# The Way Forward to Strengthen National Plant Breeding and Biotechnology Capacity

Report of the Meeting
9-11 February 2005

Rome, FAO Headquarters

Agriculture Department, Plant Production and Protection Division,
Crop and Grassland Service

This report represents a summary of discussions that took place during a meeting held at FAO headquarters between 9th and 11th February 2005. The meeting addressed issues in connection with strengthening national plant breeding and biotechnology capacity. Over twenty representatives of agencies and institutions involved in genetic resource use and plant breeding, including an observer from the International Union for the Protection of New Varieties of Plants (UPOV) and about ten representatives from FAO attended the meeting. The participants came from approximately twenty countries.

**1.0 Background**

Agriculture is the mainstay of the economies of numerous developing countries, supporting the livelihoods of large proportions of their populations. Subsistence agriculture is a particular feature of many of these countries, especially those that have suffered from the ravages of war and the vagaries of climate. With few alternatives, rural populations must often secure their sustenance and income from farming. Plant breeding, relying on judicious use of Plant Genetic Resources for Food and Agriculture (PGRFA), has supplied adapted crop varieties to many countries across the globe, with the principal exception of a number African countries. Green Revolution improved varieties have raised production levels, provided food security and generated income for many developing country farmers.

The process of producing improved varieties is slow and requires long-term sustained commitment to plant breeding. In many countries application of biotechnology to agricultural research and production has hailed a new era. There is the promise that application of biotechnology can speed up some aspects of plant breeding, although the techniques complement rather than substitute for conventional plant breeding methods. However, neither the potential of biotechnology nor the proven value of plant breeding in general can be realised in the absence of adequate investment. Unfortunately public sector investment in plant breeding and biotechnology, and the research that supports them, has been in decline over recent times. National Agricultural Research Systems (NARS) have been the principal sufferers in this resource-constrained environment as plant breeding programmes have been trimmed and the possibilities for introducing biotechnological tools have receded. Private sector investment in agricultural research and plant breeding, often using the tools of biotechnology, has increased, but linkages with the public sector have been sub-optimal. Furthermore, scarce attention is paid to crops where seed trade is minimal, and which are often important crops of smallholder agriculture in developing countries. It has been suggested that realisation of the Millennium Development Goals might be facilitated by increased investment in plant breeding in both developed and developing nations.

The declining capacity of many national plant breeding programmes has also meant that fewer crops can be researched and bred. There are many vitally important crops that have not received adequate attention from scientists and plant breeders. Given the current financial constraints, it seems unlikely they will receive the resources they merit to enable diversification for food security and poverty alleviation. The International Treaty (IT) on PGRFA, which has been ratified by 66 countries, serves to enhance access to and sustainable use of PGRFA. The Global Crop Diversity Fund was established to contribute to PGRFA conservation efforts. The issue remains, however, that conservation only represents half of the problem. While PGRFA conservation is crucial for providing the raw material for plant breeders to work with, PGRFA use is key to sustaining livelihoods, ensuring food security and contributing to national development.

**2.0 The national plant breeding survey questionnaire**

To quantify the status and progress in investment and production of national plant breeding programmes, FAO considered it necessary to implement a survey. The approach to the

issue in general, including the questionnaire in particular, was designed through an expert consultation. This in turn led to the paper Towards the Sustainable Use of Plant Genetic Resources Food and Agriculture (PGRFA): Strengthening Plant Breeding, which was prepared for the Working Group on PGRFA of the CGRFA (CGRFA/WG-PGR-2/03/2). The questionnaire is included as Annex I. It is being used to gather information on plant breeding capacity in terms of budget allocation and staff establishment between 1985 and 2004. Moreover, it requires information to be supplied on the crops addressed in national programmes and the extent of application of biotechnology to plant breeding. At the time of the workshop, 18 countries had completed the questionnaire. It is planned to build on the results of the pilot phase and send the questionnaire to many more countries, with the ultimate aim of producing and maintaining an up-to-date database on national plant breeding programmes. Some of the information from the completed questionnaires was presented and discussed at the workshop.

**3.0 Objectives and structure of the workshop**

The objectives of this workshop were to bring together participants from developing countries of Africa, Asia and South America, representing a variety of backgrounds and expertise, to discuss the problem of the decline in plant breeding and how this might be remedied. The workshop aimed to provide guidance on, and detail linkages between, modern and traditional plant breeding. The necessary move from conservation of PGRFA to sustainable use was also a major discussion point.

The workshop programme is given in Annex II and a list of the workshop participants is provided in Annex III. The workshop comprised presentations of country profiles, based on the results of the questionnaire. Discussion groups addressed many of the principal issues and constraints concerning plant breeding status and direction in developing countries. The presentations and discussions were synthesised into the following text and recommendations.

