Harnessing PGRFA for Enhanced Crop Productivity
Challenges and Opportunities

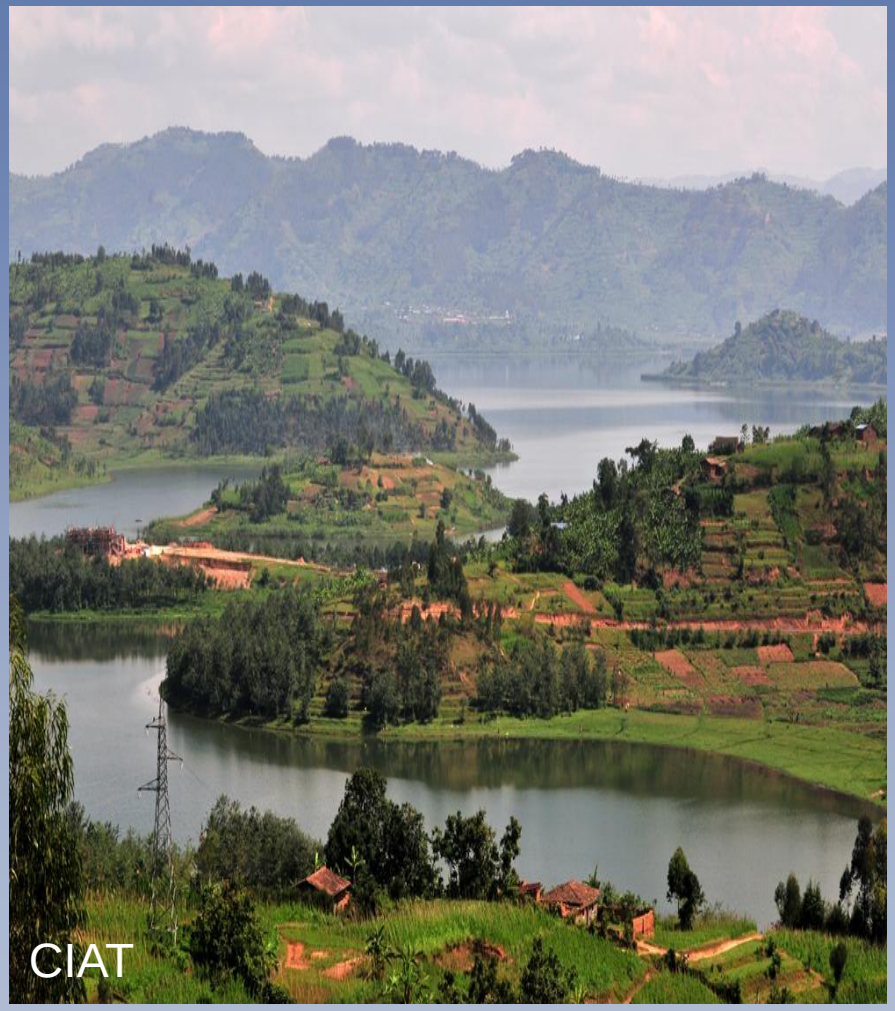
Chikelu Mba
Plant Genetic Resources and Seeds Team (AGPMG)
Plant Production and Protection Division
Agriculture and Consumer Protection Department

Food and Agriculture Organization of the United Nations

for a world without hunger

Outline

- Context of Food Insecurity
- Unleashing the potentials of plants
- Harnessing PGRFA Optimally
  - PGRFA as Global Commonwealth
  - PGRFA Management as a Continuum
- Introducing the Multi-stakeholder Partnership, GIPB
- Towards Mainstreaming Strategic Interventions



