# Challenges and Opportunities for Cooperation in Agrobiodiversity Research in the Context of the Labex Program

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**Suwon - Republic of Korea**

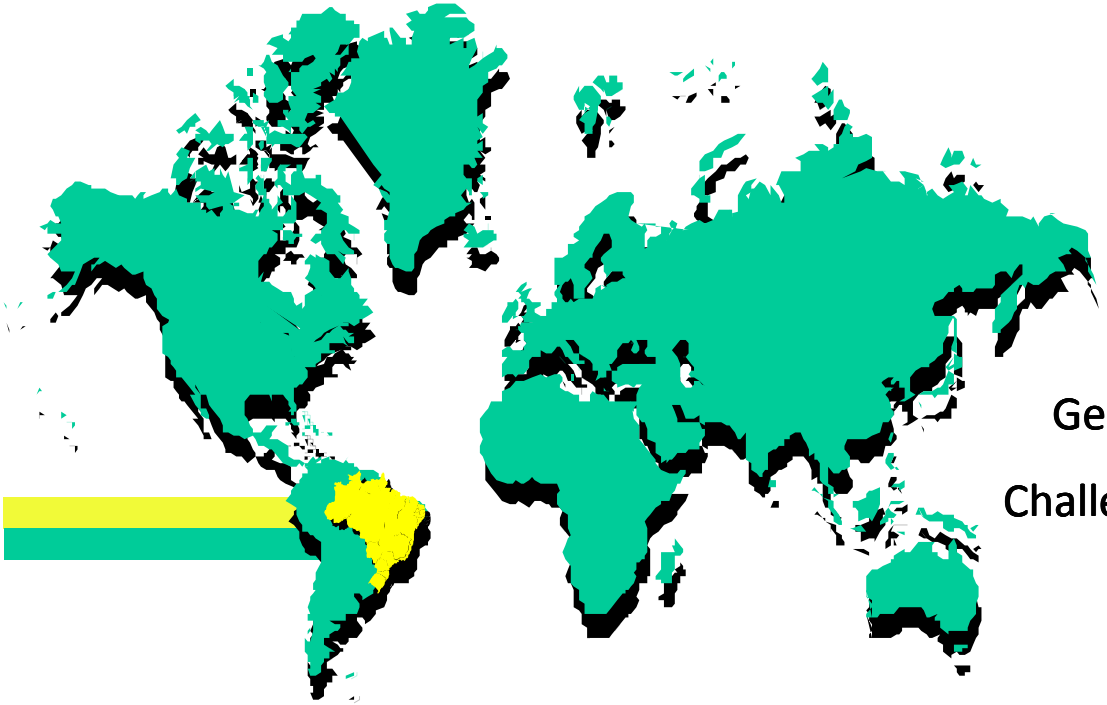
# Challenges and Opportunities for Cooperation in Agrobiodiversity Research in the Context of the Labex Program


## SUMMARY

For over a decade the Embrapa Labex Program has become an innovative initiative of international cooperation of Brazil with North America and Europe, creating opportunities for identification of trends and opportunities of cooperation and for implementation of R&D activities in partnership with multiple international organizations. The decision to implement a Labex in South Korea, with the creation, by RDA, of a similar structure in Brazil (RAVL), is a fact that creates opportunities for improving the Labex concept, since both organizations will be able to embrace the challenges and the leaning process together, towards maximum benefits for both sides. The decision to include genetic resources as a priority area of cooperation creates an opportunity for both, Embrapa and RDA, to boost their ability to access and use genetic variability as means of overcoming challenges and seeking new opportunities for agriculture, agribusiness and bioindustries of both countries. The emerging bioeconomy, the expected risks and challenges associated with global climate change and the increasing pressures for development of sustainable agricultural production systems point to the need to streamline the process of enrichment, conservation, characterization, value addition and use of plant, animal and microbial genetic resources. Adequately studied and better known, many biological functions stored in germplasm collections, in non-domesticated species and in biodiversity resources not yet collected or described, may be gradually incorporated into species of importance to agriculture and bioindustry. Traits and values not yet important to conventional breeding programs, such as those related to environmental services, dynamics of carbon, as well a biological functions in the confluence with the food, pharmaceutical, chemical, health and energy industries will, certainly, increase the interest in biologic resources, as well as in innovative processes to mobilize and use genetic variability in the near future.

However, in this type of cooperation it is important to take into consideration that issues related to access and use of biological resources, which were until recently considered in the scientific domain, have acquired political, social, economic and legal dimensions. Therefore, R&D programs that depend on exchange and use of biological resources must make concrete efforts to analyze and to understand policy and legal issues related to their mobility, taking into account developments in both international and national contexts. In light of the above, any Brazil-Korea cooperation in biological resources must be fully compatible with national strategies and policies implemented in both countries, as well as aligned to the global policy landscape. Labex Korea will be developing, in partnership with the Korea Advanced Institute of Science and Technology (KAIST), in Daejeon, an information and decision support process to facilitate future exchange and use of biological resources for agriculture and bioindustry between the two countries.

# Challenges and Opportunities for Cooperation in Agrobiodiversity Research in the Context of the Labex Program



The Embrapa Network

The Labex Program

Labex in Asia

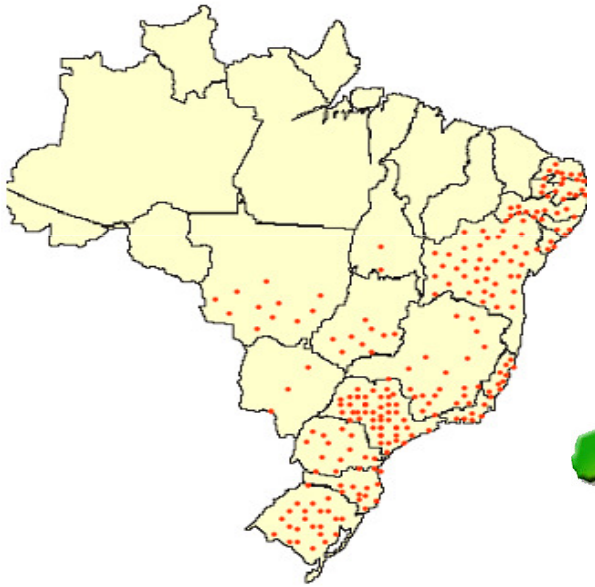
Genetic Resources in the Labex Program

Challenges and Opportunities of Cooperation

Discussion

# The Brazilian Agricultural Research System

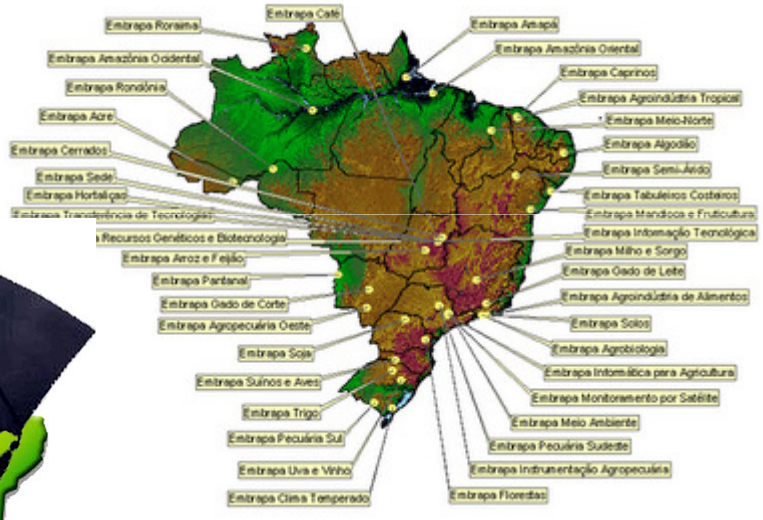
## 17 State Research Networks
## OEPAS



**CONSEPA**
Conselho Nacional dos Sistemas Estaduais de Pesquisa Agropecuária

## 70 Universities

## The Brazilian Agricultural Research Corporation
## 40 Embrapa Centers




## Private Sector

Brazil has also an active and growing private sector, which supplies technologies and technical assistance mainly in farm inputs and food processing

Embrapa

# The Brazilian Agricultural Research System


## A strong academic base

10,000 doctors trained every year
16,000 scientific papers
Rank 13 in scientific publications
A growing intensity of industry R&D

"Brazil clearly has very real strength in life sciences, particularly related to natural resources. It really is the 'natural knowledge' economy… "

Brazil is also strong in areas related to animal and plant biology, agriculture and veterinary science. Its greater than 5% share of world publications has underpinned key economic sectors but also gives it the knowledge base to develop its 'natural knowledge'."

