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COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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**IDENTIFYING NEW OPPORTUNITIES AND PARTNERSHIPS FOR
PLANT BREEDING: OPTIONS AND CHALLENGES**

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I. BACKGROUND

1. At the same time that the Commission requested FAO to develop an options paper on strengthening plant breeding in developing countries, FAO was already beginning to confront the challenges of insufficient plant breeding capacity through a broad partnership platform. The Commission's request was a timely opportunity to redouble efforts in this area.
2. From the early part of the 21st century, FAO and many other national and international organizations became very concerned about an apparent decline in investment in agriculture-based development, especially in poor countries where the needs were greatest. In 2006, FAO launched the Global Partnership Initiative for Plant Breeding Capacity Building (GIPB) (<http://km.fao.org/gipb/>), as a mechanism to reverse the declining capacity in plant breeding world-wide.
3. In parallel with carrying out national programme surveys of plant breeding capacity, GIPB brought together a broad base of its partners (more than 300) in a participatory exercise of developing a comprehensive, long-range business plan, focusing initially on the period from 2009 to 2013. The plan addresses the questions and concerns that the Commission proposed, and is the basis for the options described here: *to strengthen plant breeding in developing countries, identifying new opportunities for effective partnerships between the public and private sector, with the involvement of the CGIAR Future Harvest Centres, .*
4. The plan identifies five broad areas where plant breeding strengthening is required in order to succeed at delivering new varieties to farmers:
 - policy dialogue, coordination and implementation;
 - education and training;
 - access to technologies and know-how;
 - access to plant genetic resources;
 - sharing of knowledge and information
5. Hosted by FAO, GIPB has behind it some of the crucial agreements in global issues of plant genetic resources for agriculture, such as the Convention on Biological Diversity, the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture, and finally the International Treaty for Plant Genetic Resources for Food and Agriculture. The research centers of the Consultative Group on International Agricultural Research, and the Global Crop Diversity Trust are some of the key partners, with their mutual interest in conservation and sustainable use of PGRFA. GIPB is the only globally-oriented platform with the emerging potential to bring together the multiple interests and capacities in the crop improvement and delivery sectors – across geographical and political boundaries, across institutions, and across disciplines.

II. THE DEFINITION OF PLANT BREEDING CAPACITY BUILDING

6. Plant breeding capacity building is defined here in a broad sense as the process of developing and strengthening the skills, abilities, processes and resources that countries and organizations need in order to establish and maintain plant breeding programs capable of surviving, adapting, and thriving in a fast changing world.
7. Capacity building at the professional level refers to activities that improve the plant breeder's ability to define his/her goals or to do his/her work in more effective ways. Professional

level capacity building is targeted to improve technical abilities, leadership, advocacy skills, communication skills, and other areas of personal and professional development.

8. At the institutional and organizational level, capacity building must be targeted to improve governance, leadership, mission and strategy definition, programme development and implementation, partnerships and collaboration, advocacy and policy change, monitoring and evaluation, among other activities and functions that may enhance the organization capacity to develop or support successful breeding programs.

9. Capacity building must also function at country, regional and global levels, as well as in promoting interaction and synergy with other sectors and complementary functions.

III. A VISION FOR CAPACITY BUILDING

10. The longer-term vision of success for capacity building in plant breeding is the improvement of crop performance and food security based on the establishment of enhanced sustainable national plant breeding capacity. Improved cultivars will be produced and adopted in larger numbers and they will be better adapted to climate change and to protection of the environment and biophysical resource base through reduced use of pesticides and more efficient use of inorganic and organic fertilizer, water and energy. Improved stress tolerant cultivars will contribute to reduced consumer price, enhanced human health, and increased income and employment. In its broadest context, improving plant breeding capacity will impact the very essence of what constitutes the foundations of global food security.

11. The contemporary global vision of plant breeding includes an expanding range of options, demands and goals. These changes are the result of both new information and new conditions. The rapidly developing field of molecular genetics opens many possibilities to make plant breeding more effective and more efficient. Genetic resources are better understood at the molecular and at the phenotypic levels, bringing better possibilities for their improved conservation and use in breeding. The better understanding of the social milieu surrounding the success of new varieties is driving the development of participatory selection and promotion techniques in breeding. Finally, climate change is driving new thinking and new demands on the way we manage genetic resources, and develop and utilize crops.