The Work We Do in the Context of Food Insecurity

Millennium Development Goals: Taking Stock

Goal 1: Eradicate Extreme Hunger and Poverty

Goal 2: Achieve Universal Primary Education

Goal 3: Promote Gender Equality and Empower Women

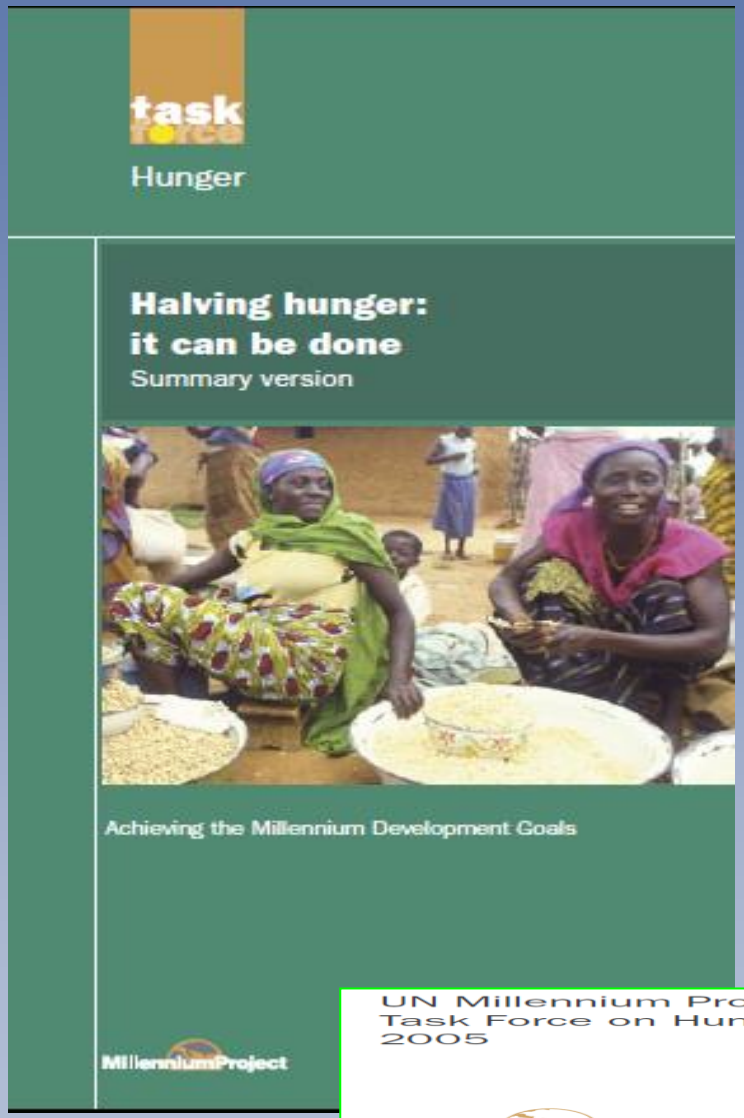
Goal 4: Reduce Child Mortality

Goal 5: Improve Maternal Health

Goal 6: Combat HIV/AIDS, Malaria and other diseases

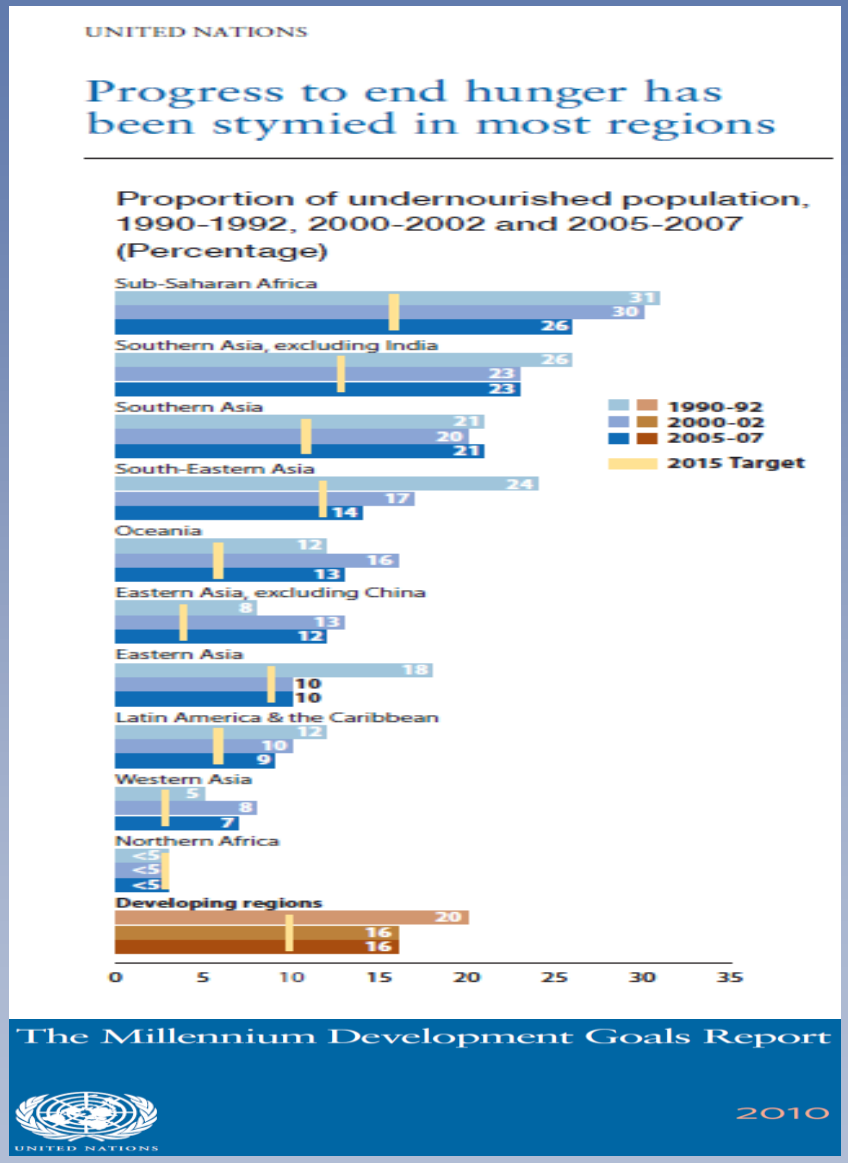
Goal 7: Ensure Environmental Sustainability

Goal 8: Develop a Global Partnership for Development



Profiling Food (In)Security

- Wake up call in the recent food price increases
  - Post-green revolution complacency
- 1 billion people go hungry today
- At current rates, population by 2050 estimated at 9 billion
  - Need to increase food production by 70%
- Uncertainties exacerbated by
  - climate change and variations
  - demographics, changing dietary patterns
  - competing diversions of foodstuff to bioenergy, livestock feeds, fibers



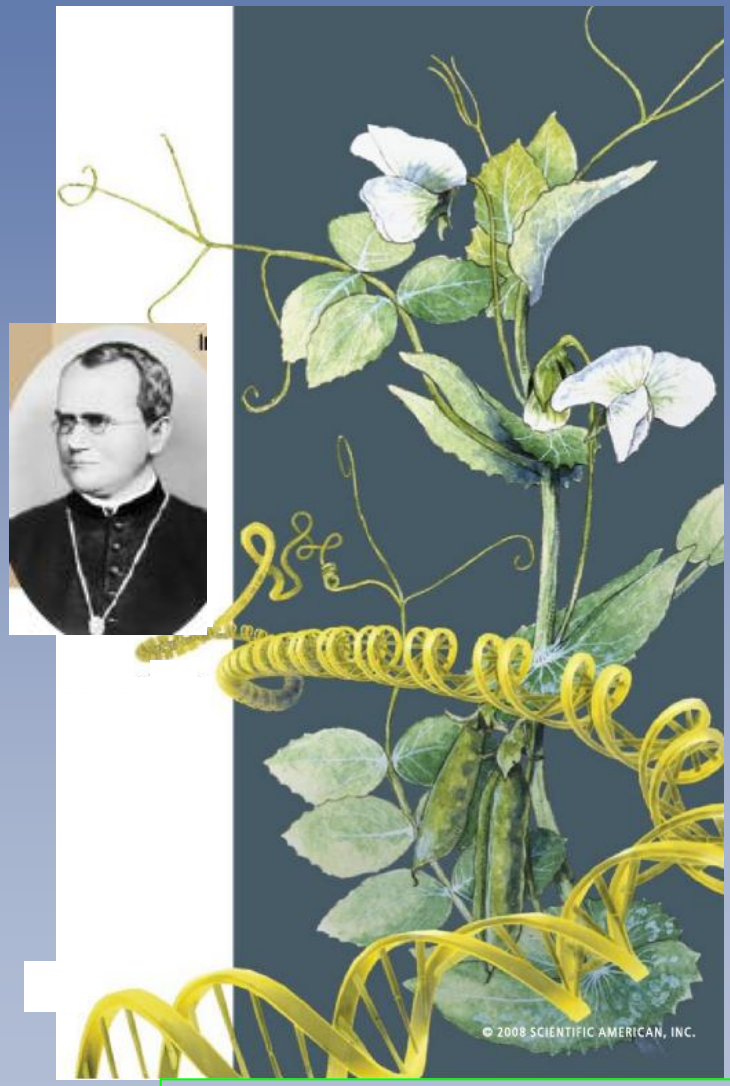
Increasing Crop Production

- Finite natural resources base
  - Available water and arable land either stagnant or dwindling
  - Prohibitive cost of agricultural inputs
- So, increased productivity is the most viable option!
  - Genetic gain accounts for 50% of increased crop yield
  - Balance is due to improved agronomic practices

Unleashing the potentials coded into blueprints

Its All About Nature and Nurture!

- Re-enact the drivers for agriculture
  - Evolution, Domestication, Speciation
  - Green revolution
- Plant Breeding --- Science of altering the genetic pattern of plants in order to increase their value



Scientific American, Jan. 2009

Classical Plant Breeding

- Relies on hybridization
- (Deliberate) interbreeding of closely or distantly related individuals
- Crossbreeding introduces traits/genes from one variety or line into a new genetic background
- Selection

Obstacles to realizing potentials

But, breeding better & resilient crops complicated by

- narrow genetic base of breeding materials
- poor policy frameworks
- sub-optimal human & material resources

