indo-Burma**
   eggplant, rice, yam
6. **Indo-Malaya**
   banana, coconut, sugar cane
7. **China**
   sorghum, millet, soybean
8. **Central America**
   bean, corn tomato
9. **Peru-Ecuador-Bolivia**
   bean, potato, squash
10. **Southern Chile**
    potato
11. **Brazil-Paraguay**
    peanut
12. **North America**
    sunflower
13. **West Africa**
    millet, sorghum
14. **Northern Europe**
    oats, rye

ing were developed by the Dialogue group to provide a sense of the magnitude of funding needs. The funding estimates outlined below were based on the best information available to the Dialogue group at the 31 May-4 June, 1991 Oslo Plenary session. These estimates are conservative and will require more detailed analysis. However, we are confident that the order of magnitude is realistic and indicative of real and urgent needs.

In calculating the needs for additional funding, certain assumptions were made. Central to a global activity are national programmes. Each country requires genetic variation in support of ongoing breeding programmes (working collections). This would seem to fall within the na-

tional responsibility. Additional funding would then be allocated on the basis of the importance of PGR found in the country beyond those short-term needs.

Consequently, major recipients would be located in the recognized centres of diversity. (See map on following page.) A national programme generally includes both a formal gene bank and community level activities. No attempt is made to separate the two in terms of funding as that would probably differ by country.

Most major industrialized countries fall outside centres of diversity and for that reason would not qualify as major recipients of funding. However, there is a question as to whether the level of economic wealth of a country should be taken into account. The concept of contributors of funds and contributors of germplasm may follow a general pattern now, but may do so less in the future as countries develop. Also, information, enhanced materials, and technology may become increasingly important as in-kind contributions to a global system, and may have to be taken into account. In addition, the roles and responsibilities of various elements of the global system will be evolving, as discussed elsewhere in this report. Many of these matters have not yet been resolved. Hence, financial requirements have been estimated only for the period 1993-2000. It is assumed that beyond that period the results of UNCED 1992 will have become operational and available funding determined, on the basis of in-depth analyses of the real needs.

Components Requiring Funding

All funding estimates discussed below are presented as percentages of available funds, which the Dialogue group believes should total US $300 million per annum (1991 US dollars) in the 1993-2000 period.

Present holdings of PGR, as documented in the IBPGR Database on *ex situ* conservation, number approximately 3.5 million accessions of which 50 percent are known to be stored under long- and medium-term conditions (i.e., at -10 to -20 degrees Celcius).

National Programmes. In calculating financial requirements to collect, store, maintain, and document a reasonable sample of still existing PGR diversity or seed in cold storage, a number of assumptions are made.

- Only part of the present day holdings are unique samples (probably less than 50 percent).
- All unique samples have to be stored in at least two gene banks.
- The number of unnecessary replicated samples over those in gene banks will approximately be balanced by additional samples still to be collected, and therefore the total number of accessions in collections will not exceed 4 million.
- The capital expenditure for adequate gene bank facilities is approximately $75 per sample.
- The cost of storage, maintenance, and documentation per sample is estimated to be on the order of $50 per sample, based on current costs of a number of gene bank programmes.

To conserve the total estimated world collection of 4 million unique samples at $50 per sample requires $200 million. Current expenditure is estimated at $75 million. Hence the added financial requirement per annum should be 43 percent of the Fund.

Field Gene Banks and In vitro Collection. A sizeable number of crops cannot be stored long term in cold storage. This includes vegetatively propagated crops, many tree species, and species with seeds that lose their viability rapidly under conventional storage conditions. These species have to be maintained in field collections and/or *in vitro* collections (tissue culture). At present, approximately 150,000 accessions are stored under these conditions with an estimated 2,000 accessions in *in vitro* collections. It is estimated that 10 percent of total future holdings will be in field gene bank collections.

It is difficult to provide a reliable estimate of the possible cost of a total world collection of such crops. However, the additional financial requirements for expanded collections is unlikely to be less than 6 percent of the Fund.

On-Farm Conservation. Current recorded expenditure for stimulating and facilitating on-farm and community conservation through NGOs is

Total Costs per Annum

National Programmes	43%
Field Gene Banks	6%
On-farm Conservation	6%
Supporting Activities	10%
Research	17%
Training	4%
Public Education & Awareness	8%
Subtotal	94%
Capital Investment/Annum from 1993-2000	6%
Total*	**100%**

estimated to be on the order of $7 million. A substantial increase would seem reasonable in view of expanding programmes in this area: 6 percent of the Fund should be allocated toward this end.

In Situ Conservation. It is assumed that *in situ* conservation of PGR will be an integral part of overall biodiversity conservation. To insure adequate conservation requires a number of activities including eco-geographical surveys, monitoring of important habitats, etc. These costs are included in the financial requirements for research.

Supporting Activities. Coordination and stimulation of the international system (FAO, IBPGR, networks, etc.) as well as an adequate intergovernmental implementation structure of the kind discussed below may require an additional amount equal to 10 percent of the Fund.

Research. Rationalization and provision for PGR conservation with an appropriate knowledge base may require 17 percent of the Fund.

Training. Provision of enough skilled personnel to execute various activities on plant genetic resources may require 4 percent of the Fund.

Public Education and Awareness. Generation of public awareness of PGR and their importance so that long-term conservation is secured may require 8 percent of the Fund.

Capital Investments. Of the current holdings approximately two million samples are stored in long-term or medium-term storage facilities. Hence, there is a need to build new gene banks or expand present facilities for another two million samples at $75 per sample. The total capital expenditure required therefore is 6 percent of the Fund.