**4.0 Preamble - A complex issue**

Development of national plant breeding capacity and its current and future status is a complex issue. Geographical and economic circumstances differ enormously over the developed and developing world. Even on a regional basis, there can be large differences among countries. Civil conflict and natural disasters have had long-lasting effects on national capacities to undertake agricultural research. Countries also have very different natural resource bases; some are rich and others poor. Some have well-educated workforces while others do not. Given such complicating factors, it is not possible to describe a single model of the status of plant breeding and biotechnology application in the developing world. Nor is it possible to design a single set of remedial measures needed to halt the decline in plant breeding. Accurate models will necessarily be situation-specific.

**5.0 Working group discussion**

Presentations and discussions took place over the course of three days. For convenience, the main ideas and issues are discussed under six broad headings.

5.1 *Public and private sectors*

The public sector, in particular the NARS, has the largest responsibility for conducting agricultural research and applying the results. This includes producing improved crop varieties for cultivation by a country's farmers. The capacity to undertake this work varies enormously among countries and even within regions. This was highlighted during the presentations of country data and regional syntheses. While some countries have taken on board some of the more advanced methods of biotechnology, most are struggling to maintain, rehabilitate and initiate meaningful plant breeding programmes. Although the overall trend is towards reduced funding and decreased capacity to produce new, adapted varieties of essential crops, there are certain regions that are able to do a better job than

others are. A few countries are very advanced. One of the principal factors underlying the problem of reduced funding faced by the public sector is lack of awareness among policy makers of the impact of plant breeding on national development. Those countries that were not able to benefit from the improved varieties and farming practices that derived from the Green Revolution have not made as much progress as those that were able to benefit. It is generally under-appreciated that the returns to investment in plant breeding are substantial and that without plant breeding it is difficult to effect progress in agrarian societies.

The private sector encompasses a range of enterprises, including plant breeders, processing industries, seed distributors, agrochemical producers and marketers among others. Numerous private sector companies are integral components of the agricultural economy of many countries, where they play essential roles. During recent times, some companies in the private sector, particularly large multinationals have invested heavily in agricultural research, and particularly in biotechnology. The results of much of this research are not publicly available and cannot be used by national programmes to improve the situation of small farmers in developing countries. In the absence of regulatory frameworks in many developing countries, adapted crop varieties that incorporate elements of genetic engineering cannot be deployed. Moreover, private industry has concentrated heavily on a small number of crops of global importance. These are not necessarily the most important crops for small-scale farmers who often have to meet subsistence needs before they can consider cultivating crops to generate income.

The major issue in connection with the roles of the public and private sector is that they largely operate independently. In addition, the private sector is often able to attract the best qualified and most able individuals, to the detriment of the public sector. Public-private joint ventures, based on complementarity rather than competition, were seen by the working group as being vital to supporting agricultural production and plant breeding in developing countries. Co-operatives were considered a good example of how small-scale farmers could benefit from a more business-like approach to crop production and retail, especially in the seed sector. Encouraging small-scale agricultural enterprises was seen as a good way to boost development.

5.2 *Donors and funding*

With changing priorities among multilateral, bilateral and national donors, there has been a general move away from funding plant breeding. Not only do many donors have agendas that are not set according to recipient country needs, the agendas also change relatively rapidly in comparison with the long-term commitment that is necessary to realise benefits from plant breeding. A further marked failing is the fragmented way in which donors often operate. A coordinated, longer-term response was considered necessary to be able to achieve results in plant breeding that could benefit farmers and consumers in the developing world. Not only is it imperative that plant breeding programmes are funded over the long term, as plant breeders are not able to work without operational budgets, but capacity building also has to be addressed to make sure that there are trained personnel available to do the work.

5.3 *Capacity building*

Selected results from the questionnaire and consequent discussion indicated that declining plant breeding capacity, in terms of stagnant or reduced budgets and fewer released varieties, was confounded in some instances by increases in staff establishment and qualifications. One factor underlying this was changing age profiles of staff. Young, well-qualified people are attracted to other professions that offer better conditions and career prospects. Moreover, although biotechnology might feature among the more attractive subjects, it is very often isolated from practical plant breeding. What is required currently is a workforce that can use the tools of biotechnology in plant breeding. Without adequate

numbers of suitably qualified staff, productive plant breeding will not be possible. Capacity building to achieve these ends was considered a priority area.

The international agricultural research centers of the CGIAR have tremendous potential for contributing to capacity building. Not only do they conduct research on many of the world's most important crops, but they also represent an opportunity for NARS to send staff for training and retraining in a wide variety of subjects. Furthermore, ample field, laboratory and greenhouse facilities allow practical work to be pursued in cooperation with academic institutions elsewhere, including regional centers of excellence, which might provide training in plant breeding theory. Several CGIAR centres contribute substantially to NARS plant breeding efforts through supplying advanced germplasm, but they do not substitute for strong NARS: they strengthen NARS.