Global Research Report – Brazil, Research and collaboration in the new geography of science
Thomson-Reuters - http://researchanalytics.thomsonreuters.com/grr/

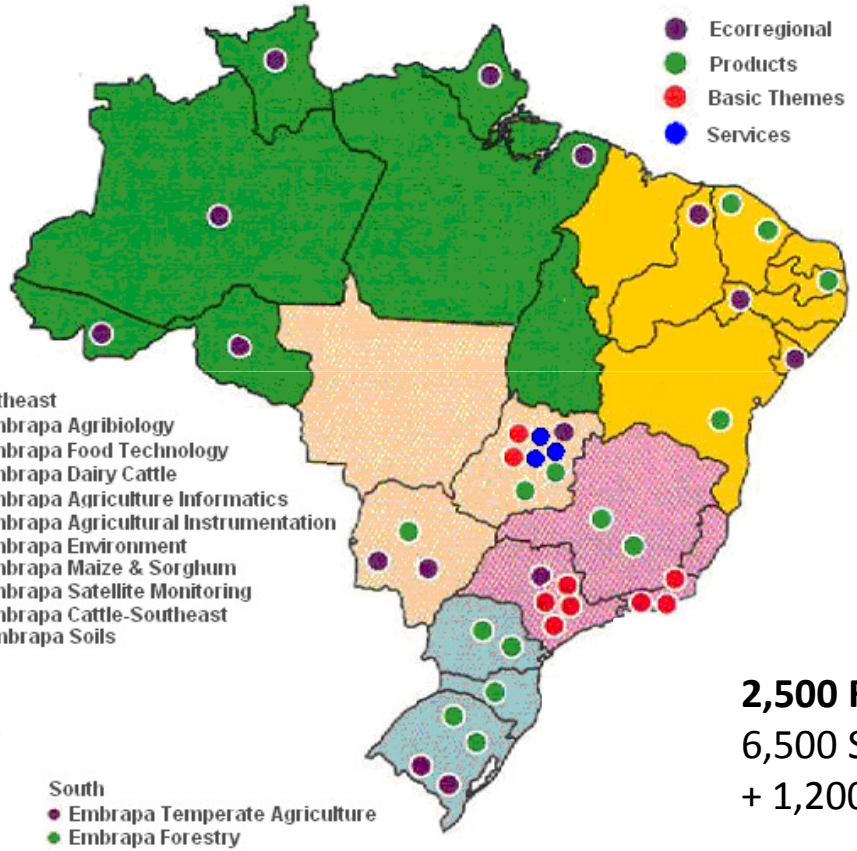
Embrapa

# The Brazilian Agricultural Research System

The Brazilian Agricultural Research Corporation – Embrapa, is the largest component of the Brazilian ARD System

## Embrapa Network for R,D&I

- ✓ 41 Research Centres and Services Units
- ✓ 3 Virtual Laboratories Abroad (Labex)
- ✓ Offices for Technology Transfer: 14 in Brazil and 2 abroad (Africa and Venezuela)




**North**
- Embrapa Acre
- Embrapa Amapa
- Embrapa Western Amazon
- Embrapa Eastern Amazon
- Embrapa Rondonia
- Embrapa Roraima

**Northeast**
- Embrapa Mid-North
- Embrapa Tropical Semi-Arid
- Embrapa Coastal Tablelands
- Embrapa Goat and Sheep
- Embrapa Cassava &Tropical Fruits
- Embrapa Cotton
- Embrapa Tropical Agroindustry

**Mid-West**
- Embrapa Agrienergy
- Embrapa Western Region Agriculture and Livestock
- Embrapa Rice & Beans
- Embrapa Coffee
- Embrapa Cerrados
- Embrapa Beef Cattle
- Embrapa Vegetables
- Embrapa Technological Information
- Embrapa Pantanal
- Embrapa Genetic Resources & Biotechnology
- Embrapa Technology Transfer

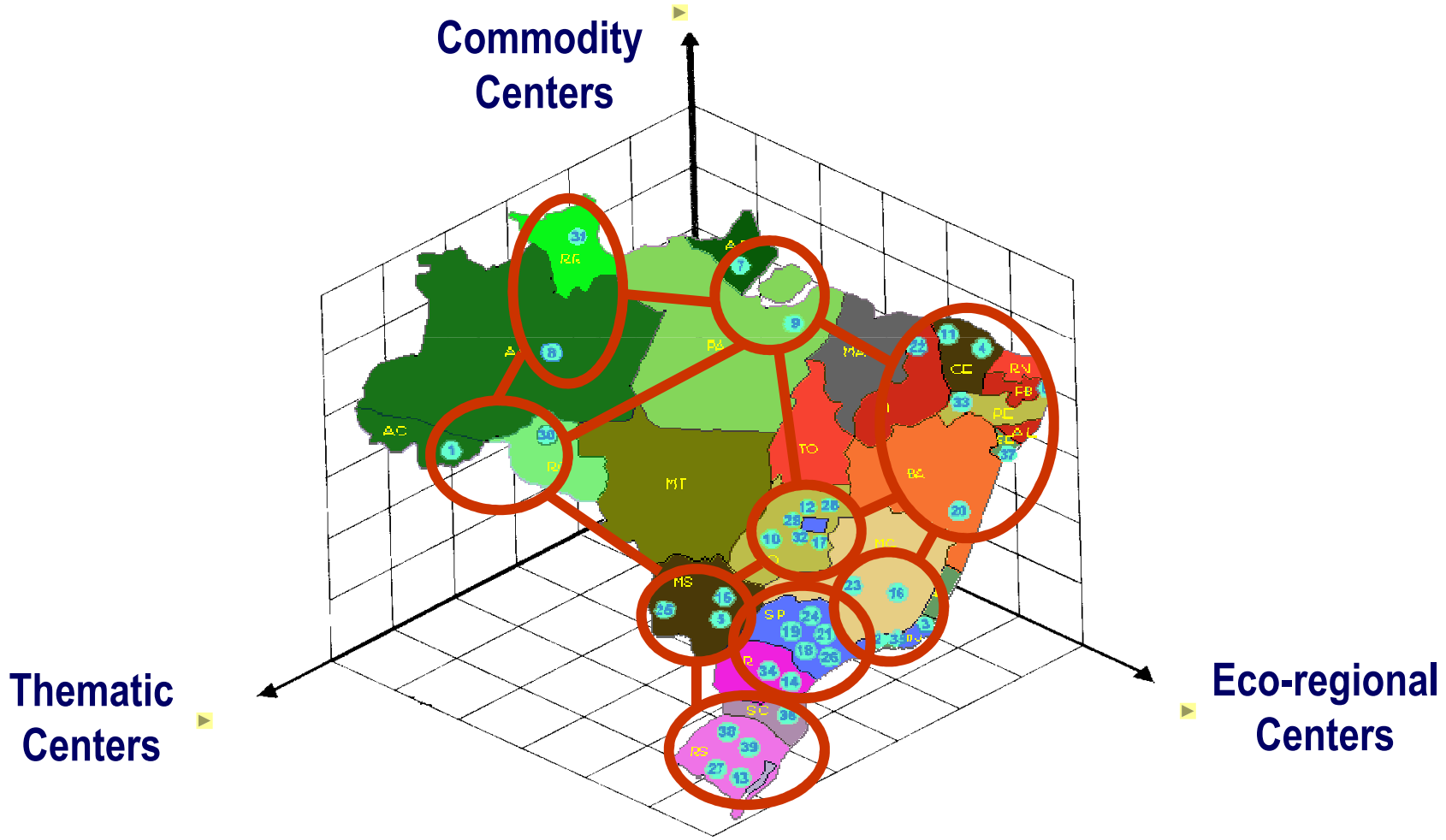
**Southeast**
- Embrapa Agribiology
- Embrapa Food Technology
- Embrapa Dairy Cattle
- Embrapa Agriculture Informatics
- Embrapa Agricultural Instrumentation
- Embrapa Environment
- Embrapa Maize & Sorghum
- Embrapa Satellite Monitoring
- Embrapa Cattle-Southeast
- Embrapa Soils