The suggested annual additional funding requirement of $300 million may seem a large sum. It is an approximately four-fold increase in global funding of PGR conservation over current levels. Considering the present state of inadequacy of the current system, that would not seem excessive. The total annual global seed value at market prices was estimated to be $50 billion in the mid-1980s. Of this, $18 billion was from farmer-saved seed, the public sector contributed $17 billion, and the private sector $15 billion. Assuming that these figures are realistic, $300 million represents no more than 0.6 percent of that total value. If estimated in terms of global agricultural output, $300 million represents less than 0.002 percent.

An organizational structure is required to manage the fund. Specific recommendations are made in the section on Institutional Structures and Implementation Mechanisms. However, it should be clear that in addition, strong technical support is needed to: develop strategies and action programmes; coordinate activities within regions in all aspects of collection management and utilization; provide training; assist in institution building; stimulate community involvement; and so on. Many of these activities are presently carried out on a limited scale by the IBPGR. An expanded and institutionally reorganized IBPGR and appropriate regional and national gene banks might be considered for providing the necessary institutional support. It should have the confidence of the international PGR community and at the same time be accepted in the political arena.

It is clear that a build up of facilities and the development of human resources will determine the needs and the ability to utilize funds. For this period, a minimum total allocation of approximately $1.5 billion will be needed to lead into the 21st century. This figure probably represents the amount which can be efficiently expended in the seven year 1993-2000 period.

During the period 1993-2000 much will be learned regarding additional needs and the associated levels of funding required as we enter the 21st century, and the funding estimates above will need revision.

Institutional Structures and Implementation Mechanisms

Introduction and Guiding Principles

The Global PGR Initiative that is proposed here should be structured in such a way that it can contribute to the development of "Agenda 21" for the UNCED. It can then be implemented by national governments and the international community for the initial period of 1993-2000, and on into the 21st century. It incorporates specific objectives and targets, principal institutional responsibilities, and costs.

The Initiative is intended to be a joint effort by all governments of the world and by all organizations who are concerned with the conservation and utilization of plant genetic resources, including those who are contributors of germplasm, information, funds, systems of innovation, and technology.

The major tasks to be addressed under this Initiative include the development of policies and strategies for collecting, conserving, evaluating, and utilizing PGR for promoting sustainable global food security as well as the livelihood security of rural communities. The activities should include: support for research; institutional and human capacity building; field operations; genetic evaluation and enhancement; exchange of germplasm; adaptation to environmental changes; and communication, information dissemination, and training.

In developing an effective implementation mechanism for the Global PGR Initiative, the following five broad considerations have been kept in view.

- No new PGR superstructures should be created;
- Optimum use should be made of existing institutions and organizational structures for implementing the programme, filling critical gaps where essential;
- Adequate emphasis should be placed on confidence and consensus-building and better working arrangements;
- Improved convergence and synergy should be generated among the diverse agencies working in the area; and
- A high level of technical and scientific integrity and social equity should be maintained in PGR activities.

Thus, the proposed Global PGR Initiative integrates principles of ecological sustainability, economic efficiency, intra- and inter-generational equity and broad and diverse participation. To make the Initiative an operational reality institutional and implementation mechanisms need to be addressed at the following four levels:

- Community
- Country
- Regional, Intercountry, and
- Global

Our recommendations with reference to these levels of activity are presented below.

Community Level

It is at the level of local farm communities, particularly in developing *countries*, that continuous improvement and preservation of PGR takes place through informal innovation mechanisms. Informal conservers are involved in practical field work. Such work needs to be recognized, rewarded, and strengthened.

It is estimated that specific work is underway in at least 35 countries and that the annual dollar commitment to this work for established nongovernmental organizations exceeds $7 million, a sum roughly equal to the annual budget of IBPGR. The total value of all such activities at the community level significantly exceeds even this amount.

It is, therefore, important to find mechanisms that will allow the participation of the informal

community system in the formulation and execution of a full programme of action from the global to the national level. It would be helpful to prepare a database of informal conservation groups, as best they are known, throughout the world. The Dialogue group notes that FAO is undertaking such a task. Also, there exists a network of NGOs that work directly with local communities. These organizations are legal entities with administrative capabilities and they are fully accountable to their national governments.

A wider network of regional organizations dedicated to sustainable agriculture including PGR conservation, have emerged in recent years. Such "multinational" regional NGOs as the Latin American Consortium for Agroecological Development (CLADES), Southeast Asian Regional Institute for Community Education (SEARICE), Environment and Development Association (ENDA), and Seeds of Survival in Africa also have legal identities and complete administrative accountability. Through these and other networks, it is possible to engage the informal community conservation effort in the planning and implementation of global PGR work.

The linkage between the formal and informal innovation systems in plant breeding is a continuous and dynamic one. For strengthening the role of local communities in the conservation and improvement of landraces, it will be desirable that agricultural universities, research institutes, and extension agencies provide training and technical support to farmers' associations and communities and undertake participatory research with them. As discussed above, a Conservation Corps of young professionals should be established to help provide technical support to community organizations.

National Level

National efforts and commitment are critical for the success of PGR conservation and utilization programmes. While international programmes can supplement and strengthen national efforts, they cannot substitute for them. Therefore, there is need for an apex level body to stimulate and support PGR work in every country.