5.4 *Regulatory issues*

Plant breeders' rights (PBR) and intellectual property rights (IPR) were discussed as a means of encouraging private-public cooperation through promotion of public sector income generation, while protecting the interests of breeders. They are also able to accommodate participatory plant breeding. Subsistence farmers[1], moreover, are exempt from much of the legislation involved in PBR, and are able to save and sow seed of protected varieties without the need for permission of the breeder. It was considered that PBR suited a variety of circumstances, although not all.

Prospects for regional cooperation in plant breeding were discussed. Where crops and cropping systems are common to a region it might be possible to mount a regional approach to plant breeding, and thereby reduce overall costs and limit unnecessary and unproductive duplication and competition. This will only be feasible under circumstances where associated legislation, particularly that regarding transfer of plant material across national borders, is harmonised. An added benefit of this approach might be that the stronger NARS could support weaker ones in a region.

Other forms of novel policy implementation to promote funding were discussed, including levies on products (not necessarily agricultural products) that could be fed back into the system to support research.

5.5 *Biotechnology*

Biotechnology is an integral feature of modern plant breeding research and practice. It is not however sufficiently well embedded in practical plant breeding in developing countries. It covers a wide range of methods, from relatively straightforward and cheap tissue culture, through marker assisted selection to genetic engineering. Some, and in a few cases all, of the biotechnologies associated with crop development have become part of plant breeding programmes in developing countries. Inadequate infrastructure, inadequate funding and lack of trained staff represent major obstacles to uptake however. These issues have to be addressed if plant breeding in developing countries is to be kept up-to-date. Capacity building in plant biotechnology will be most beneficial when staff are part of or closely linked with plant breeding programmes.

5.6 *Next steps*

It was proposed, and generally accepted, that there was a need for more consultations before any decisions could be reached on the way forward for strengthening national plant breeding and biotechnology capacity. It was suggested that a workshop should be organised with country representatives and decision-makers to increase awareness of the benefits of plant breeding and application of appropriate biotechnology to plant breeding. Presenting

[1] Their are private and non-commercial activities are excluded from the scope of the breeder's right under the UPOV Convention.

work on small-scale seed systems and establishing the links with plant breeding could follow this. Engagement with the private sector would be beneficial to establish common ground. Finally, having developed a strategy for strengthening national plant breeding capacities, meetings could be held with donors to discuss future funding. It was thought necessary to keep these steps separate and move relatively slowly rather than attempt to address all issues and include numerous stakeholders at a single meeting.

It was agreed that it would be useful to move forward with the national plant breeding survey, including more countries. There was a perceived need to address some of the issues concerning what has happened to plant breeding staff and what underlies the observed trends in staffing. It is essential to complete analysis of the data already received and publish it. Data up to 2004 have been requested and it was suggested that information on private-public linkages would represent a useful addition to those data already collected. The survey should be reviewed regularly by the participating countries.

The possibilities of setting up a special fund were discussed, with specific reference to linking with the private sector, and particularly for crops that do not currently interest the private sector. The IT was considered a possible mechanism to leverage funds to support small-scale seed enterprises with plant breeding activities. During the course of the discussion, it was suggested that FAO might consider publishing a text describing success stories in development of small-scale agro-industries, seed industries in particular, and the linkages with plant breeding.

## 6.0 Recommendations arising from the workshop

The following recommendations were formulated following three days of discussion by the working group on the major issues and problems associated with plant breeding and application of biotechnology in the public sector in developing nations. It was recognised that both rural and urban societies, and national economies of the developing world, are largely reliant on the agricultural sector. Nations with weak agricultural sectors, and particularly those without or with only poor plant breeding support, are at a disadvantage in comparison with those that are able to provide their farmers with improved crop varieties and appropriate technologies. Strengthening infrastructure and building capacity represent cornerstones of policies aimed at addressing current shortcomings. Strengthening sustainable agriculture through plant breeding and the application of appropriate biotechnology is of primary importance. The recommendations made by the working group were differentiated on the basis of major stakeholder groups.

### 6.1 Recommendations to FAO

1. Increase awareness among all stakeholders of the strategic importance of sustainable crop improvement through plant breeding.
2. Encourage all stakeholders in plant breeding in developing and developed countries to increase awareness of the value and impact of plant breeding and application of appropriate biotechnology on development.
3. Take note of the momentum that has been created through the Convention on Biological Diversity, the IT on PGRFA and the Global Crop Diversity Fund, and establish a platform for strategic thinking in a systematic manner for future development of sustainable use of PGRFA. This would necessarily include plant breeding and the application of biotechnology.
4. Consider establishing a fund to support sustainable plant breeding, for crops that have not received due attention of plant breeders and crop scientists, including genetic enhancement, in countries and for programmes requiring support. Capacity building would be a key component.