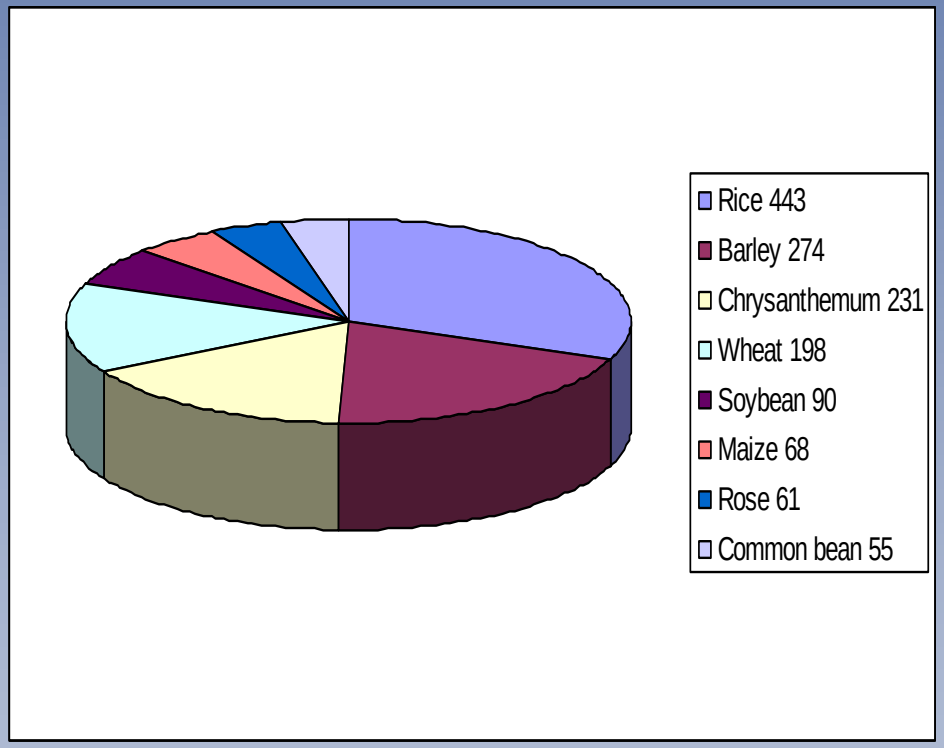
To Facilitate Plant Breeding

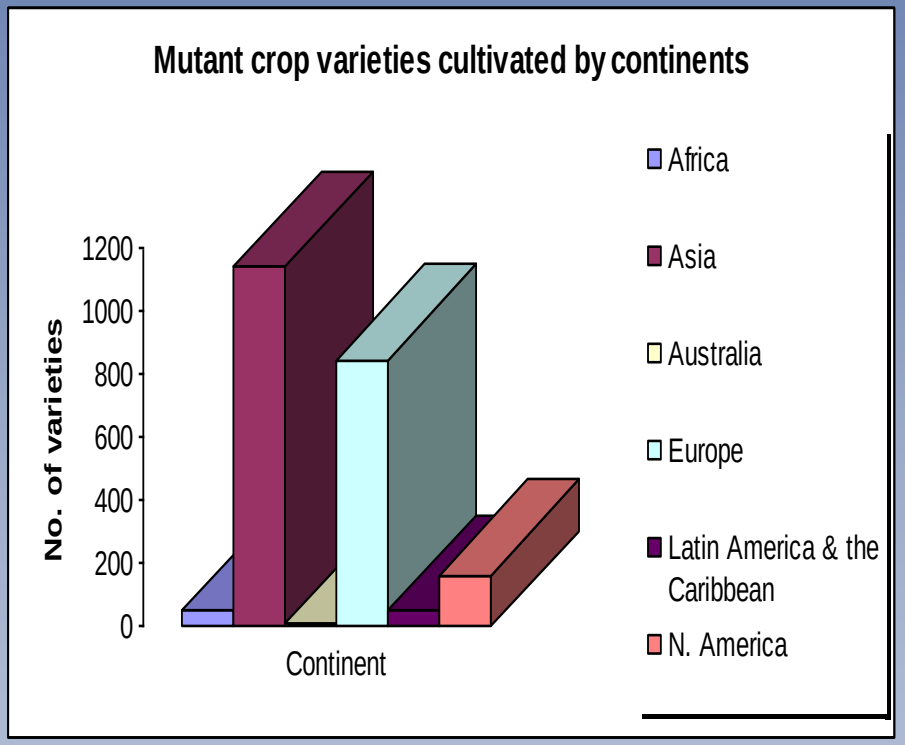
Generating diversity

- Mutagenesis
  - chemical & physical mutagens, transposons
- Enhancing hybridization
  - Cell and tissue culture
    - protoplast fusion, embryo rescue, somaclonal variation
    - doubled haploidy
- Recombinant DNA tools
  - Cloning of useful genes and genetic transformation

Induced Crop Mutants

About 3000 officially released varieties

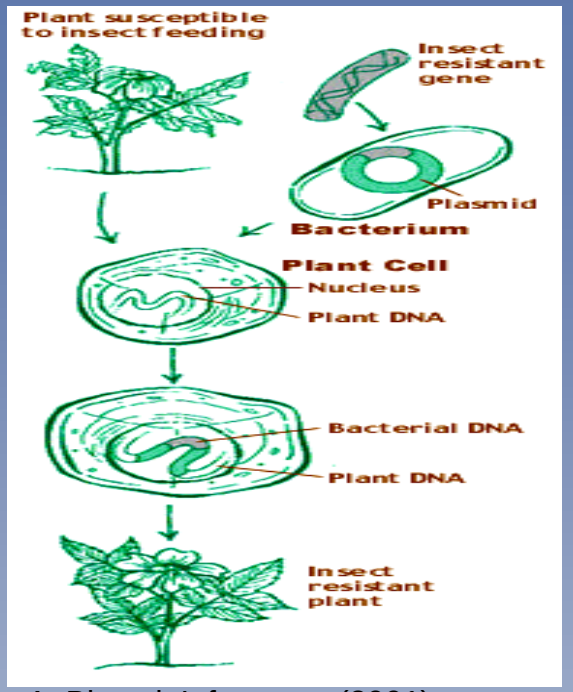




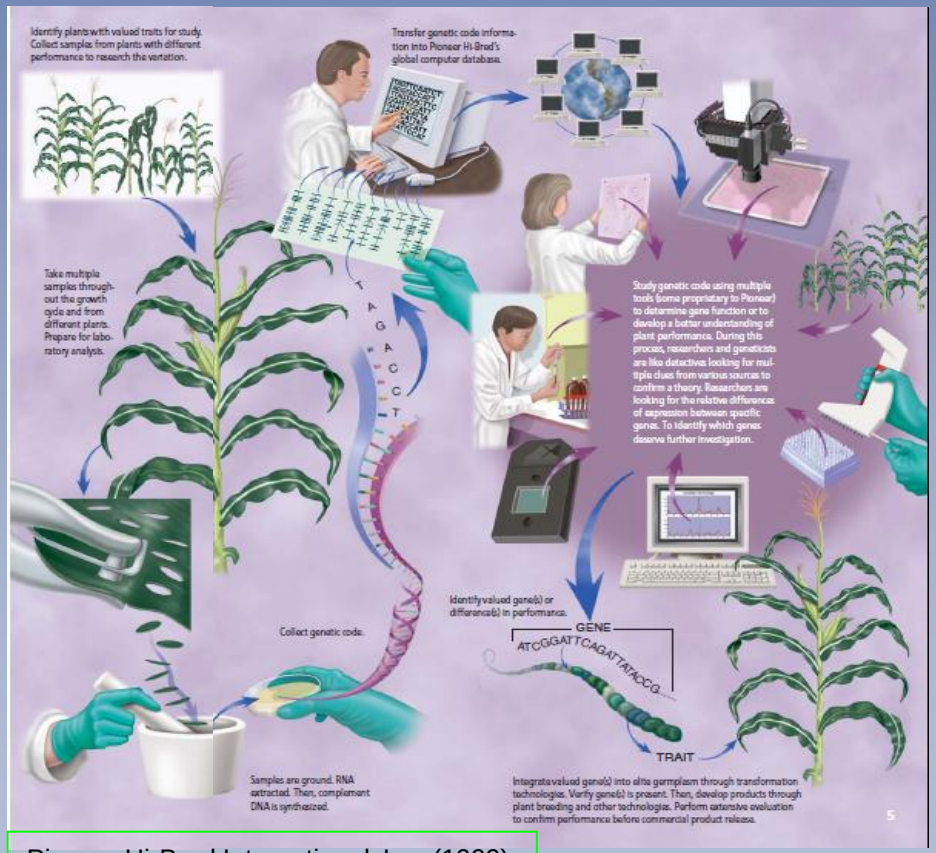
http://www-naweb.iaea.org/nafa/pbg/index.html

Enhancing Efficiency --- Molecular Breeding

http://www.ars.usda.gov/Research/docs.htm?docid=7203



AgBiotech Infosource (2001)



Pioneer Hi-Bred International, Inc. (1999)