Such a body could provide the necessary policy and political oversight and help to mobilize and administer funds. The tasks to be accomplished include: scientific research; technical advice; project evaluation and monitoring; education; information; communication; germplasm exchange and conservation; quarantine arrangements; review of legal and regulatory mechanisms; human and institutional capacity building, and coordination of community, national, and international efforts. Such an apex level body can develop an early warning system, identify hot spot locations requiring priority attention, and establish *ex situ* seed storage facilities.

The apex level body, which can be in the form of a National PGR Board or Commission, should be linked to the most appropriate ministry/government department. This will normally be the Ministry of Agriculture. Although its precise structure can vary from country to country depending on the tasks to be performed, such a body should have the administrative authority and fiscal autonomy essential for it to be able to discharge its duties effectively, economically, and expeditiously. It should be an empowered body capable of allocating funds within the limits prescribed by the concerned government for PGR activities. To be purposeful, it should be a decision-making body and not just a debating or recommending body. It should undertake periodic reviews and evaluations of national PGR programmes.

While implementation structures may vary, the aim in all countries should be to have an effective mechanism for sustainable support to the Global PGR Initiative. In Norway, for example, a National Committee on Sustainable Development under the chairmanship of the Prime Minister has been created. It has representatives from industry, the research community, policy makers, and NGOs. In such cases, the empowered committee on PGR could report to the National Committee on Sustainable Development.

A priority task for a National PGR Board/Commission will be the finalization of a national strategy and programme of work for the period 1993-2000. The Board/Commission should also undertake the task of compiling an inventory of the PGR heritage of the country.

It can periodically publish or encourage the publishing of a report on the state of PGR in the country.

The national plan of action for "Agenda 21" for the period 1993-2000 should be prioritized and costed. The concerned government department/ministry should mobilize sufficient financial and technical resources from national, bilateral, and multilateral sources for ensuring the successful implementation of the programme.

It could also issue from time to time early warning on potential losses of PGR and undertake timely action to secure precious collections. For example, the civil strife in Ethiopia could be a potential danger to the unique germplasm collection of over 50,000 accessions maintained in the Ethiopian Gene Bank. The security of existing collections and eliminating threats to the already protected areas need urgent attention. Saving endangered species listed in publications, normally referred to as Red Data books, should be a priority task. The national body should promote linkages between *ex situ* and *in situ* conservation programmes and stimulate research on economical and effective methods of conservation.

The composition of the Board/Commission/Committee should be such that all the principal stakeholders are represented. This will include representatives of government departments, private and public sector plant breeding companies, professional PGR experts, social scientists, and representatives of non-governmental and farmers' organizations. Such a body should have strong leadership and should be in a position to attract and retain as its members men and women who are committed to the cause of PGR conservation and sustainable utilization.

Regional and Intercountry Collaboration

Centres of genetic diversity do not respect political boundaries and are often shared by more than one country. Existence in most continents of political and/or economic integration systems and organizations and financial regional development banks (Asian, African, Inter-American) provide an environment conducive to regional cooperation. Regional professional associations and regional research institutes (e.g., Centro Agronomico Tropical de Investigaciones y Ensenanza (CATIE)) also offer umbrellas for cooperation.

Regional cooperation in various PGR activities, such as joint collecting, characterization, evaluation, documentation, research, training, and quarantine arrangements, may prove more relevant socially and culturally, and more cost effective. However, any regional cooperation must be firmly based on strong national programmes. There are opportunities for division of labor and distribution of tasks among collaborating countries and emergence of one or more lead centres for one or more crops. Joint activities in a task, such as germplasm evaluation, involve sharing scarce human resources, equipment, and collective use of advanced techniques and specialized facilities.

Examples of regional cooperation exist on all continents. These include: the Nordic Gene Bank; the Andean Crop Network; the industry supported Latin American Maize Project (LAMP); the Southern African Development Coordination Conference (SADCC) Gene Bank; Southeast Asian Regional Committee on Plant Genetic Resources; the European Cooperative Programme on Genetic Resources (ECP/GR); the Mediterranean Gene Bank in Italy; and crop research networks of the IARCs. An international network of N.I. Vavilov Research and Training Centres for the Sustainable Management of PGR and Biological Diversity, as proposed by M.S. Swaminathan, is currently under development. The network will concentrate on regional training programmes and on participatory research with rural communities.

Crop research networks should be expanded in all regions since they provide effective linkages between conservation and utilization. They help to foster cooperation between national systems and organizations such as the Botanic Gardens Conservation Secretariat (BGCS), International Union for the Conservation of Nature and Natural Resources (IUCN), World Wide Fund for Nature (WWF), and other specialist bodies and organizations. The IBPGR is also involved in

helping to establish such networks. All of these organizations should be encouraged to support the regional PGR networks through joint projects, training facilities, and technical advice.

Regional PGR Advisory Committees consisting of the chairpersons of the national committees of the countries participating in the regional programme would be valuable. United Nations programmes such as Technical Cooperation among Developing Countries (TDCC) and Economic Cooperation among Developing Countries (ECDC) should be used effectively. Priority in regional collaboration should go to threatened ecosystems such as mountain and coastal ecosystems.

Global Level

Any global mechanism designed to promote political and policy oversight, mobilization and distribution of funds, and implementation of well-defined tasks should fulfill the following basic criteria:

- It should have the confidence of all countries which are important repositories of PGR;
- It should inspire support from contributors of germplasm, information, funds, and technology; and
- It should be capable of ensuring effective, economical and timely implementation of approved programmes.