### 6.2 Recommendations to the Commission on Genetic Resources for Food and Agriculture (CGRFA) and the governing body of the International Treaty on PGRFA

1. Promote discussion of the use of PGRFA through plant breeding as an essential extension to conservation efforts. The IT might assist in strengthening the mechanisms and modalities for capacity building and technology transfer to developing countries (article 13 of the IT) to enable them to realise the potential of the PGR of their own farmers' varieties and the PGR made available through the multilateral system of the IT.
2. Encourage PGRFA users, particularly plant breeders, to contribute to CGRFA discussions and decision-making on sustainable use to complement efforts on conservation. Member countries of the CGRFA, where possible, should consider including specialists in sustainable use of PGRFA in their delegations to meetings of the Commission and IT Governing Body.
3. Give urgent consideration to capacity building and technology transfer to developing countries so that they are able to use PGRFA in plant breeding programmes and contribute to the sustainable development of agriculture and allied activities.
4. Consider establishing a fund to support sustainable plant breeding for crops that have not received the due attention of plant breeders and crop scientists, including genetic enhancement, in countries and for programmes requiring support. Capacity building would be a key component.

### 6.3 Recommendations to NARS

1. Improve priority setting, incorporating awareness of markets and consumption chains and the paths of scientific and technological innovation.
2. Play an increasingly active role in decision making, especially in connection with capacity building and the need to strengthen it.
3. Adopt a multi-disciplinary approach to plant breeding, including biotechnology where appropriate.
4. Attempt to develop a solid and stable infrastructural and financial national base to ensure sustainability of crop improvement.
5. Seek to develop improved linkages, including those with farmers and the private sector, particularly with the informal seed sector where possible.
6. Increase awareness of the strategic importance of sustainable crop improvement.
7. Monitor and evaluate the impacts of IPR/IP on the development and effectiveness of breeding so that adjustments to strategies can be made on an informed basis.

### 6.4 Recommendations to Donors

1. Listen to all parties and promote awareness with a view to supporting plant breeding and its enhancement in developing countries.
2. Exert influence in developing national bases of support.
3. Improve coordination among donors.
4. Support networks to enhance capacity of national programmes, including through mechanisms such as the facilitating mechanism of the Global Plan of Action.
5. Support efforts to facilitate merging and integration of conventional and advanced breeding strategies.
6. Contribute to initiatives that foster sustained funding and long-term support needed to carry out plant breeding.

### 6.5 Recommendations to the CGIAR

1. Review survey documentation and advise on interpretation and strategic investments in crop improvement.

2. Balance donor demands and the needs of NARS and continue to support plant breeding through conducting research and capacity building according to the needs of national programmes and national programme staff.
3. Monitor the impact of capacity building efforts with a view to maintaining focused programmes.
4. Encourage and support cooperation at regional and sub-regional levels, and enhance south-south linkages.
5. Coordinate efforts to facilitate merging and integration of conventional and advanced breeding strategies.
6. Provide leadership in transfer of tools and technologies to NARS.

**6.6 Recommendations to Policy-makers**

1. Recognise the continued importance of agriculture to the national economies of developing nations and to the livelihoods of the rural and urban populations therein.
2. Recognise the contribution of plant breeding to improved food security and income generation in developing nations.
3. Understand the long-term nature of plant breeding and the needs for sustained support to ensure its success.
4. Encourage multi-stakeholder participation in decision-making processes that support conservation and use of PGRFA.
5. Encourage highly professional debate, relying on specialised representation, in forums such as the IT, on plant breeding and stress its importance in maintaining livelihoods in developing nations.
6. Harmonise policies related to sustainable use of PGRFA including seed systems.
7. Examine and understand the linkages between sustainable use and conservation of PGRFA.
8. Assist in implementing appropriate forms of rights for the developers and users of plant varieties used in agriculture in developing nations.
9. Monitor and evaluate the impacts of IPR/IP on the development and effectiveness of breeding so that adjustments to strategies can be made on an informed basis.

# Annex I

## National Plant Breeding Survey

The objective of this survey is to develop a plant breeding country profile to provide decision makers with the means to strengthen national programme capacity to respond to needs and priorities on sustainable use of Plant Genetic Resources for Food and Agriculture (PGRFA). **The information provided will be managed as confidential; under no circumstance will information about individual breeding programmes be disclosed.** Only country average will be presented and discussed in published reports

This survey intent to cover the period 1985-2004 using mainly five-year interval data, but if information is available for every single year or only for years different than the ones indicated, it should be included.

1) What kind of organization are you representing?

☐ Public sector (research institution)

☐ Public sector (university)

☐ Private company

☐ Other (explain)_____

2) How many years has your organization been involved in
Plant breeding _____ years
Plant biotechnology _____ years
If there was change in name or structure of the organization, please consider the full period length.