12. *Base-broadening and pre-breeding.* Plant breeding, in its traditional mode, tends to evolve toward a narrowing of the genetic base in farmers' fields. The environmental and other variations that the farmer-breeder previously adjusted to through genetic variation in the varietal base, are now adjusted to through management practices, e.g. through pesticide application, irrigation, and fertilizer use. Nonetheless, there is growing appreciation for the effectiveness and resource management necessity of returning to a more genetically based approach to managing these types of environmental variation. This is being done through greater use of germplasm collections to broaden the genetic base of crops, especially through *pre-breeding*. Pre-breeding is the process of bringing the unadapted genebank materials, including their valuable genes, to a level of agronomic suitability, such that they can be utilized directly by plant breeders in their crop improvement programs.

13. *Core collections.* The concept of core collections has been around for some 30 years, but their effective use in plant breeding continues to expand. The main reasons are the improved ability to identify core collections that truly represent the entire collection, based on molecular techniques, and on more precise bio-geographical information through the use of Geographical Information Systems (GIS) linked to databases on climate, soils, pests and other information. Core collections are therefore a continually better option for efficiently identifying potential sources of traits for breeding programs.

14. *Under-utilized crops.* While there are hundreds of plant species used as food, the ten most important crops provide 80% of the world's calorie consumption. The science of plant breeding has the potential to bring a greater diversity of species into the mainstream of human nutrition. Doing so will allow a more sustainable use of a range of environments, bring better and more balanced nutritional options to consumers, and present new income-generating alternatives to farmers. Currently under-utilized crops will play a role in bringing alternatives to regions where traditional crops are driven out by climate change.

15. *Participatory breeding.* Farmers were the original plant breeders, and still retain many of the skills and much of the information that is necessary for success in varietal development. In the past 20 years, participatory breeding has become a broadly accepted approach to making the products of breeding more relevant to the clients, i.e. farmers and consumers. Nonetheless, there is much progress still to be made in incorporating participatory methods in many plant breeding programs. Science-based plant breeding – only about 100 years old – is capable of improving on and accelerating the breeding of farmers. But plant breeders continue to rely on accurate and timely feedback from their clients (usually farmers) in order to succeed. This feedback and close links with the clients is always important, but especially so in times of changing needs. Smart participatory and feedback mechanisms will grow in importance as demands change due to market shifts, changes in production practices, and environmental changes due to climate change.

16. *Linking conservation with seed systems.* The effective utilization of genetic resources involves linkages in the entire value chain from on-farm conservation, through genebank management, breeding, and delivery to growers through seed systems. Any point of disruption in the flow of germplasm and information through this system renders it ineffective. The different entities involved in each stage need to coordinate and collaborate for optimum results. Breeding and seed systems involve an ever-greater private sector component, especially in developed countries. However, in most developing countries these activities are still largely in the hands of the public sector. Private companies typically limit their involvement to a few of the most profitable crops, while farmers will continue to depend on the public sector for most crop species. The public and private sectors need to reach an understanding in each country or region about the optimum way forward to bring the best results to farmers and to society.

17. *Challenges and opportunities.* The growing demand for the products of plant breeding is based on both challenges and opportunities. Increasing populations lie at the heart of agriculture's challenges, and this remains primarily an issue in developing countries. Scarcity and cost of the resources of production – good soil, water, fertilizer – call for breeding crops that make the most efficient use of those resources. Climate change is becoming recognized as a likely major determinant of what plant breeders will need to produce in the next decades. The major adjustments will be for adaptation to drought, flooding and changes in pest and disease dynamics. A broad germplasm base and good support for the total plant breeding system will be needed for success. Along with these externally created demands, plant breeders will also be expected to meet demands for lessening the carbon footprint of humanity by supporting the production of biofuels, in species and in ways that do not compete with food crops. Fortunately, plant breeding has the capability of meeting these challenges in an environment of adequate support, and coordination with the multiple institutions and organizations that work within the overall system of producing food for humankind.