For achieving the above tasks we feel that four major instruments will be needed. These are:

- An **Intergovernmental Council** (IGC), based on the principle of one country, one vote, to discuss and decide on policies and priorities, and approve a biannual plan of action, programme of work, and budget.The IGC will include **Associate Members** to ensure inputs from the broader PGR community;
- An **Executive Board** (EB) of the IGC that is authorized to take action on the implementation of the priorities specified in an approved plan of action;
- A **Scientific and Technical Advisory Committee** (STAC) of independent professionals to provide the necessary scientific and technical advice and support to both IGC and its EB; and
- A **PGR Trust Fund** operated as a special trust fund through a designated fiduciary agency.
- Our recommendations concerning these instruments are found below and are depicted in Figure One on the facing page.

Intergovernmental Council (IGC).

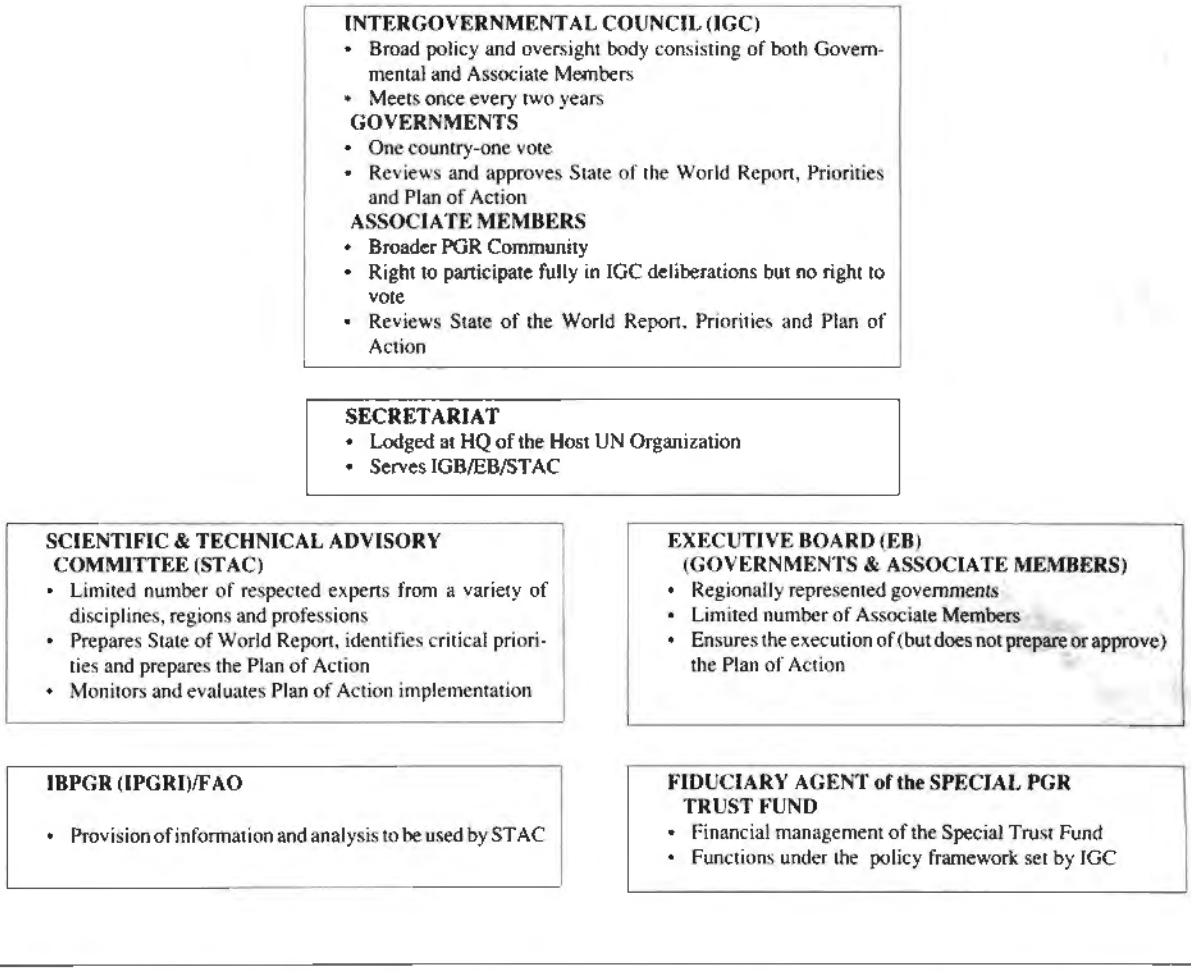
We recommend that the Global PGR Initiative be implemented under the legal authority and oversight of an intergovernmental United Nations body in which all the countries of the world can be represented, operating on the principle of one country, one vote. We also recommend that the competence of this body be enhanced through the creation of a mechanism that can ensure the participation of national government representatives who are knowledgeable about PGR matters in all their dimensions.

The IGC, however, should have a category of **Associate Members** who are entitled to participate fully in the deliberations of IGC but without the right to vote. As noted above, decisions requiring a formal vote will be on the basis of one country, one vote.