3) Number and educational level of scientists of your organization involved in plant breeding and biotechnology in the period 1985 to 2004. This information should be reported in Full Time Equivalent (FTE) to allow capturing the activities of scientists who work only part-time in plant breeding and/or biotechnology (see the definition of FTE in the definitions section). If there are plant breeders or biotechnologists working in administrative positions they must be included in the table.

**Plant breeding**

| Education level | 1985 | 1990 | 1995 | 2000 | 2004 |
|---|---|---|---|---|---|
| B.Sc. | | | | | |
| M.Sc. | | | | | |
| Ph.D. | | | | | |

Obs: this information may be completed on crop and/or crops-group basis by replicating the table.

**Plant biotechnology**

| Education level | 1985 | 1990 | 1995 | 2000 | 2004 |
|---|---|---|---|---|---|
| B.Sc. | | | | | |
| M.Sc. | | | | | |
| Ph.D. | | | | | |

4) Please indicate your organization's total budget and the proportion that was allocated to plant breeding activities in the period 1985 to 2004 (please use current local currency, do not transform to US$ or any other currency). Please indicate if the budget includes salaries. If there is no data for the specified years, but they are available for other years, please include the information and specify the year it refers to.

| **Financial resources** | **1985** | **1990** | **1995** | **2000** | **2004** |
|---|---|---|---|---|---|
| Total research budget | | | | | |
| Plant breeding | | | | | |
| %[1] | | | | | |

[1] **In cases where there is no breakdown by activities, use the percentage line to provide an idea of the allocation for plant breeding.**

5) Considering the total organization's resource allocation (human and financial) for plant breeding activities what would be the percentage distribution by crops and/or crops-group? Each column should sum to 100%.

| **Crops** | **1985** | **1990** | **1995** | **2000** | **2004** |
|---|---|---|---|---|---|
| Wheat | | | | | |
| Rice | | | | | |
| Maize | | | | | |
| Sorghum and Millet | | | | | |
| Others small grains (e.g. Barley and Oats) | | | | | |
| Oilseeds (e.g. Soybeans, Groundnuts) | | | | | |
| Fiber crops (e.g. Cotton) | | | | | |
| Roots and Tubers | | | | | |
| Forages | | | | | |
| Others grain legumes (e.g. Chickpea, Cowpea, Phaseolus) | | | | | |
| Vegetables and Fruits | | | | | |
| Miscellaneous | | | | | |
| **Total** | **100** | **100** | **100** | **100** | **100** |

6) Taking into account the total organization's resource allocation (human and financial) for different crops and/or crops-group improvement activities. What would be the present percentage allocation considering the current base-year. Please, also indicate what the trend is over the previous decade for the three major areas proposed (assign number **1** if it is increasing, **2** if it remains the same and **3** if it is decreasing since 1990). To help with your answer we are providing the following example: in the 1990's the programme invested 10% of its total resources to "germplasm enhancement", 30% to "line development" and 60% to "line evaluation". In 2004 the investments were 10% of its resources to "germplasm enhancement", 50% to "line development" and 40% to "line evaluation". Therefore, the number indicating the trends are 2 for "germplasm enhancement", 1 for "line development" and 3 for "line evaluation". If there is an increase in one area there must be a decrease in another. It is important to understand that the amount of resources in 2004 may have increased or decreased in relation to the 1990's, but that does not influence the trends; the programme may have less resources in 2004, but out of the available resources a greater percentage will go to "line development".

| **Crops** | **Allocation** | | | | | | **% must add to** |
|---|---|---|---|---|---|---|---|
| | Germplasm enhancement[1] | | Line development[1] | | Line evaluation[1] | | |
| | % | Trend | % | Trend | % | Trend | |
| Wheat | | | | | | | 100 |
| Rice | | | | | | | 100 |
| Maize | | | | | | | 100 |
| Sorghum and Millet | | | | | | | 100 |
| Others small grains (e.g. Barley and Oats) | | | | | | | 100 |
| Oilseeds (e.g. Soybeans, Groundnuts) | | | | | | | 100 |
| Fiber crops (e.g. Cotton) | | | | | | | 100 |
| Roots and Tubers | | | | | | | 100 |
| Forages | | | | | | | 100 |
| Others grain legumes (e.g. Chickpea, Cowpea, Phaseolus) | | | | | | | 100 |
| Vegetables and Fruits | | | | | | | 100 |
| Miscellaneous | | | | | | | 100 |

[1] See the definitions in the appropriate section.

7) Considering the total resources available in the organization, what is the proportion (%) going to the different research areas? Each column should sum to 100%.

| **Research Area** | **1985** | **1990** | **1995** | **2000** | **2004** |
|---|---|---|---|---|---|
| Line development[1] and evaluation[1] | | | | | |
| Plant biotechnology[1] | | | | | |
| Germplasm enhancement[1] | | | | | |
| **Total allocation (%)** | **100** | **100** | **100** | **100** | **100** |

[1] See the definitions in the appropriate section.

8) Please, mark which are the biotechnology areas the organization is working on?