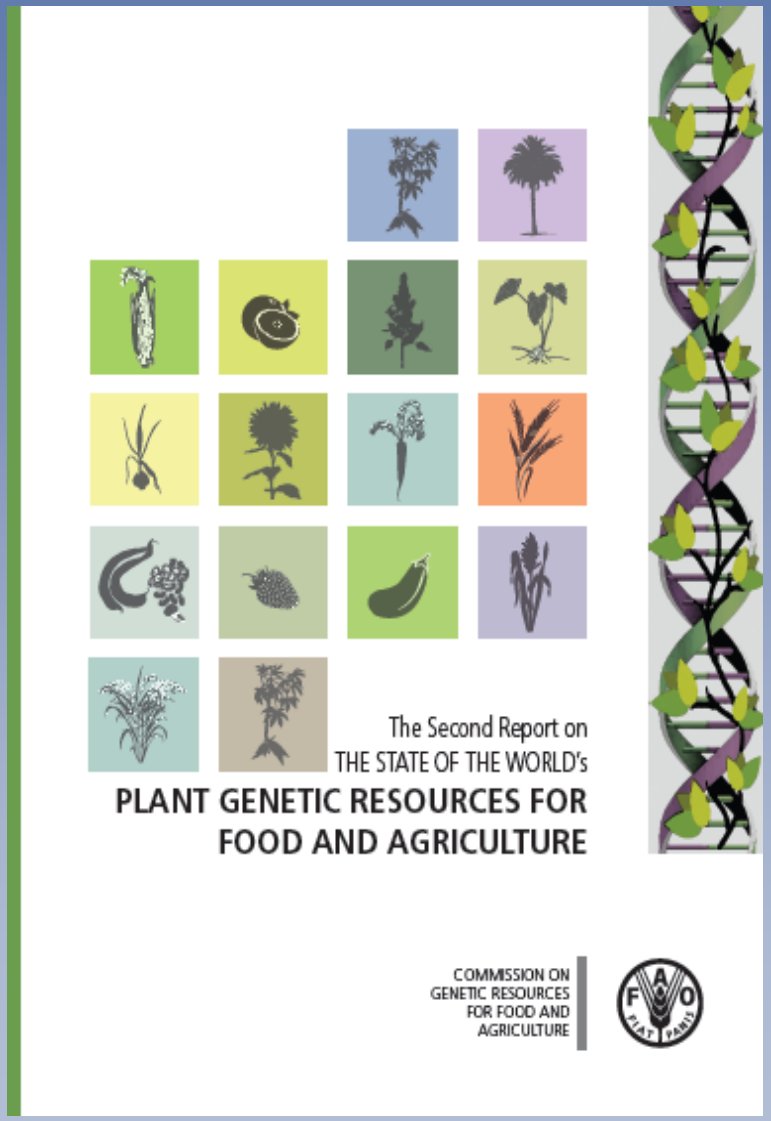
http://www.plantphenomics.org.au/HRPPC

Harnessing PGRFA in the Most Optimal Ways in Order to Reap the Most Benefits

Plant Genetic Resources as commonwealth

- International Plant Protection Convention 1952
- Convention on Biological Diversity, 1992
  - contracted rather than facilitating exchange and hence, use
- Global Plan of Action for the Conservation and Sustainable Use of PGRFA, 1996
- The International Treaty on Plant Genetic Resources for Food and Agriculture, 2001
- Global Crop Diversity Trust, 2004