The Associate Members of IGC should represent the major groups of organizations involved in PGR activities. This could include the following:

- Specialized agencies of the UN such as FAO, UNEP, UNESCO, UNDP, IAEA, WHO, United Nations Industrial Development Organization (UNIDO), WMO and WIPO, and other intergovernmental organizations like UPOV;
- International and regional development banks, such as the World Bank, Inter-American Development Bank, African Development Bank, and Asian Development Bank;
- International professional organizations like CGIAR, IBPGR, IUCN, and CABI;
- Nongovernmental organizations like World Wide Fund for Nature (WWF), Rural Advancement Foundation International

Figure One
Proposed Structure for the Global PGR Initiative



(RAFI), and Genetic Resources Action International (GRAIN);

- Industry and the corporate sector represented through the Federation Internationale du Commerce des Semences (FIS) and the International Association of Plant Breeders for the Protection of Plant Varieties (ASSENSEL);
- Philanthropic foundations making substantial contributions to PGR activities; and
- Academia, including the Presidents of European Association for Research on Plant Breeding (EUCARPIA), Society for the Advancement of Breeding Researchers in Asia and Indonesia (SABRAO), Latin American Plant Breeding Association, Crop Science Society of North America, African Academy of Sciences, and International Union of Forestry Research Organizations (IUFRO).

IGC should elect a chairperson from its governmental delegates who is known for their PGR expertise for a term of four years. It should meet at least once every two years to perform the following tasks:

- Consider and approve the biannual Plan of Action which will include a programme of work and budget to be financed by the PGR Trust Fund;
- Develop policies and priorities for the effective implementation of the approved Plan of Action;
- Examine and approve for wide dissemination a State of the World Report on the Status of the Security and Sustainable Use of PGR;

- Review legal and regulatory mechanisms relating to PGR conservation and utilization; and
- Review arrangements for sharing the benefits of PGR systems with particular reference to economically and ecologically underprivileged farm families.

Associate Members representing the broader PGR community will provide their inputs for decision-making on all items on the agenda of the IGC. However, they will not participate in formal voting when this becomes necessary. Associate Members may also meet separately before IGC meetings or periodically to formulate their views on PGR matters to be considered by the IGC.

Executive Board (EB).

In order to ensure timely and effective implementation of the approved Plan of Action, the IGC should constitute an Executive Board with representatives from both its member governments and the Associate Membership. Such a board should have the authority to make decisions in between IGC meetings on matters delegated to it by the IGC.

The Chairperson of the IGC will also chair the EB in order to foster linkages between the two bodies. The composition of the EB could be as follows:

- Representatives of national governments from different regions of the world elected according to the standard UN formula (seven representatives);
- Representatives of UN agencies such as the FAO, UNEP, UNDP, UNESCO, and WIPO (five representatives);
- International organizations such as the IBPGR and IUCN (two representatives);
- International and regional development banks such as the IBRD, African Development Bank, Asian Development Bank, Inter-American Development Bank (four representatives);
- Non-governmental organizations (two representatives);
- Industry and the corporate sector possibly through FIS and ASSENSEL (two representatives);
- Philanthropic foundations actively engaged in supporting PGR work (two representatives); and
- PGR academic and scientific community (five representatives).

Scientific and Technical Advisory Committee (STAC).

The effectiveness and success of both the IGC and its EB will depend upon access to the best possible scientific, technical, and professional advice and help. The STAC should therefore include in its membership high-level professional PGR experts, plant breeders and biotechnologists, social anthropologists and geographers, agricultural economists, scientists from the private sector, and farmers.

STAC should undertake such functions as may be assigned to it by IGC/EB from time to time including:

- Prepare a State of the World Report in relation to PGR once every three years that should highlight priorities for new action and critical gaps in ongoing work;
- Prepare a Plan of Action that includes a biannual programme of work and budget and, at the outset, for the "Agenda 21" period 1993-2000 along the lines agreed to at the 1992 UNCED;
- On a biannual basis, review proposals submitted by national governments and recommend priorities and the amount of financial resources to be provided from, among other sources, the PGR Trust Fund;
- Review proposals received from nongovernmental organizations and farmers' associations and recommend needed financial and technical support;
- Review ongoing efforts in PGR conservation, evaluation, enhancement, and exchange and recommend suitable international, regional, and national training programmes;
- Undertake monitoring of gene availability and flow; and

- Promote anticipatory research in the areas related to adaptation to climatic and sea-level changes.

In order to accomplish these functions, the STAC should draw upon the expertise and staff resources of the IBPGR and FAO in particular, as well as other organizations as necessary and appropriate.

STAC may meet three times a year and may set up both standing and ad hoc work groups. It may sponsor from time to time regional and international consultations. The STAC should be comprised initially of 15 members. The Director General of IBPGR (IPGRI) should be invited to serve as a member of the STAC in an ex-officio capacity in order to establish symbiotic linkages between the STAC and IBPGR (IPGRI).

Members of STAC should be selected carefully in order to enable the PGR system to derive maximum benefit from a broad spectrum of experience and expertise. STAC members may serve a term of five years and a suitable rotation system should be developed.

The members of STAC could be identified by a two-step process. A Search Committee could be constituted by the Chairperson of IGC. This committee could consider names recommended by national governments, professional bodies, industry, and NGOs and recommend suitable names to an Appointment Committee that would consist of the representatives of national governments elected to serve on EB. The Chairperson of STAC should be one known internationally for her/his contributions to PGR work. STAC members should not be eligible to serve on the EB or as governmental or Associate Members of the IGC. The Chairperson of STAC should be invited to attend meetings of EB and IGC to present STAC's recommendations.

The Secretariat.

For the sake of cohesion, economy, and efficiency, the Secretariat for the entire initiative should rest at the headquarters of the intergovernmental body and should service the work of that body as well as the EB and STAC.The Secretariat should be headed by an Executive Secretary of sufficient stature to be able to deal effectively with national governments and the global PGR system.

Location of IGC, EB, STAC, and the Secretariat.