IV. AN ORGANIZATIONAL FRAMEWORK

18. An internationally facilitated partnership forms the basis for achieving the goal of strengthening plant breeding capacity by catalyzing and supporting national, regional, and global action among relevant international organizations, foundations, universities and research institutes, the private sector, civil societies, and national and regional bodies. In particular, the international partnership role of GIPB is aimed at strengthening national plant breeding policies

and strategies and national institutional capacity for coordinated action on training plant breeders, accessing technologies and developing skills for crop improvement, exchanging and accessing diverse genetic resources, as well as sharing information and knowledge.

19. Partnerships between the public and private sectors are one of the key mechanisms to improve plant breeding capacity, for equitable benefits. Governmental and non-governmental entities must work jointly to bring together all the elements of success. Thirty years ago the private sector was nearly non-existent in the developing world seed business, with the exception of a handful of larger countries like Brazil, Mexico, Argentina and India. And while these countries can be models for others, there is in addition the need for a range of models to fit the wide variation in situations. What is becoming clear, nonetheless, is that government policy that supports an optimum synergy between the public and private sectors is one of best tools at hand for agricultural development. The private sector is increasingly realizing the need for a strong public sector, for example: to provide a steady flow of trained plant breeders; to be the guardians of the basic germplasm resources; and to provide efficient and effective certification systems and intellectual property rights legislation. In addition, the public sector needs to give strong support to those crops that will not attract private investment, such as many vegetatively propagated or self-pollinated crops, or crops with localized importance.

V. BENEFICIARIES AND STAKEHOLDERS

20. The primary direct beneficiaries will be the national populations of the selected countries along the food chain from production to consumption, and those who provide input, processing and marketing services. Consumers will benefit, through increased and affordable food intake, in terms of improved nutritional and health status. Producers will also benefit directly from improved socioeconomic status resulting from increased productivity and production and availability of food and other commodities. Because of the economic multipliers related to inputs, output handling and value added from processing, distribution and marketing services, economic benefits will accrue in terms of increased income and employment along the various supply chains.

21. Improved capacity in plant breeding will both foster and benefit from a network of a large number of national and regional plant genetic resource conservation and utilization programs, seed systems and farmers, NGOs, United Nations and other international organizations, universities, extension services, national and regional research organizations and donors. The national plant breeding programs and seed systems in turn will connect to national agencies in the agriculture, health, education, trade and industry sectors, and to various linked service sectors for processing, distribution and marketing, farmer and producer organizations, and other civil society stakeholders.

22. An important group of beneficiaries will be the professionals and their respective scientific disciplines along the whole continuum from conservation of plant genetic resources to pre-breeding to breeding and crop improvement through to seed delivery systems. GIPB will facilitate the development and promotion of relevant and high quality science underpinning the various branches of modern genomics, plant breeding and biotechnology. The potential for scientific and professional benefits offered by a platform for capacity building cannot be overestimated, including the generation of strategic and applied scientific and technical knowledge along with the strengthening of its peer review processes.

VI. SUMMARY OF OPPORTUNITIES AND PARTNERSHIPS

23. The follow list of opportunities and partnerships for plant breeding is not exhaustive, but covers some of the most relevant areas where GIPB can make a significant contribution:

- Building capacity in plant breeding based on opportunities for improved food security and income generation;
- Building capacity in plant breeding based on opportunities for improved food security and income generation;
- Building capacity in plant breeding that enables adaptation to climate change and efficient use of scarce resources;
- Building capacity that capitalizes on the best of traditional and modern technologies;
- Forging partnerships among diverse research and development institutions in the public and private sectors to optimize progress;
- Empowering farmers through participatory breeding methods;
- Broadening the genetic base of crops for reduced vulnerability and greater potential for genetic progress;
- Identifying, building and utilizing core collections for improved management of collections and design of breeding strategies;
- Bringing a greater diversity of species into the mainstream of human nutrition;
- Linking conservation, breeding and seed systems to deliver better crops to farmers.