**South**
- Embrapa Temperate Agriculture
- Embrapa Forestry
- Embrapa South Animal Husbandry & Sheep
- Embrapa Soybean
- Embrapa Swine and Poultry
- Embrapa Wheat
- Embrapa Grape & Wine

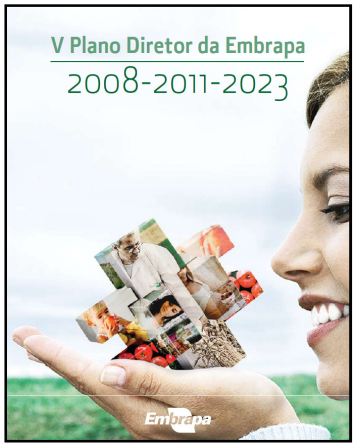
**2,500 Researchers**
6,500 Staff
+ 1,200 new hirings (2013)

2009 Budget: US$ 1 Billion

# The Brazilian Agricultural Research Corporation

# The Brazilian Agricultural Research Corporation



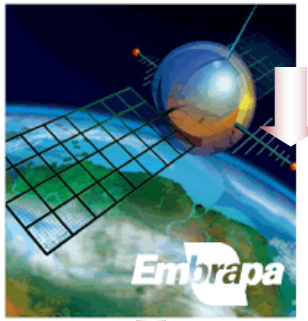

**Strong emphasis in perfecting its strategy to shape research programs to meet the demands of the users**


**Competitivity Sustainability**


**Renewable Energy**


**Natural Resources**


**Agrobiodiversity Conservation and Use**




**Frontier Programs**

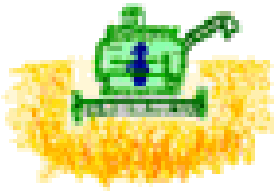
# The Brazilian Agricultural Research Corporation

Emphasis in the continuum R&D – Technology Transfer - Communication
Quality to Science - an internal competitive system strongly sustained in peer review.
R&D & TT strategies that that promote networking and strong slinks with the private sector

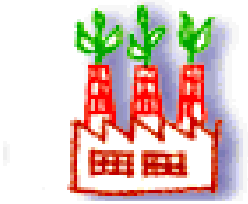

| | | | |
|---|---|---|---|
| **R&D** | R&D | R&D | R&D |
| TT | TT | **TT** | **TT** |
| Comum. | Comum. | Comum. | **Comum.** |