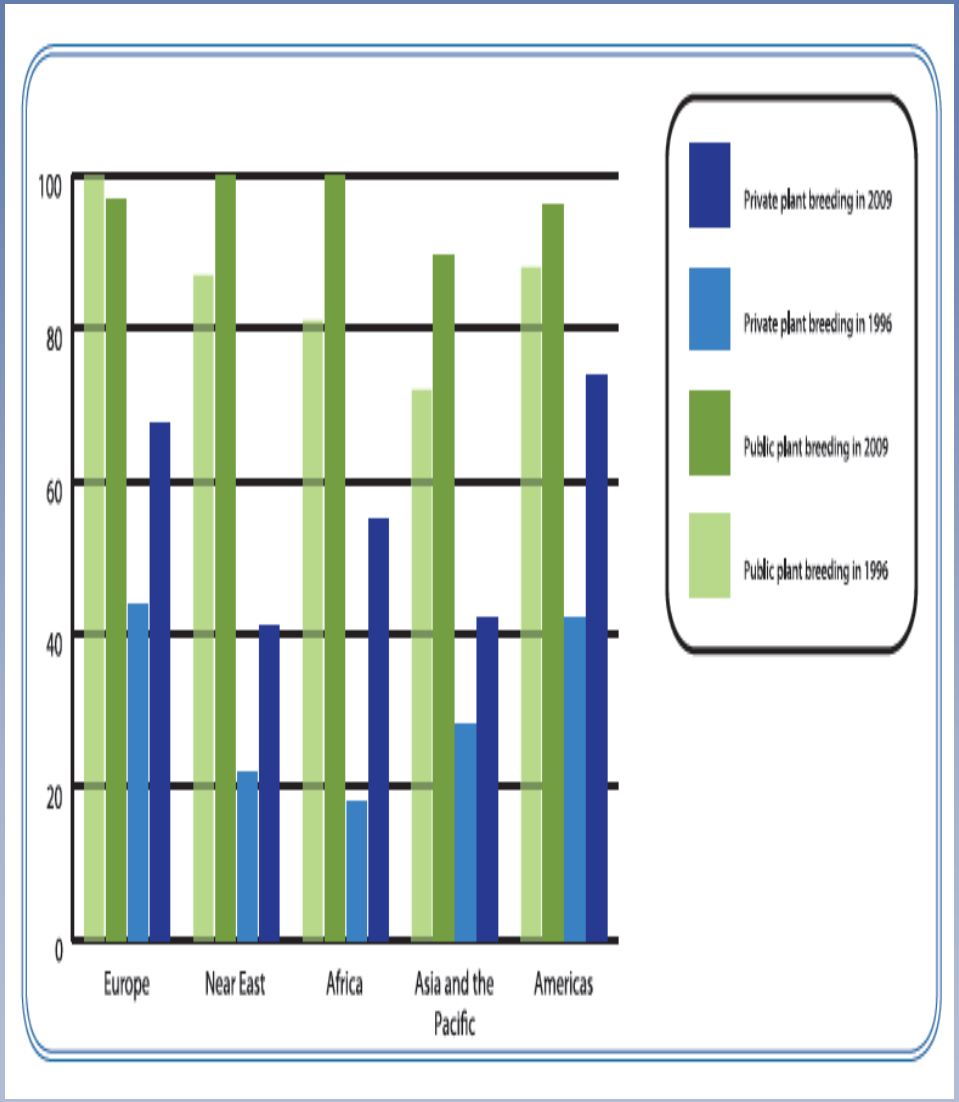
State of the World's PGRFA



Coverage of the SoWPGR-2

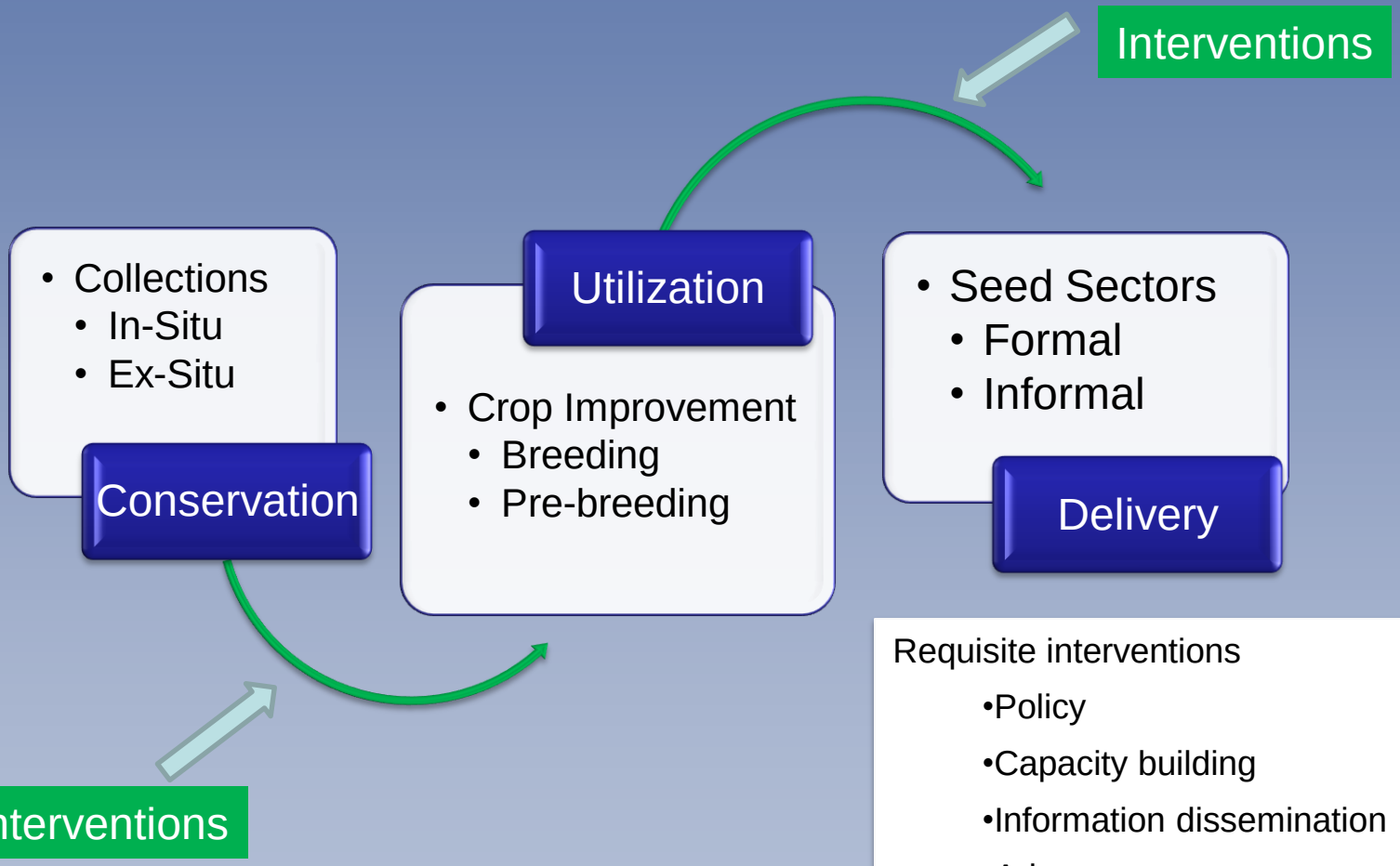
- Current status of plant diversity, how it is being preserved and used
- Main achievements at the global, regional and national level
- Key technical and scientific advances
- Major gaps and needs that require urgent attention

Capacity for Crop Improvement



- Capacity for breeding new crop varieties largely stagnant or shrinking
- Severally identified as major constraint