- ☐ Molecular characterization
- ☐ Tissue culture
- ☐ Double haploid breeding
- ☐ Marker assisted selection
- ☐ Genetic engineering
- ☐ Gene isolation
- ☐ Wild crosses
- ☐ Other (specify) _____

9) Considering the organization's breeding programme, write the average numbers managed for every crop and/or crop-group. Consider 2004 as the present base-year to provide this information.

| **Crops** | **Activity** | | | |
|---|---|---|---|---|
| | Number of crosses made[1] | Number of segregating populations considering all generations[2] | Number of trials[3] | Number of locations used for field trials |
| Wheat | | | | |
| Rice | | | | |
| Maize | | | | |
| Sorghum and Millet | | | | |
| Others small grains (e.g. Barley and Oats) | | | | |
| Oilseeds (e.g. Soybeans, Groundnuts) | | | | |
| Fiber crops (e.g. Cotton) | | | | |
| Roots and Tubers | | | | |
| Forages | | | | |
| Others grain legumes (e.g. Chickpea, Cowpea, Phaseolus) | | | | |
| Vegetables and Fruits | | | | |
| Miscellaneous | | | | |

[1] In self-pollinated crops the number of crosses refers to the number of parental combinations made and not to the number of crosses made to insure parent A by B combination.

[2] Please consider that a single cross may produce 100 $F_3$ segregating populations, 300 $F_4$, and so on. The question is asking for the total number regardless of their segregating cycle.

[3] Please provide the sum of all trials the programme carries out, including segregating materials, observational and yield trials, as well as demonstration trials.

10) For each major crop and/or crop-group, what are the main sources of germplasm used in the breeding programme of your organization? Consider 2004 as the base-year to provide this crop information. Please indicate the percentage obtained from each source. Each row should sum to 100%.

| **Crops** | **Germplasm source** | | | | | | | | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| | Local germplasm bank[1] | National germplasm bank | Introduction through bi or multilateral agreements | Introduction through participation in germplasm evaluation networks | CGIAR gene banks | Public organizations in industrialized country | Private sector | Farmers material | |
| Wheat | | | | | | | | | **100** |
| Rice | | | | | | | | | **100** |
| Maize | | | | | | | | | **100** |
| Sorghum and Millet | | | | | | | | | **100** |
| Others small grains (e.g. Barley and Oats) | | | | | | | | | **100** |
| Oilseeds (e.g. Soybeans, Groundnuts) | | | | | | | | | **100** |
| Fiber crops (e.g. Cotton) | | | | | | | | | **100** |
| Roots and Tubers | | | | | | | | | **100** |
| Forages | | | | | | | | | **100** |
| Others grain legumes (e.g. Chickpea, Cowpea, Phaseolus) | | | | | | | | | **100** |
| Vegetables and Fruits | | | | | | | | | **100** |
| Miscellaneous | | | | | | | | | **100** |

[1] This column is only to be completed by institutions which have local gene banks, in addition to the national one.

11) For the following crops and/or crops-group indicate the environment breeding priority for your organization during the 1980's (or more recently in case your Organization did not exist at that time) and today (**1** = high priority; **2** = medium priority, **3** = low priority).

| Crop | Targeted environment | Priority | |
|---|---|---|---|
| | | 1980 | 2004 |
| Wheat | Highly favourable | | |
| | With abiotic[1] stress | | |
| | With biotic[2] stress | | |
| Rice | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Maize | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Sorghum and Millet | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Others small grains (e.g. Barley and Oats) | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Oilseeds (e.g. Soybeans, Groundnuts) | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Fiber crops (e.g. Cotton) | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Roots and Tubers | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Forages | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Others grain legumes (e.g. Chickpea, Cowpea, Phaseolus) | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Vegetables and Fruits | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |
| Miscellaneous | Highly favourable | | |
| | With abiotic stress | | |
| | With biotic stress | | |

[1] Abiotic stress – drought, heat, cold, etc
[2] Biotic stress – diseases, insects, etc

12) How can the international community (FAO, CGIAR Centers, World Bank, IFAD, multilateral or bilateral development agencies, etc) assist your organization in increasing efficient use of PGRFA? Please rate them using the following numbers: **1** = high, **2** = medium high, **3** = medium, **4** = medium low, **5** = low priority. Do not repeat the number and leave blank where priority is lower than 5.