# The Brazilian Agricultural Research Corporation

## Contributions of Embrapa



**Advanced Production Systems**

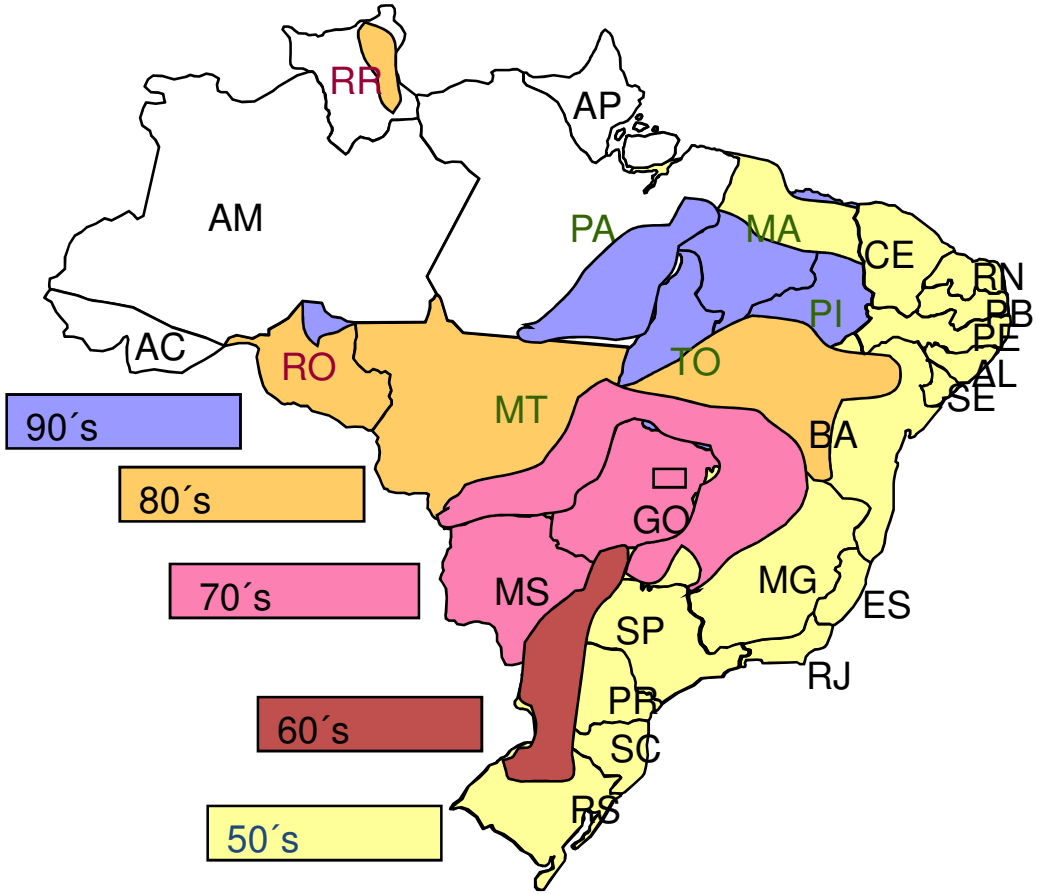


**Agroindustry**

**Environment**

**Regional Development**

# The Brazilian Experience in Tropical Agriculture




## Brazilian Agriculture

### From the 50´s to the 90´s

http://www.thedailygreen.com/cm/thedailygreen/images/EM/Cerrado_map-lg.jpg

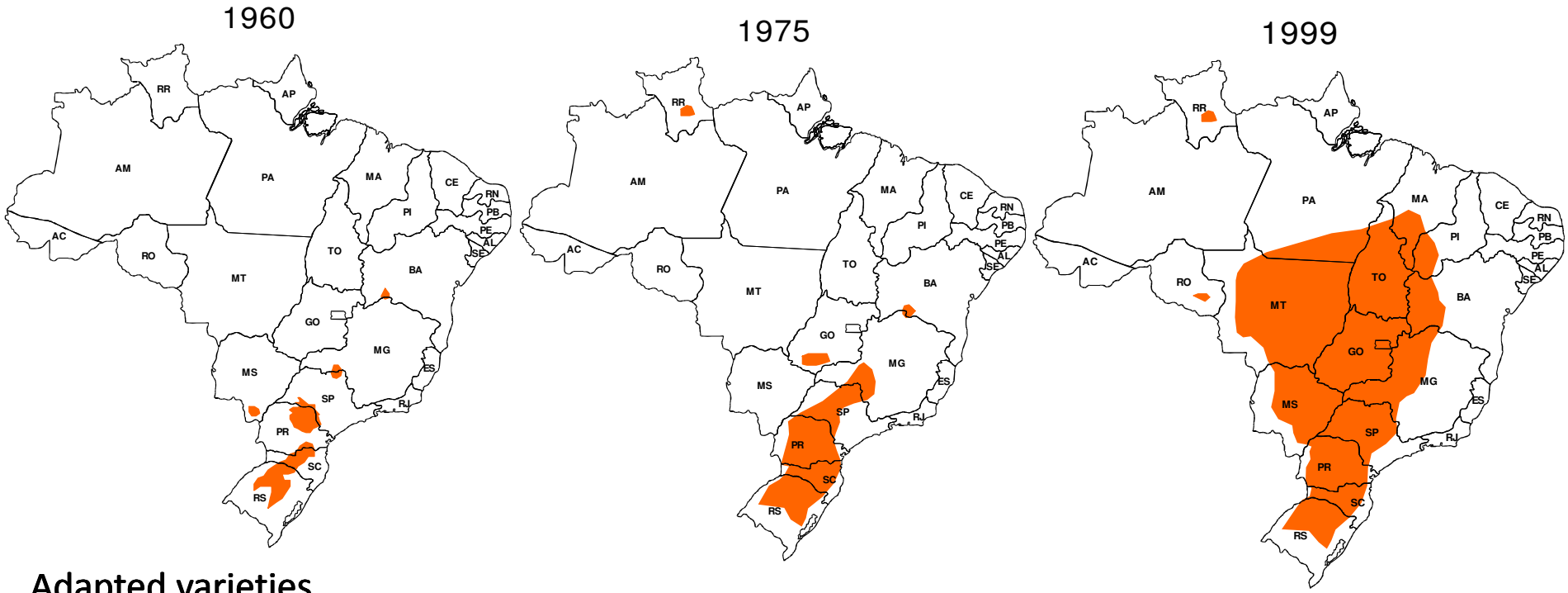
Source: MAPA, 2002

# The Brazilian Experience in Tropical Agriculture

# The Brazilian Experience in Tropical Agriculture

## Tropical soybeans

### Technological evolution and crop expansion in Brazil




Adapted varieties

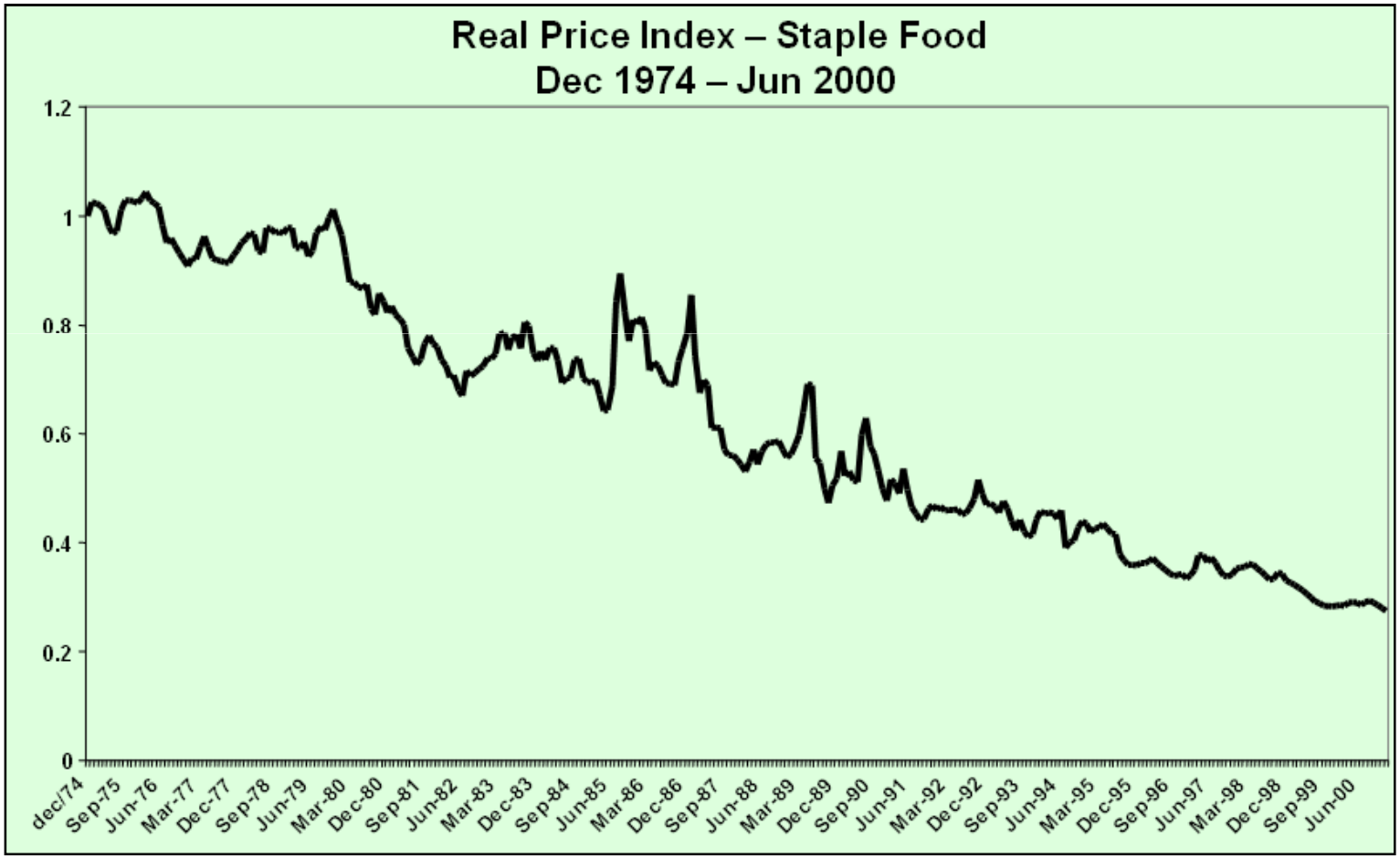
Biological nitrogen fixation

Minimum tillage - mechanization

Source: Embrapa Soybean

Embrapa

# Agricultural Innovation and Food Security in Brazil




Source: Embrapa

Embrapa

# Agribusiness in Brazil – Food, Feed, Fiber

## Exports

In 2008 Brazil exported more than 1500 types of agricultural products to foreign markets

## Commercial partners

Around 79% of the Brazilian food production is consumed domestically and 21% is shipped to over 212 foreign markets