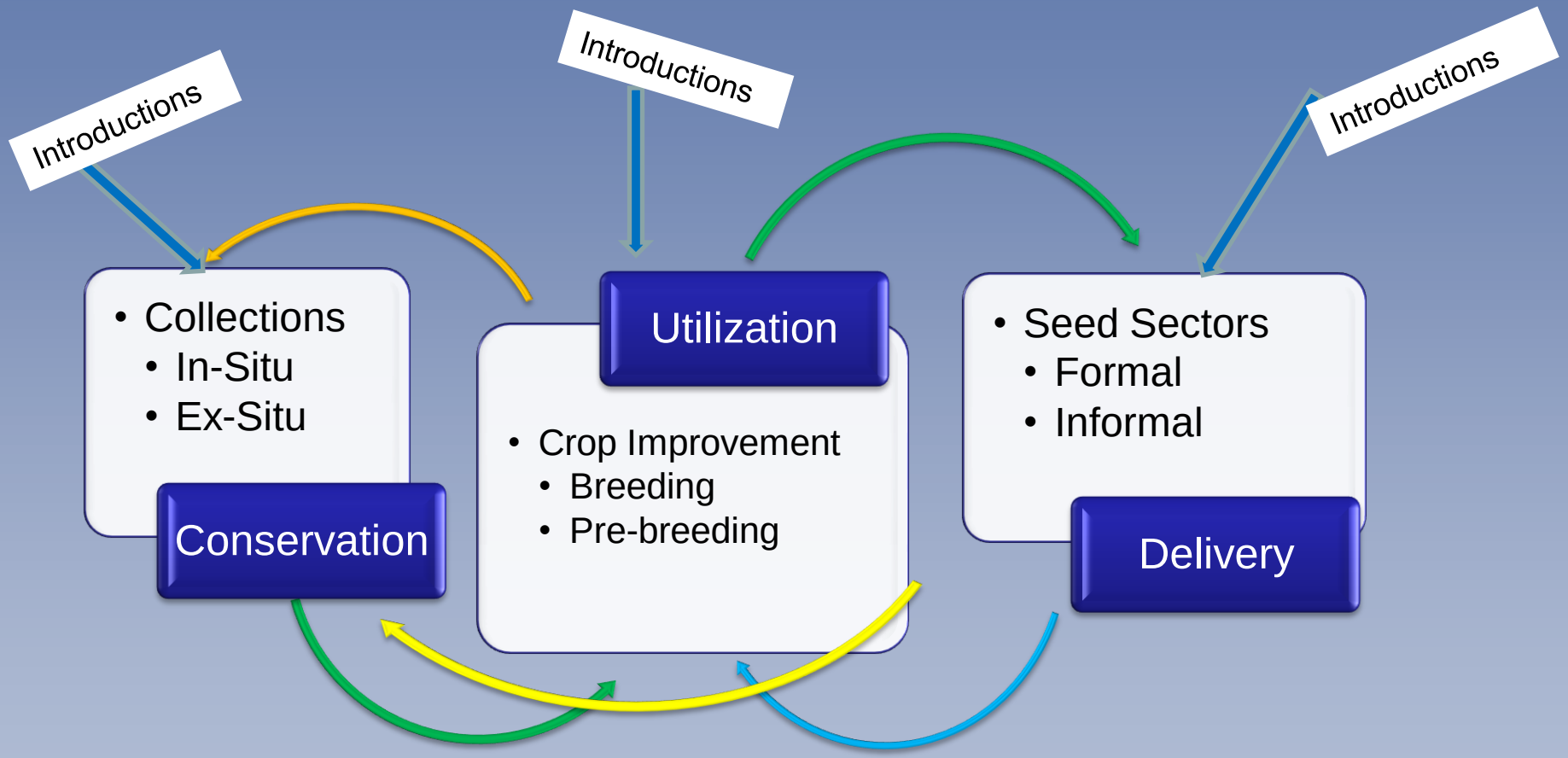
The PGRFA Continuum



Requisite interventions

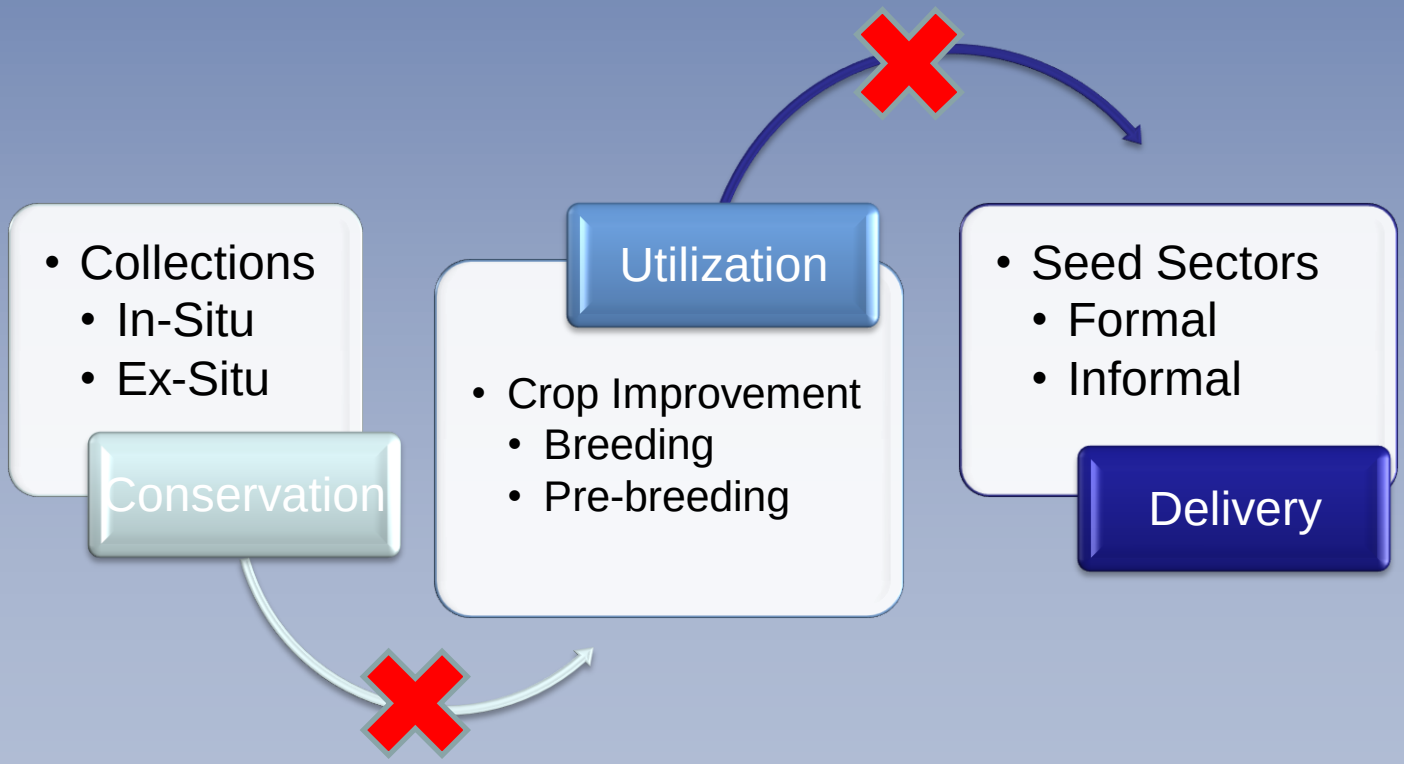
- Policy
- Capacity building
- Information dissemination
- Advocacy
- Emergency

The PGRFA Continuum



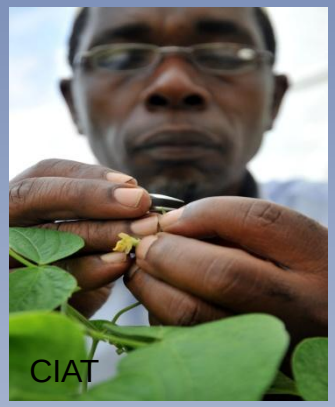
The PGRFA Continuum

Not always continuous. Indeed, broken often



Need for re-thinking PGRFA management

- Activities too often very severely compartmentalized
- Components operated as if they were independent entities rather than a continuum
- Seamless dovetailing is key --- components are mutually enriching



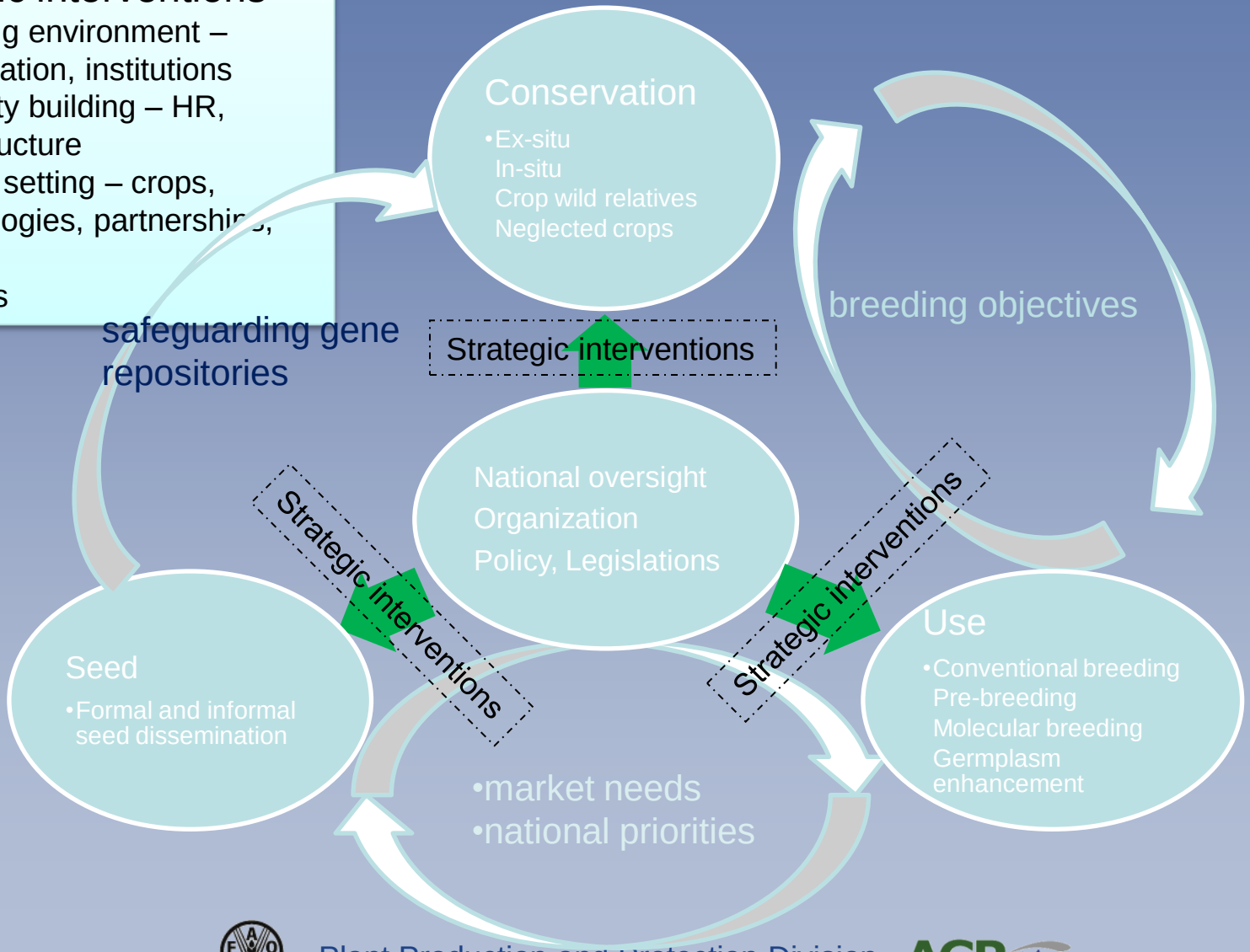
Towards Managing PGRFA as a Continuum

- A National Strategy on PGRFA
  - All inclusive from conservation through breeding to seeds
- A High-Level Coordinating body
  - Overall responsibility for PGRFA management
- Strengthening of Capacity
  - Human resources and infrastructure