In order to bring into existence a global PGR system of the kind outlined above we believe that the location of the IGC/EB/STAC and Secretariat should be conducive to the autonomous and effective functioning of the system. We consider the operational autonomy of this organizational structure to be essential for ensuring the successful implementation of the proposed Global PGR Initiative which is of critical importance for sustaining global food security and agrarian prosperity in the 21st century and beyond. We are also firmly convinced that whatever location is found to be suitable, the world community *must act* swiftly to put the proposed structure in place so that the critically important work of PGR conservation and sustainable utilization can proceed.

Keeping these objectives in mind, we considered possible locations using the following criteria. It must:

- be an intergovernmental forum open to any state;
- operate on the principle of one country, one vote;
- be involved in PGR utilization;
- recognize and involve nongovernmental groups;
- participate in the global PGR systems;
- possess adequate fiduciary capacity; and
- inspire confidence in its financial and overall management capabilities.

In light of these criteria, the Dialogue group discussed past and current activities of existing institutions and organizations and the international legal context (see above).

We concluded that at present there does not exist any ideal organization that completely fulfills all of these criteria. However, we identified the following options:

- Considering its long time experience and involvement in PGR matters, and the development of its Global System on the Conservation and Utilization of PGR that includes an intergovernmental Commission and an International Undertaking on PGR, FAO is a logical location if within its constitution and policies it will be possible to establish an operationally autonomous IGC/EB/STAC structure for the PGR Initiative. This possibility could be appropriately considered by the FAO Conference due to meet in November 1991.
- The ongoing intergovernmental discussion on the formulation of a framework convention for biological diversity under the auspices of UNEP might lead to institutional structures for the conservation and sustainable management of biological diversity. Conservation of biological diversity involves an integrated approach to *in situ* and *ex situ* methods of protecting the global biological wealth. The *ex situ* components of such an initiative will deal largely with PGR. PGR, however, requires special and specific consideration because of its direct linkages with food security and rural prosperity, particularly in developing countries. Therefore, the institutional structure and funding mechanism provided for the international biological diversity convention could incorporate a designated component for the PGR Initiative proposed by us. If this happens the administration of the PGR Initiative could be on the EB/STAC model, with the policy guidelines being provided by the same intergovernmental structure which may be created to provide political oversight to the Biodiversity Convention.
- We understand that the UNCED Preparatory Committee will be considering institutional structures essential for the effective implementation of the programmes for inclusion in "Agenda 21." The Preparatory Committee could also examine the recommendations made by us for the PGR Initiative with the view to identifying the most appropriate and cost effective institutional mechanism.
- Recognizing the obstacles that a non-UN organization would have in meeting our criterium of an intergovernmental body that operates on the principle of one country, one vote, the CGIAR may become a suitable location for the Global PGR Initiative if it is able to develop a policy-making structure along the organizational lines of the IGC/EB/STAC, possibly by linking the CGIAR to a relevant UN intergovernmental body for the purposes of this Global PGR Initiative.

PGR Trust Fund and the Fiduciary Agency.

The Global Initiative for the Security and Sustainable Use of PGR requires a global financial facility to support critical programmes and projects with designated expenditures at the global, regional, national, and community levels. We firmly believe that it is in the interest of all nations, both industrialized and developing, to conserve and enhance the world's plant genetic resources. Much of the world's PGR exists in developing nations, while new gene combinations arising from the breeding programmes of developed countries may be of value in developing countries.

Thus, it is clearly in the interest of all countries to actively participate in this Global PGR Initiative regardless of any temporary limitations or differences in ways to effect exchange.

To accomplish the Global PGR Initiative's purpose, financial contributions are a vital element in combination with contributions of germplasm, information, technology, and systems. Therefore, we wish to reaffirm our conclusion from the earlier Dialogues in this Series that a PGR Trust Fund will require contributions from all nations in order to make the Initiative viable and actively supported by the holders of all of the critical resources that comprise the Initiative.

Earlier in this report we have emphasized that a minimum of $1.5 billion of additional funds will be needed during 1993-2000 to promote the critical mass of effort essential for safeguarding PGR for current and future use. As was noted in previous Dialogue reports, we are concerned that the PGR Trust Fund should be established on a sus-

tainable basis and that it draw upon new money, that is, it should not be taken from existing development assistance budgets and not be subject to erratic or unreasonable fluctuations. The proposed PGR Trust Fund is not, however, in any way intended to substitute for the continuation of bilateral and multilateral arrangements either already in operation or contemplated for the future.

We believe that an existing intergovernmental agency should be requested to act as the fiduciary agent for the disposition of funds for the Initiative as per the policies and priorities established by the IGC.

We are aware that suitable mechanisms may emerge for raising the necessary resources for implementing "Agenda 21" through the UNCED process. We will therefore leave it to the UNCED process to decide the most effective method of mobilizing the resources essential for the implementation of the PGR Initiative as a vital and integral part of "Agenda 21."

Implementation. As mentioned earlier, the aim of this Initiative is to optimize the benefits from existing institutions and organizations by helping them to overcome major constraints and gaps in ongoing efforts. Therefore, the active participation and help of the following agencies will be sought in carrying out the Plan of Action:

- National PGR Systems where much of the implementation will take place;
- International and Regional PGR Systems, including IBPGR, International Agricultural Research Centres (IARCs), and other appropriate organizations/institutions;
- Global and regional networks;
- Nongovernmental organizations and farmers' associations; and
- Private and public sector plant breeding industry.