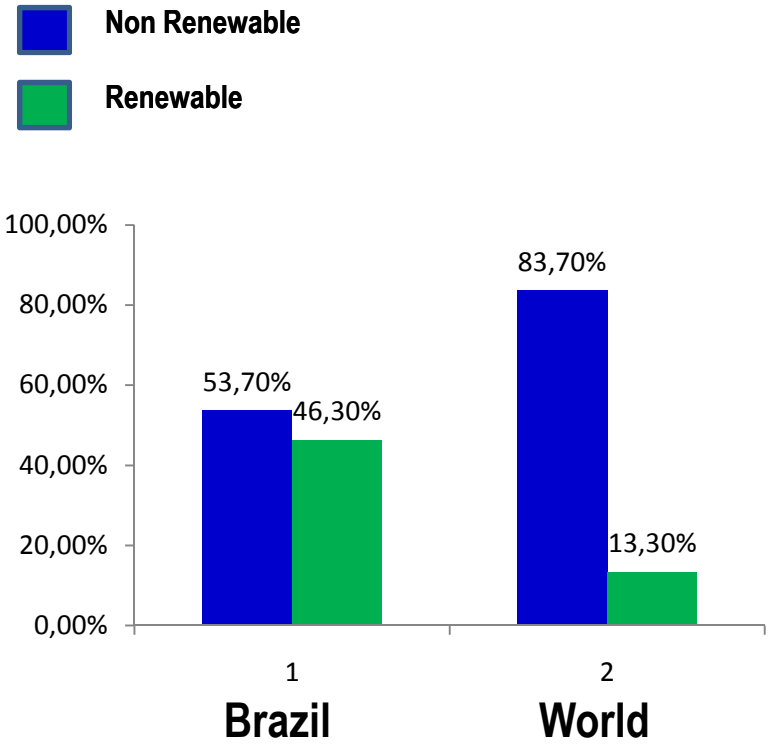
| Product | Production | Exports |
|---|---|---|
| Sugar | 1st | 1st |
| Orange juice | 1st | 1st |
| Coffee | 1st | 1st |
| Beef | 2nd | 1st |
| Soybean | 2nd | 1st |
| Tobacco | 3rd | 1st |
| Broiler | 3rd | 2nd |
| Corn | 3rd | 4th |

Source: SPA/MAPA (Agricultura Brasileira em Números)

Embrapa

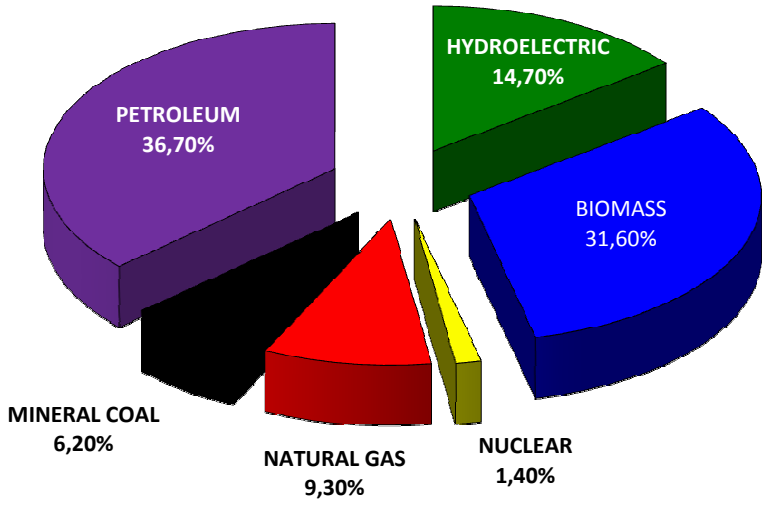
# Agribusiness in Brazil – Food, Feed, Fiber and Fuel

## Brazilian vs World Energy Matrix




Source: MME, 2008

## BrazilianEnergy Matrix

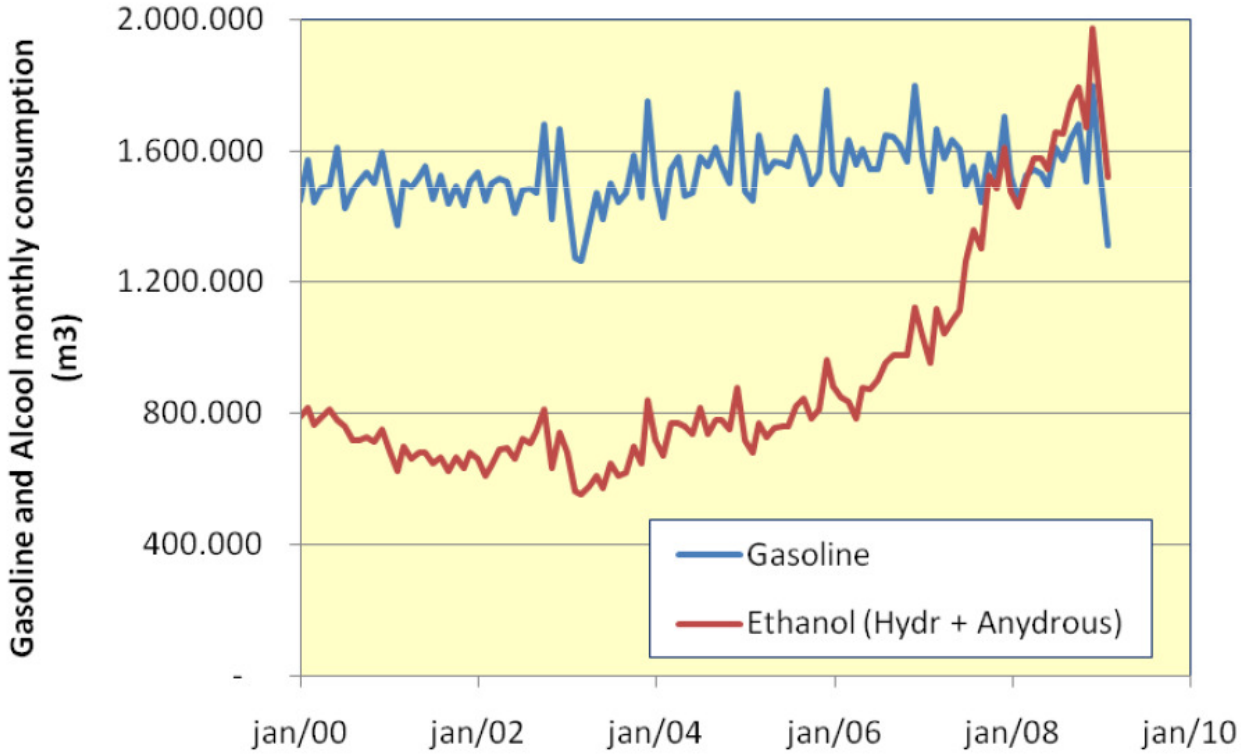



Source: EPE, 2008.

# Agribusiness in Brazil – Food, Feed, Fiber and Fuel

## Sugarcane Etanol as Energy Source in Brazil

**`Gasoline is Becoming the Alternative Fuel in Brazil`**




Source: ANP, 2009 and Brito Cruz, 2009

Embrapa

# International Cooperation is Key to Embrapa

## Our Belief

**As the world becomes more interconnected and challenges become more complex, it will be increasingly necessary to work through intense cooperation.**

### President Lula: "The Internationalization of Embrapa is a State Policy"

*September 11, 2009 · Leave a Comment*

Source: Embrapa

The Brazilian President Luiz Inácio Lula da Silva welcomed the new President of Embrapa during the inauguration ceremony, last July. He said that "the mark of Embrapa has always to be the technical expertise, no other" and that "Brazil is a plural country and Embrapa has to be plural and capable to attend many, as well as to increase its contribution to the world." President Lula spoke about the expectations for the new management and one of his most emphatic remarks was that "the internationalization of Embrapa is not only a desire for the government, but a state policy, which will be a constant in the future." Read more (in Portuguese) here.