Conceptualizing a National PGRFA Strategy

Strategic interventions

- Enabling environment – coordination, institutions
- Capacity building – HR, infrastructure
- Priority setting – crops, technologies, partnerships, budget
- Markets



Introducing the Multi-stakeholder Platform -- the Global Partnership Initiative for Plant Breeding Capacity Building -- GIPB

Who --- GIPB in PGRFA context

- FAO-convened multi-party initiative of knowledge institutions committed to developing strong and effective plant breeding capacity globally

- Partnership of stakeholders from the public, private and civil society sectors, that catalyze and support national, regional and global action relevant to PGRFA

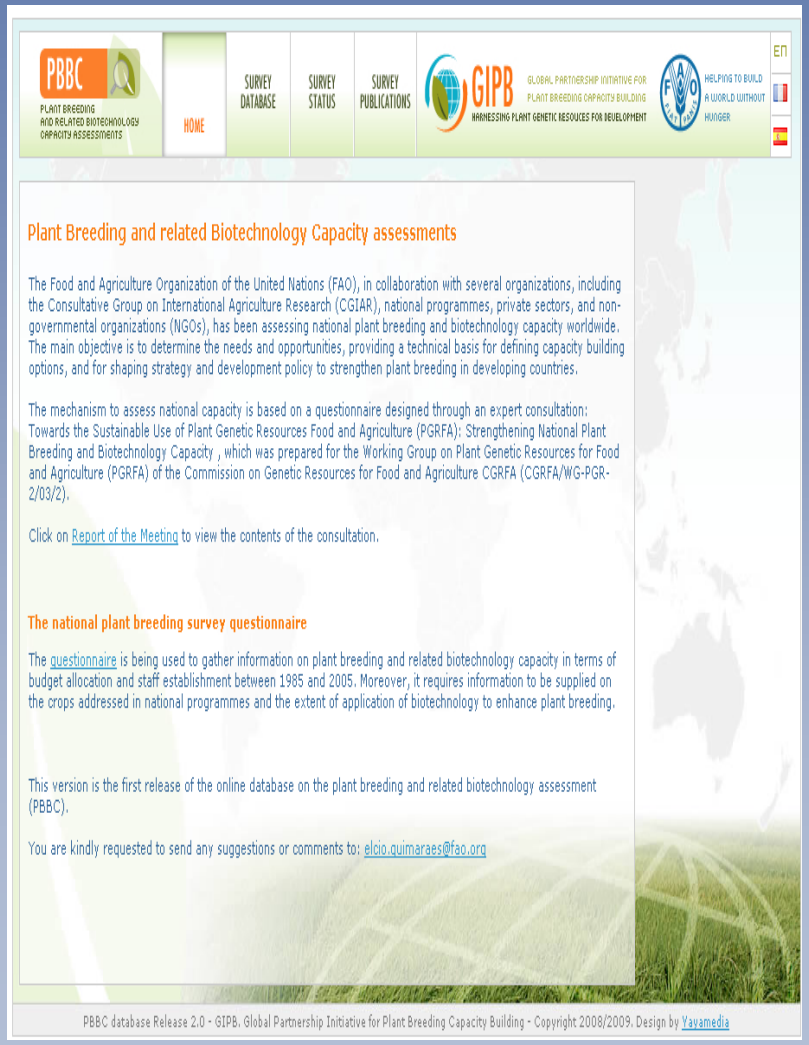
- Underpins the efforts towards the realisation of Article 6 of the IT-PGRFA:
  - sustainable use of plant genetic resources via better plant breeding and seed delivery systems

What --- 5-point Agenda

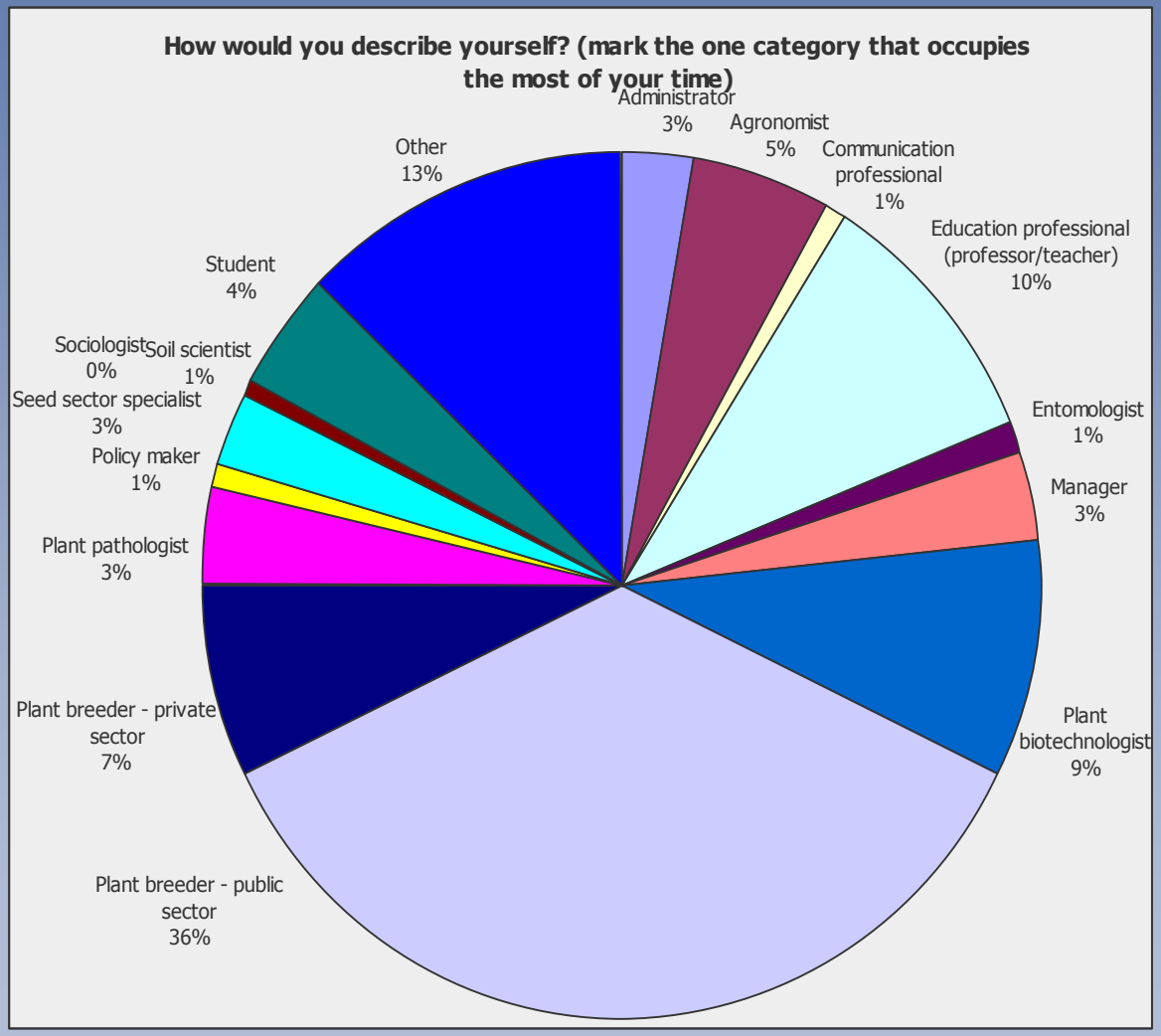
- Policy
- Education & Training
- Access to Technologies
- Exchange of PGRFA
- Sharing of Information

How --- Strategies adopted

- Establish the baseline: national capacity surveys
- Define the interventions and approaches that work
- Develop national plans for best use of plant genetic resources for agriculture
- Build capacity for highest effectiveness



Whence --- Overview



Which country are you from?