☐ Promoting training programmes on biotechnological tools

☐ Promoting training programmes on conventional breeding methods

☐ Helping preparing projects for funding

☐ Facilitating germplasm exchange

☐ Facilitating access to new biotechnological tools

☐ Strengthening national programme capacity through investments

☐ Other (specify) _____

13) Indicate the number of varieties released each period by your organization for each crop and/or crop-group.

| **Crop** | **Number of varieties released[1]** | | | | |
|---|---|---|---|---|---|
| | **1980-1984** | **1985-1989** | **1990-1994** | **1995-1999** | **2000-2004** |
| Wheat | | | | | |
| Rice | | | | | |
| Maize | | | | | |
| Sorghum and Millet | | | | | |
| Others small grains (e.g. Barley and Oats) | | | | | |
| Oilseeds (e.g. Soybeans, Groundnuts) | | | | | |
| Fiber crops (e.g. Cotton) | | | | | |
| Roots and Tubers | | | | | |
| Forages | | | | | |
| Others grain legumes (e.g. Chickpea, Cowpea, Phaseolus) | | | | | |
| Vegetables and Fruits Miscellaneous | | | | | |

[1] If the country does not have a varietal release system in place, provide the number of varieties made available to farmers.

14) Indicate the aspects the Organization considers the most limiting for the success of the plant breeding programmes. In the first column identify the ones that are current relevant and in the second column indicate the ones important in the 1980s. Please, only write the main five and put them in order of importance, given the number “1” to the most important and “5” to the least important. Do not repeat the number and leave blank where priority is lower than 5.

| **Aspects** | **Actual** | **1980s** |
|---|---|---|
| Inadequate number of breeders for each crop | | |
| Inadequate experimental fields conditions | | |
| Inadequate access to recent literature | | |
| Inadequate knowledge level of the general plant breeding strategies | | |
| Limited access to international genetic resources | | |
| Limited access to national public and/or private genetic resources | | |
| Lack of knowledge about participatory plant breeding techniques | | |
| Lack of knowledge about the use of molecular technique support plant breeding programmes | | |
| Inadequate availability of laboratory infrastructure to carry out experiments using advanced plant breeding techniques | | |
| Lack of financial resources to carry out field and laboratory experiments | | |
| Lack of support from the international community, including organizations like Centres of the CGIAR system, FAO, etc | | |
| Others (specify) | | |

**Definitions:**

**Biotechnology** – means any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or process for specific use (Convention on Biological Diversity, June 1992). It includes different molecular technologies such as gene manipulation and gene transfer. For this exercise tissue culture also is included.

**Plant Breeding** – research that includes any activities related to the application of plant breeding methodologies, going from germplasm enhancement (pre-breeding) to line development and evaluation.

**Full Time Equivalent (FTE)** – is the work done by a person who has any responsibility linked to plant breeding (genetic enhancement, line development, line evaluation or genetic studies) during one year (365 days). This information should not include support personal (technicians, laboratory and field workers, students, etc).

**Public sector** – any organization (national and state research organizations, universities, special funded programmes, etc) that relays on public resources to carry on their regular breeding activities.

**Private sector** – any organization that uses only private resources to carry on their regulars breeding activities.

**Scientist** – only include personal who are directly involved in plant breeding, including scientists responsible for varietal trials of introduced materials such as those from CGIAR centers, do not include other areas of expertise, field labor or technicians.

**Germplasm enhancement** – Any activity that includes: a) gene transfer via sexual or asexual means from germplasm accessions; b) increasing the frequencies of desirable genes in crop pools that will be used for developing parents or cultivars (Frey, 1996); and c) germplasm characterization.

**Line development** – Any activity of crossing and selection that has the direct purpose of developing or releasing varieties.

**Line evaluation** – Any activity of evaluating advanced breeding lines or introduced varieties with the direct purpose of releasing varieties, including on-station and on-farm evaluation.

# Annex II

**The Workshop programme**

| | |
|---|---|
| | **The way forward to strengthen national plant breeding and biotechnology capacity** |
| | **09 - 11 February 2005**<br>**FAO, Rome, Italy** |
| | **PROVISIONAL AGENDA** |

| **Day 1 (09/02/05)** | **Philippines Room – Building C 277-281** |
|---|---|
| 08:30 – 09:30 | Registration |
| 09:30 – 10:15 | **Opening Ceremonies** |
| | • Welcome remarks: **M. Solh**, Director, AGP<br>• Framing the workshop and adoption of the agenda: **E. Kueneman**, Service Chief, AGPC |
| 10:15 – 10:30 | *Coffee/tea break* |
| **Session I (part 1)** | **Country case presentations**<br>Chair: **Mohan Saxena** |
| 10:30 – 11:00 | Presentation 1: Assessment of national plant breeding and biotechnology capacity: Philippines<br>Speaker: **Desiree Hautea** |
| 11:00 – 11:30 | Presentation 2: Assessment of national plant breeding and biotechnology capacity: Venezuela<br>Speaker: **Orangel Borges** |
| 11:30 – 12:00 | Presentation 3: Assessment of national plant breeding and biotechnology capacity: Kenya<br>Speaker: **Josephine Songa** |
| 12:00 – 12:30 | Presentation 4: Assessment of national plant breeding and biotechnology capacity: Angola<br>Speaker: **Elizabeth Matos** |
| 12:30 – 14:00 | *Lunch break* |
| **Session I (part 2)** | **Country case presentations** |
| 14:00 – 14:30 | Presentation 5: Analysis of the plant breeding and biotechnology survey: Examples from Venezuela and The Philippines<br>Speaker: **Jose Falk-Zepeda** |
| 14:30 – 15:00 | Presentation 6: Assessment of national plant breeding and biotechnology capacity: aggregated information for Africa<br>Speaker: **Elcio P. Guimarães** |
| 15:00 – 15:45 | General Discussion led by the Chair |
| 15:45 – 16:00 | *Coffee/tea break* |
| 16:00 – 16:15 | Orientation for the working group discussions |
| **Session II (part 1)** | **Working group discussions**<br>Group A – Philippines Room (C277-281)<br>Group B – AG meeting room (B750 bis) |