http://labexkorea.wordpress.com/

# International Cooperation at Embrapa


## Two Distinct Strategies

### Technology Transfer Offices

### Virtual Laboratories Abroad- Labex

# International Cooperation at Embrapa

## Technology Transfer Offices


### Embrapa Latin America

**Technology transfer office in Caracas, Venezuela, since May 2008**

**11 Agreements and ongoing projects in Latin American countries**

**Embrapa Americas will be soon opened in Central America - Panama**


### Embrapa Africa

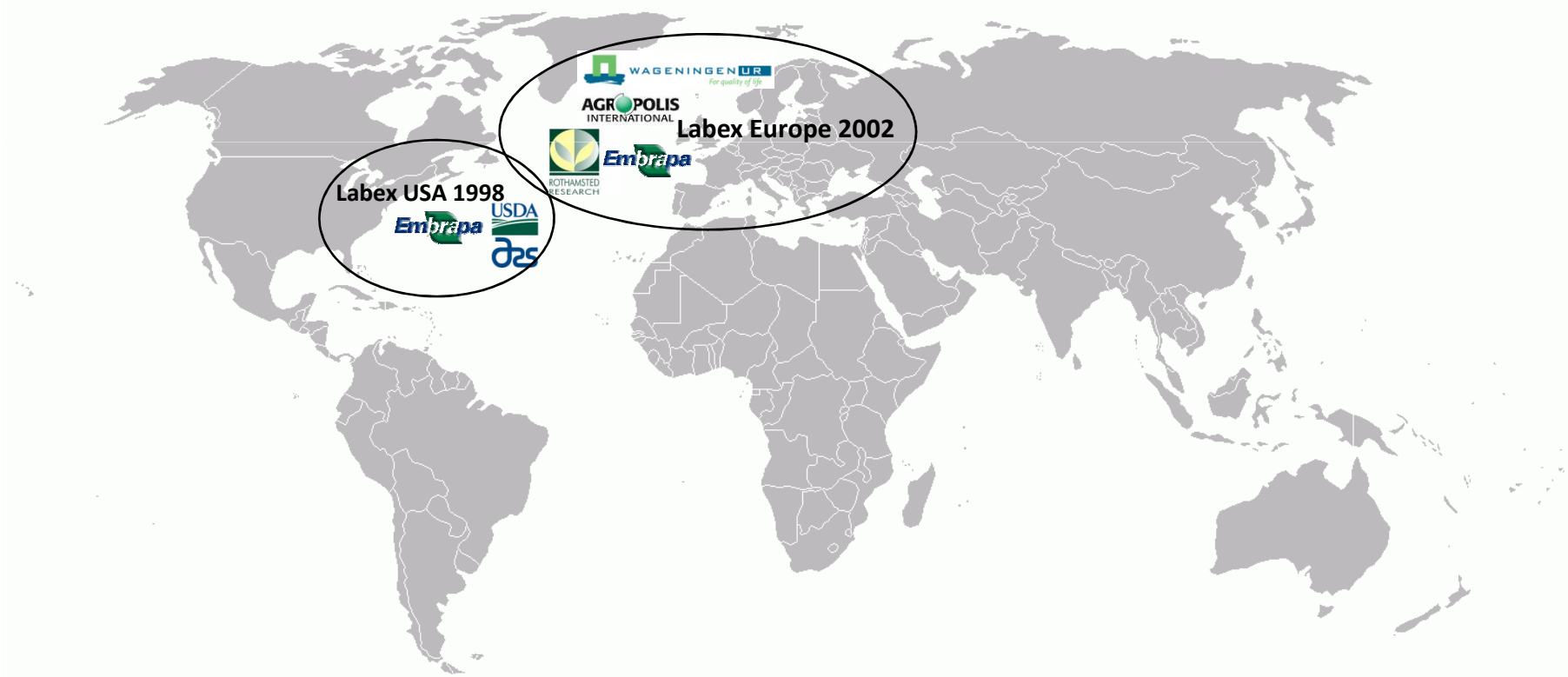
**Technology transfer office in Accra, Ghana since November 2006**

**11 agreements and ongoing projects in several African Countries**

**8 agreements and projects being negotiated**

# **Labex** – cooperation in cutting-edge agricultural R&D

**Embrapa has developed more than a decade ago the concept of "Virtual Laboratories Abroad" – Labex, as means of increasing its scientific and technological ties with advanced research organizations around the world.**




Embrapa

# Expanding the Labex Program to Korea

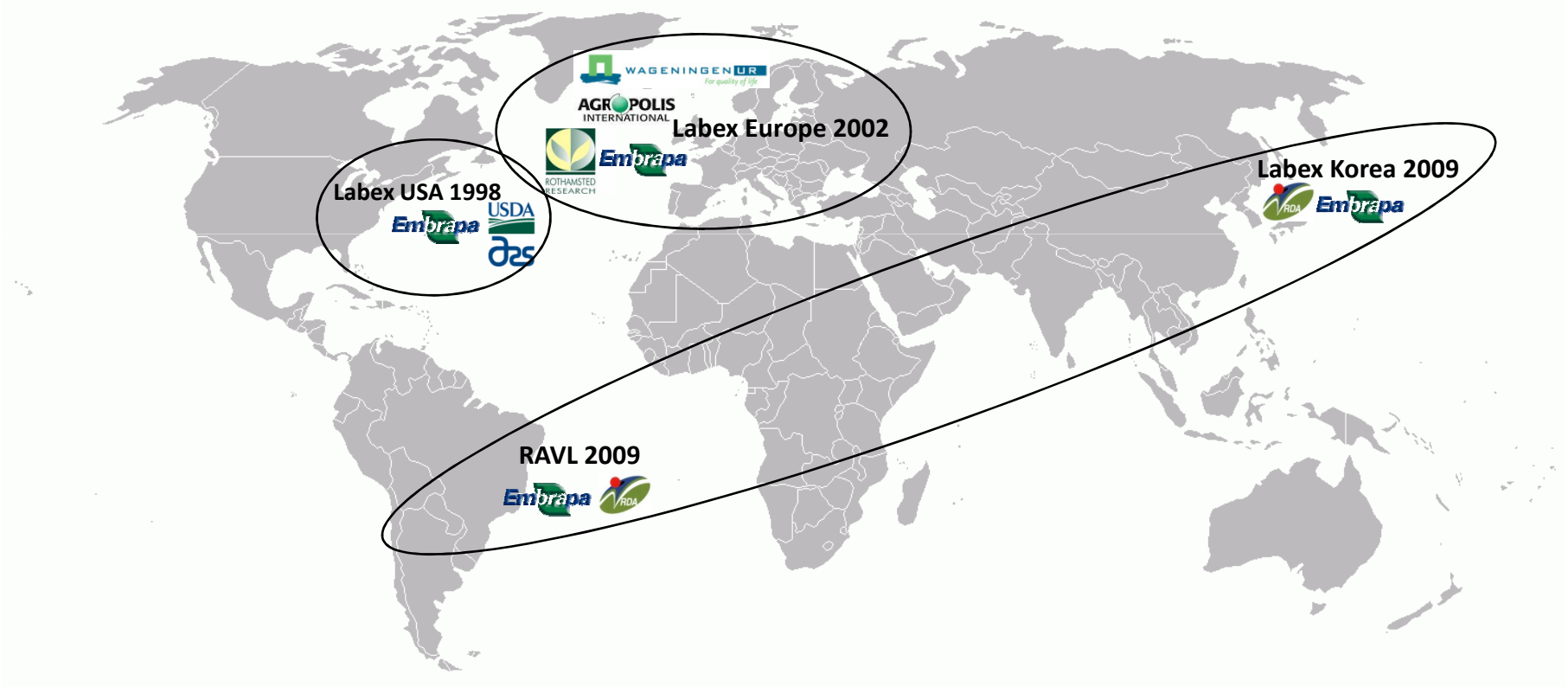
Inauguration of Labex Korea (12.2009)