Total Answers: 464	**Mandatory:** Yes	
MORE SIGNIFICANT ANSWER OPTIONS	**NUMBER OF ANSWERS**	**%**
United States of America	75	16.2%
Brazil	36	7.8%
India	35	7.5%
Kenya	15	3.2%
United Kingdom	11	2.4%
Canada	10	2.2%

So far

- Assessment of national plant breeding capacity
- Policy awareness and development
  - Advocacy materials
  - Many countries developing comprehensive national strategies
- Knowledge Resource Centre
  - Web portal that uniquely provides plant breeding and other PGRFA-relevant information
- Strengthening of Capacity
- Formulation of a 5-year operational plan

Facilitation of training in pre-breeding

GIPB

Pre-breeding for effective use of plant genetic resources
e-learning course

Course Menu | Back to Lesson

ABOUT THIS COURSE
- Overview
- Structure and Workload
- Contributing Organizations
- Contributing Individuals

MY COURSE

SEARCH

RESOURCES

HELP & SUPPORT

LEGAL INFORMATION

OVERVIEW

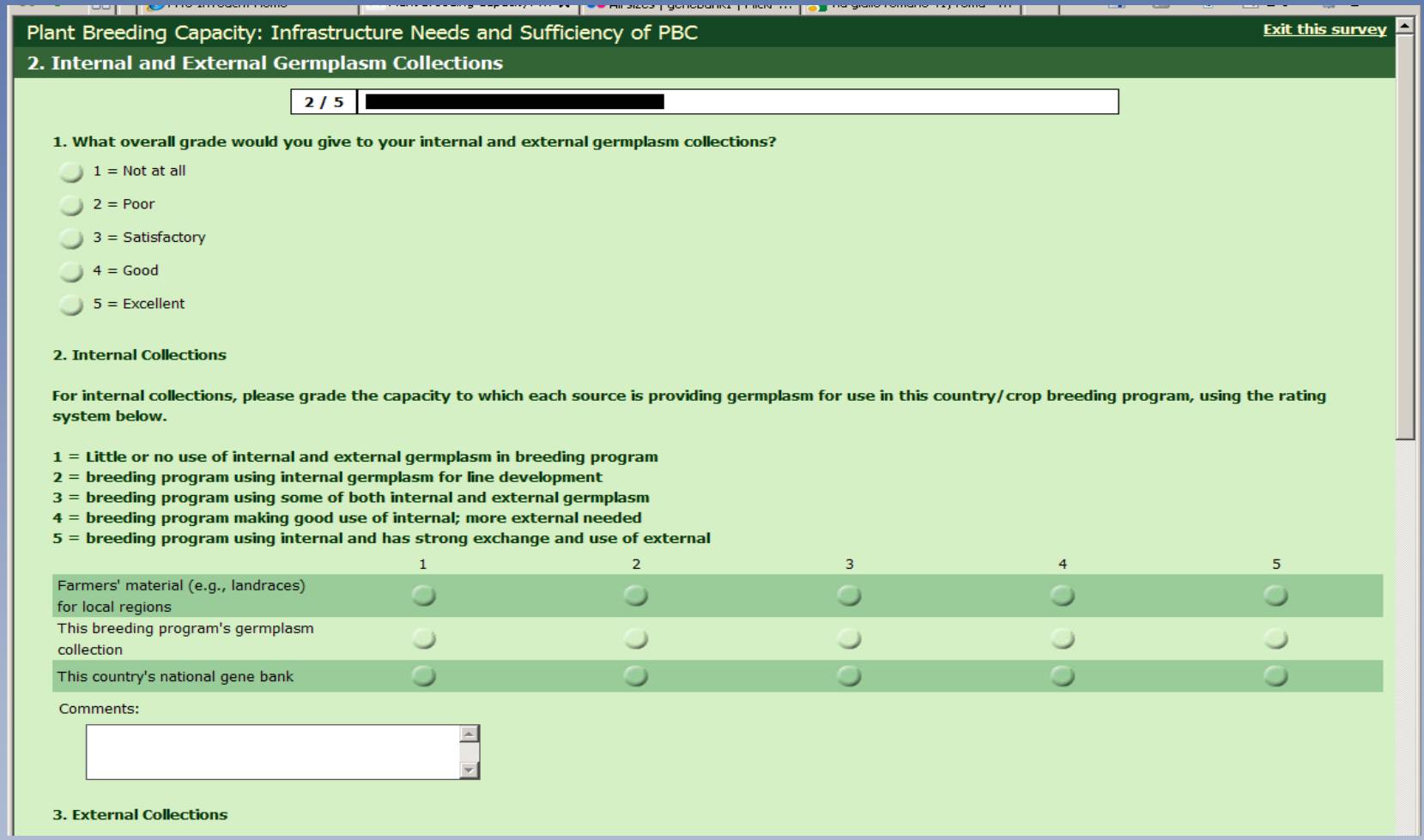
Welcome to the course on **Pre-breeding for Effective Use of Plant Genetic Resources**, designed to support and optimize genetic improvement of crops for the sustainable benefit of growers and consumers. The importance of germplasm resources for crop improvement is widely recognized, but their effective use in breeding can be complex, risky, and expensive. On the other hand, it can have very large rewards in terms of making valuable traits more accessible to plant breeders, to address critical global issues such as food security in the face of climate change.

Pre-breeding is an opportunity to build a bridge that brings together the people who understand the scope and value of germplasm collections (genebank managers) with those who need to introduce new traits into their cultivars (plant breeders). This course will build capacity of breeders to make more effective use of the diversity conserved in genebanks.

The course draws from the expertise of world experts in genebank management, pre-breeding, plant breeding and molecular techniques, aimed toward integrating this information into a systematic and comprehensive resource for anyone involved in pre-breeding. The **principal audience** includes the **genebank managers** and **plant breeders** working in public or private organizations. Others who will benefit are university lecturers and students working in crop science and related faculties, and extension specialists. The development of the course has been funded by the Global Crop Diversity Trust.

Beta version: www.imarkgroup.org/projects/PBcourse.htm

Assessing Capacity to Deliver Improved Crops Varieties



Plant Breeding Capacity: Infrastructure Needs and Sufficiency of PBC

Exit this survey

2. Internal and External Germplasm Collections

2 / 5

1. What overall grade would you give to your internal and external germplasm collections?

- 1 = Not at all
- 2 = Poor
- 3 = Satisfactory
- 4 = Good
- 5 = Excellent

2. Internal Collections

For internal collections, please grade the capacity to which each source is providing germplasm for use in this country/crop breeding program, using the rating system below.

1 = Little or no use of internal and external germplasm in breeding program
2 = breeding program using internal germplasm for line development
3 = breeding program using some of both internal and external germplasm
4 = breeding program making good use of internal; more external needed
5 = breeding program using internal and has strong exchange and use of external

	1	2	3	4	5
Farmers' material (e.g., landraces) for local regions					
This breeding program's germplasm collection					
This country's national gene bank					

Comments:

3. External Collections

To support design of results-oriented breeding programs

Mainstreaming Strategic Interventions

Development of Policy Elements

A three-phase process

- **Symposium** to articulate set of best practices for the three components of PGRFA management – conservation, use and dissemination – and for strengthening their interfaces

- **Articulation of policy elements** by translating best practices into policies; and

- **Validation and Dissemination** through regional consultative workshops, publications and backstopping

Best Practices and Policy Interventions

	Effective linkages between conservation of PGRFA and breeding	Use of PGRFA in breeding and pre-breeding, novel techniques	Effective linkages between plant breeding and dissemination of seeds
Policy environment			
Education and capacity building for the next generation of plant breeders			
Scientific, technical and technological tools and methodologies in support of plant breeding			
Information technology support tools			
Partnerships			

Thank you very much!!!