| | |
|---|---|
| 16: – 18:00 | Proposed issues for discussion<br>• Strategies to strengthen national plant breeding and biotechnology capacity considering: Crop, country and/or regional strategy |
| | |
| **Day 2 (10/02/05)**<br>**Session II (part 2)** | **Working group discussions**<br>Group A – Philippines Room (C277-281)<br>Group B – AG meeting room (B750bis) |
| 009:00 – 10:00 | Presentation by Groups and discussions (Philippines Room C277-281)<br>Chair: **Ann Marie Thro** |
| 10:00 - 10:15 | *Coffee/tea break* |
| 10:15 - 12:30 | Proposed issues for discussion<br>• How biotechnology can better support plant breeding in developing countries<br>• How to achieve sustainability in plant breeding programmes |
| 12:30 - 14:00 | *Lunch break* |
| 14:00 - 15:00 | Presentation by Groups and discussions (Philippines Room C277-281)<br>Chair: **Rolf Folkertsma** |
| 15:00 - 15:15 | *Coffee and tea break* |
| 15:15 - 17:00 | Proposed issues for discussion<br>• Role of CG Centres<br>• Role of donor agencies<br>• Role of strong NARS (e.g. regional, south/south)<br>• Role of private sector, including plant variety protection |
| 17:00 - 18:00 | Presentation by Groups and discussions (Philippines Room C277-281)<br>Chair: **Mauricio Lopes** |
| | |
| **Day 3 (11/02/05)**<br>**Session II (part 3)** | **Working group discussions**<br>Group A – Philippines Room (C277-281)<br>Group B – AG meeting room (B750bis) |
| 08:30 – 10:15 | Proposed issues for discussion<br>• Policies to enhance private sector investments<br>• Enabling policies for public and private actions<br>• Advice on future consultations to shape investments/policies<br>• How to enhance the survey |
| 10:15 - 10:30 | *Coffee and tea break* |
| 10:30 - 11:00 | Proposed issues for discussion (continuation)<br>• Policies to enhance private sector investments<br>• Enabling policies for public and private actions<br>• Advice on future consultations to shape investments/policies |

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|---|---|
| | • How to enhance the survey |
| 11:00 - 12:00 | Presentation by Groups and discussions (Philippines Room C277-281)<br>Chair: **Robert Evenson** |
| 12:00 - 13:00 | Recommendations to FAO<br>Chair: **Robert Evenson** |
| 13:00 - 15:00 | *Lunch break* and Draft Report preparation |
| | |
| **Session III** | **Meeting Report Adoption**<br>Chair: **M. Solh,** Director AGP |
| 15:00 - 16:00 | Final review of meeting report summary |
| 16:00 - 16:30 | Adoption of Report and Recommendations |
| 16:30 - 17:00 | **Closing Ceremony** |

**Working Groups**

| **Group A (Philippines room)** | **Group B (AG meeting Room)** |
|---|---|
| Elizabeth Matos (Angola | Desiree Hautea (Philippines) |
| Josephine Songa (Kenya) | Orangel Borges (Venezuela) |
| Mohan Saxena (ex-ICARDA) | Hernan Ceballos (CIAT) |
| Kedear Nath Rai (ICRISAT) | Alexei Morgounov (CIMMYT) |
| Ann Marie Thro (USDA) | B. B. Singh (IITA) |
| Qingyao Y. Shu (FAO/IAEA) | Jose Falk-Zepeda (IFPRI) |
| Jonathan Robinson (Consultant) | Mauricio Lopes (EMBRAPA) |
| Patricia Zambrano (IFPRI) | Robert Evenson (Yale University) |
| Moussa Sié (WARDA) | Rolf Folkertsma (ILRI) |
| Kakoli Gosh (FAO/AGPS) | Ehsan Dulloo (IPGRI) |
| Hoan Le (FAO/AGPC) | Peter Button (UPOV) |
| Andrea Sonnino (FAO/SDRR) | Jonathan Latham (EcoNexus) |

# Annex III

## List of participants:

| **Participant/country** | **Adress/telephone/E-mail address** |
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