Korea-Brazil Summit (11.2008)


Embrapa

RDA

# **Labex** – cooperation in cutting-edge agricultural R&D



# The Embrapa Labex Program

## “Labex Mission and Objectives”

**To bring the international dimension to the Embrapa network**

***Monitoring trends in S&T and opportunities of cooperation***

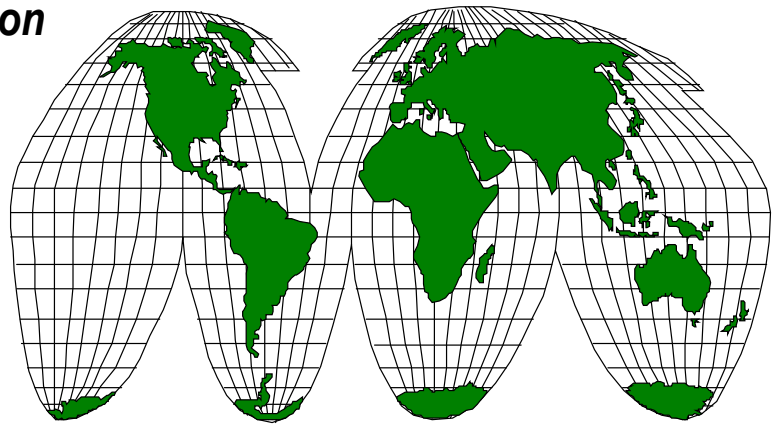
***Promoting collaborative projects in strategic areas***

***Facilitating exchanges of scientists***

***Identifying training opportunities***

***Promoting technical meetings and scientific exchange***

***Follow-up on joint research projects***



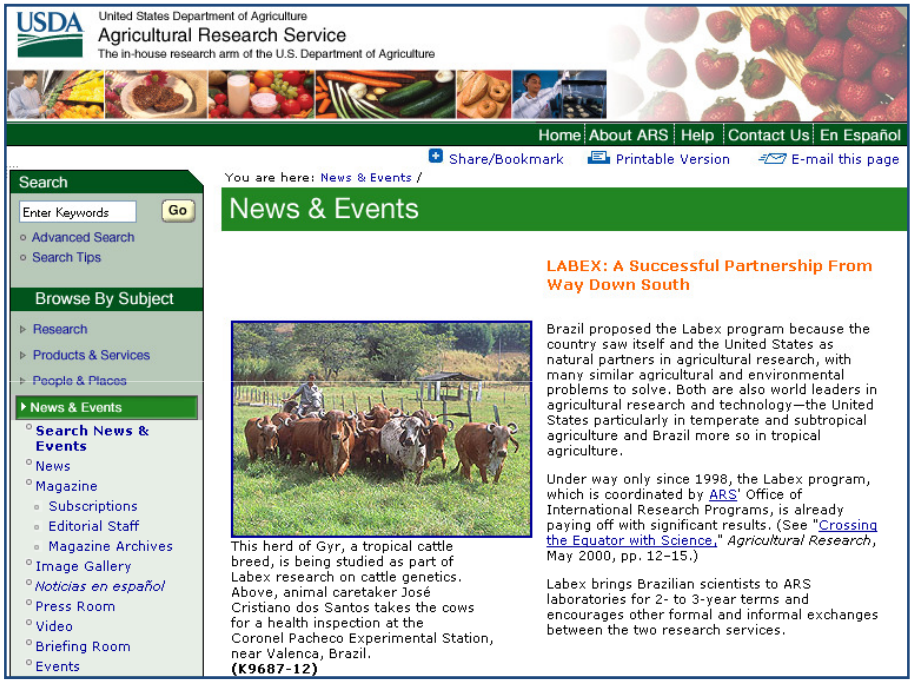
# The Embrapa Labex Program

## "The Labex Impact"

**International networking - cutting-edge research - capacity building - access knowledge access new funds and tools - increased visibility - dialogue in international fora, etc,etc...**

"Advanced Biology"
"Applied Nanotechnology"
"Food Safety"
"Genetic Resources"
"Agro-energy"
"Animal Health"
"Climate Change"
"Natural Resource Management"
"Precision Agriculture"
"Food Processing"
"Forestry"
"Intellectual Property"
"Functional Foods"

# The Embrapa Labex Program




http://www.ars.usda.gov/is/AR/archive/dec01/labex1201.htm


http://www.ars.usda.gov/is/AR/archive/feb07/seeds0207.htm

# Labex Korea – Agenda of Priorities

1. Bioenergy
2. Genetic resources
3. Biotechnology (Plant & Animal)
4. Plant breeding (Crop & Horticulture)
5. Agro-ecosystem and environment
6. Agricultural engineering

# Labex Korea – Agenda of Priorities

## Bioenergy

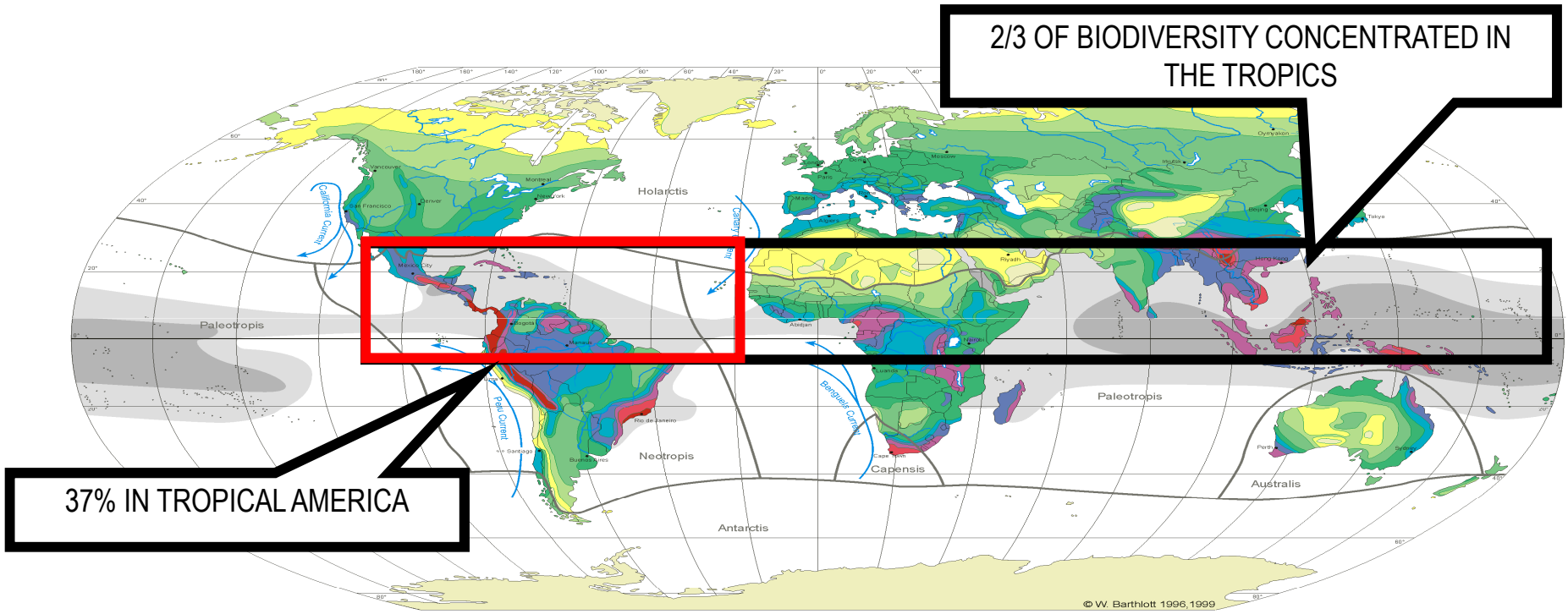
Research cooperation for 1st generation bioethanol production technology