We are confident that the four major instruments recommended above—the Intergovernmental Council, the Executive Board, the STAC, and the PGR Trust Fund—will help to foster the growth of a PGR system ranging from the village to the global level, capable of ensuring the security of PGR and its effective and equitable utilization.

The implementation of a programme of this technical complexity and financial dimension will require excellent institutional backup. For this purpose it will be necessary to organize a consortium of international, regional, and national institutions to assist in servicing the research, training, communication, conservation, and monitoring networks. IBPGR and FAO can play important roles in assisting such a PGR consortium.

Call for Immediate Action

In establishing this new Global PGR Initiative, we are, for the first time, creating the basis for a general cooperative venture based on mutual benefit. We have every reason to believe that the Global PGR Initiative, taken as a whole, will inevitably create a new environment of trust and exchange. We also bear in mind that the purpose of the Global PGR Initiative is to act now to ensure conservation and use forever.

We recognize that it may take some time for the Global PGR Initiative on the lines developed by the Dialogue group to become operational. Meanwhile, the tasks needing attention and financial support are urgent. Every day's delay in pursuing the programme of action that we have recommended may result in a considerable loss of genetic variability in plants of current and potential use. We, therefore, recommend that the following priority programmes be initiated during 1991-1993:

- Implement emergency attention to the security of PGR collections in countries like those in Eastern Europe and Ethiopia;Strengthen arrangements for the preservation, and security of PGR at national and community levels;
- Develop a special PGR collection, evaluation, preservation and enhancement programme directly related to the promotion of sustainable advances in crop productivity.Such a programme could include collections of nitrogen fixing species, species

containing natural pesticides, microorganisms that enhance plant nutrition and fertilizer efficiency, species of value in agroforestry, and species useful in the prevention of soil erosion.

- Develop a global network of genetic conservation centres of tree species, shrubs, and annual plants directly relevant to adaptation to potential changes in temperature, precipitation, sea levels, and ultraviolet radiation.

The above programmes may be suitable for funding under the Global Environment Facility (GEF) in view of the high priority accorded by GEF to the protection of biological diversity. We suggest that a suitable project proposal may be prepared and submitted for consideration for support under GEF by a small project preparation group organized under the auspices of IBPGR and FAO. We estimate that this priority programme may need an investment on the order of $100 million.

APPENDIX A

Plant Breeders' Rights and Patents: A Brief Description of the Systems

The participants in the Keystone Dialogue felt that in the discussions on the implications of intellectual property systems on agricultural production and the conservation and use of plant genetic resources, there is often an incomplete understanding of how PBR and patents function. Therefore, a description of these systems is included below to help provide clarity and understanding for the discussions in the text of the report.

Plant Variety Protection

Plant Variety Protection (PVP) is a specific system of protection for plant varieties. It has analogies to patents, but also important differences. Rights are granted for a limited period of time (typically 20 years) to the breeder of the specific unit of plant material that constitutes a plant variety. In contrast to rights granted under patent systems, the breeder of a protected plant variety cannot seek exclusive rights in a unique feature of her/his variety. The breeder of the first blue rose cannot monopolize blueness. It is open to all other breeders to breed and protect blue roses which are distinct from the first such variety.

A protected variety must be new and distinct, uniform, and stable. "New" means that the variety must not previously have been exploited commercially. "Distinct" requires it to be clearly distinguishable from all other varieties known at the date of the application for protection. "Uniform" means that all plants of the variety are sufficiently uniform in light of the method of reproduction of the species. "Stable" means that the variety can be reproduced unchanged.

Under the existing International Union for the Protection of New Varieties Convention (UPOV), the holder of Plant Variety Protection can prevent others from producing propagating material of the variety, and can prevent others from marketing such material. Under the 1991 revision of the Convention (not yet in force), the Breeders' Right has been further extended to harvested material produced from propagating material whose use was not authorized by the breeder, unless the breeder has had reasonable opportunity to exercise his right in relation to the propagating material. The Breeders' Right, under the revised Convention, could be used to restrict the import of harvested material resulting from the unlimited use of propagated material of his variety.

The breeder's permission is also required, under the existing UPOV Convention, for the repeated use of the variety in question as a parent line to produce, for example, an F1 hybrid, and under the 1991 provision, for the exploitation of any variety which is essentially derived from the protected variety. A variety is considered *to be* essentially derived for this purpose when it is derived from the protected variety and retains virtually the entire genetic structure of the protected variety.

Any protected plant variety can be freely used as a plant genetic resource for the purpose of breeding other varieties. Under the existing Convention, the Breeders' Right does not extend to the re-use on a farm of seed from the previous harvest although countries are free to extend the Breeders' Right if they chose to. The revised Convention provides that, "within reasonable limits and subject to the safeguarding of the legitimate interests of the breeders," states may restrict the Breeders' Rights.

Under the existing Convention, countries are required not to grant patents for species for which Plant Breeders' Rights protection is available (ban on double protection). There is no such provision in the revised Convention. UPOV member states accordingly can offer patents as an optional alternative to Plant Breeders' Rights for plant varieties or to accumulate PBR and a patent for the same variety.

Patents

A patent gives certain exclusive rights to the

owner of an invention for a limited period (generally 20 years). Essentially, it is a right to forbid commercial exploitation of the invention by others in the country where the patent is granted. Before a patent can be issued, specific conditions must be met, including all of the following:

1. The invention must be new.
2. It must be inventive (i.e., not obvious; represent a real advance that might not have been reached without the creative insight of the inventor).
3. It must be disclosed in a way which enables the skilled public to reproduce it.
4. The scope of protection granted must be in proportion to the invention.

These four conditions are the fundamental basis of all patent systems. The intention is to balance a temporary exclusivity for the inventor with the interest of society in having the invention disclosed and possibly used. Economists argue whether the system is a success, but few suggest that these conditions should be relaxed. Unless they are met, the balance is tipped too far toward the patentee and against society. Unfortunately, not all patents fully meet these conditions. Those that do not are aberrant. Either they have been granted in error or the legal system which granted them needs amendment.

The application of these four conditions can vary to some extent in different countries. Thus some countries consider as new anything which is not known locally (though the trend is to take note of whatever is known anywhere in the world). Also, what is "obvious" can be a matter of fine judgement. But these four conditions are universal in some form.

There is one further condition that an invention has to meet:

5. It must relate to a technology where patents are permitted.

Most variation in patenting systems is found under this condition, regarding the scope of "patentable subject matter." Usually the invention must be "capable of industrial application": for example, an industrial process or product, and not merely an idea, discovery, artistic work, or business scheme. Various countries have taken different views, at different times, as to what is sensible for patent coverage. As explained in the report, these views vary with the socioeconomic situation and the state of the technology in each country. Food, drugs, and agriculture have at various times and places been excluded, in developed as well as developing countries. The United Kingdom did not allow patenting of new chemical compounds before 1949; Germany and Japan had the same prohibition until even more recently. Today, most developing countries do not allow patents on pharmaceuticals and some prohibit patents on agricultural innovations. Policies vary; each country has the responsibility to decide what suits it best.

Whether living things can (or should) be "patentable subject matter" is highly controversial. Few, if any, systems have a formal prohibition on patenting living matter as such. This is not to say that it is widely permitted. For many years it simply was assumed that patenting living organisms was impossible because by their very nature they could not meet the essential conditions of patentability. Thus, no formal prohibition was needed because the question did not arise. The question did not become real until two developments took place: one in patent law and one in science. In patent law, the custom grew of allowing patent disclosures to be supplemented by deposits of living material (generally microorganisms). This allowed criterion Three (above) to be more easily met. In science, the growth of molecular biology offered the power to increasingly modify living things, and hence to meet criterion One (above). Thus some living matter and some genetic material can now satisfy all four primary patent conditions. But should they be patented? There are several concerns, including those of economic, ethical, social, and religious nature; and all those with these different perspectives feel strongly about this issue.

Where countries do allow patents on genetic material, it does not follow that isolating a gene will always, or even usually, allow a patent on it. As the technology advances, the isolation and recombinant use of genes becomes increasingly a matter of routine, and hence unpatentable, under condition Two (above). Where a claim to a construct containing a recombinant gene is held justified, the patent rights granted cannot extend to the original gene in its natural surroundings.

When the conditions are met, what rights are to be given to the patentee? Essentially, it is the right to forbid commercial exploitation of the invention by others in the country where the patent is granted. It is no guarantee that the invention can be exploited successfully, or at all. Nor does it give rights over private, noncommercial use of the invention. Research is not usually considered to come within the scope of the right, as long as the object of the research is to understand or improve the invention.

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LIST OF ACRONYMS

ASSENSEL	National Association of Plant Breeders for the Protection of Plant Varieties
BGCS	Botanic Gardens Conservation Secretariat
CATIE	Centro Agronomico Tropical de Investigaciones y Ensenanza
CGIAR	Consultative Group on International Agricultural Research
CLADES	Latin American Consortium for Agroecological Development
EB	Executive Board for The Global PGR Initiative
ECDC	Economic Cooperation Between Developing Countries
EC	European Community
EUCARPIA	European Association for Research on Plant Breeding
ECP/GR	European Cooperative Program on Genetic Resources
ENDA	Environment and Development Association
FAO	Food and Agriculture Organization of the United Nations
FIS	Federation Internationale du Commerce des Semences
GATT	General Agreement on Tariffs and Trade
GEF	Global Environment Facility
GRAIN	Genetic Resources Action International
IAEA	International Atomic Energy Association
IARC	International Agricultural Research Centre
IBPGR	International Board for Plant Genetic Resources
IBRD	International Bank for Reconstruction and Development
IGC	Intergovernmental Council for The Global PGR Initiative
IPGRI	International Plant Genetic Resources Institute
IPR	Intellectual Property Rights
IUCN	International Union for the Conservation of Nature and Natural Resources
IUFRO	International Union of Forestry Research Organizations
LAMP	Latin American Maize Project
MAB	Man and the Biosphere
MOU	Memorandum of Understanding
NARS	National Agricultural Research System
NGOs	Non-governmental Organizations
NPGRS	National Plant Genetic Resources Systems
PBR	Plant Breeders' Rights

PGR	Plant Genetic Resources
PVP	Plant Variety Protection
RAFI	Rural Advancement Foundation International
SABRAO	Society for the Advancement of Breeding Researchers in Asia and Oceania
SADCC	Southern African Development Coordination Conference
SAN	Seeds Action Network
SARC	South Asia Regional Cooperation Countries
SEARICE	Southeast Asian Regional Institute for Community Education
STAC	Scientific and Technical Advisory Committee for The Global PGR Initiative
STAP	Scientific and Technical Advisory Panel
TDCC	Technology Cooperation Among Developing Countries
TRIPs	Trade-Related Intellectual Property Issues
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
UPOV	International Union for the Protection of New Varieties
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WMO	World Meteorological Organization
WWF	World Wide Fund for Nature

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