Genetic resources, breeding technology and production systems – biomass and energy

Cooperative research on 2nd generation bioenergy technology (cellulosic ethanol)

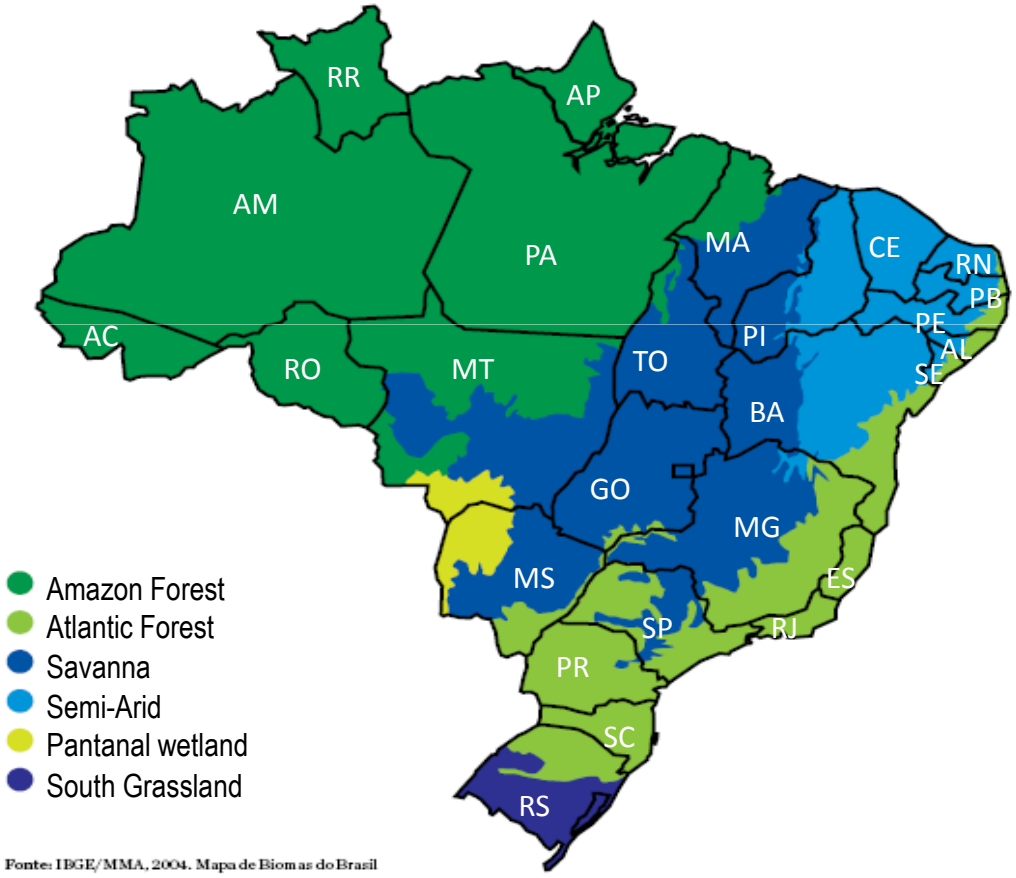
- Bioenergy Crop Research Center, RDA
- KIER – Korea Institute of Energy Research
- KRICT - Korea Research Institute of Chemical Technology
- Chungcheongnam-do Agricultural Research and Extension Service

# Agrobiodiversity Research




Barthlott, W., Biedinger, N., Braun, G., Feig, F., Kier, G. & J. Mutke (1999): Terminological and methodological aspects of the mapping and analysis of global biodiversity. In: Acta Botanica Fennica 162: 103-110.

# Brazilian Biodiversity




Fonte: IBGE/MMA, 2004. Mapa de Biomas do Brasil

## Brazilian Biomes

The country harbors nearly 12% of the entire wildlife of the planet and has high levels of endemism.

Plant diversity is estimated at 55,000 species, of which 22% endemic.

Vertebrate diversity is also quite high, with 524 species of mammals, more than 3,000 freshwater fish species, and about 1,677 bird species.

Terrestrial invertebrate diversity can is impressive, with 10-15 million estimated species of insects

*Source: www.celb.org/xp/CELB/downloads/brazil_5ffactsheet.pdf*

# Brazilian Biodiversity

| COUNTRY | Plants | Mammals | Birds | Reptile | Anfibian |
|---|---|---|---|---|---|
| Brasil | 1 | 1 | 3 | 5 | 2 |
| Colômbia | 2 | 4 | 1 | 3 | 1 |
| Indonésia | 3 | 2 | 5 | 4 | 6 |
| China | 4 | 3 | 8 | 7 | 5 |
| México | 5 | 5 | 10 | 2 | 4 |
| África do Sul | 6 | 14 | 11 | 9 | 15 |
| Venezuela | 7 | 10 | 6 | 13 | 9 |
| Equador | 8 | 13 | 4 | 8 | 3 |
| Peru | 9 | 9 | 2 | 12 | 7 |
| Estados Unidos | 10 | 6 | 12 | 16 | 12 |
| Papua Nova-Guiné | 11 | 15 | 13 | 10 | 10 |
| Índia | 12 | 8 | 7 | 6 | 8 |
| Austrália | 13 | 12 | 14 | 1 | 11 |
| Malásia | 14 | 11 | 5 | 14 | 14 |
| Madagascar | 15 | 17 | 17 | 11 | 13 |
| Congo (ex-Zaire) | 16 | 7 | 9 | 14 | 16 |
| Filipinas | 17 | 16 | 16 | 7 | 17 |

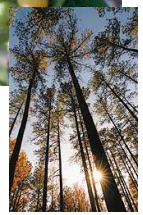
http://www.ib.usp.br/gra/ffa/ffa-biosfera-megadiversidade.htm

## World Classification Biological Diversity









Labex Korea

# Brazilian Biodiversity

| COUNTRY | Plants | Mammals | Birds | Reptile | Anfibian |
|---|---|---|---|---|---|
| Brasil | 1 | 4 | 3 | 5 | 2 |
| Indonésia | 2 | 2 | 1 | 6 | 11 |
| África do Sul | 3 | 14 | 17 | 14 | 17 |
| Colômbia | 4 | 12 | 5 | 11 | 1 |
| Austrália | 5 | 1 | 2 | 1 | 5 |
| Papua Nova Guiné | 6 | 9 | 10 | 13 | 8 |
| México | 7 | 3 | 6 | 2 | 5 |
| China | 8 | 7 | 9 | 7 | 4 |
| Madagascar | 9 | 7 | 8 | 3 | 3 |
| Índia | 10 | 11 | 12 | 4 | 10 |
| Malásia | 11 | 14 | 16 | 15 | 14 |
| Venezuela | 12 | 17 | 13 | 16 | 13 |
| Peru | 13 | 10 | 7 | 10 | 12 |
| Filipinas | 14 | 5 | 4 | 8 | 16 |
| Equador | 15 | 16 | 14 | 9 | 7 |
| Estados Unidos | 16 | 6 | 11 | 12 | 9 |
| Congo (ex-Zaire) | 17 | 12 | 15 | 17 | 15 |

http://www.ib.usp.br/gra/ffa/ffa-biosfera-megadiversidade.htm

## World Classification Endemic Species

# Brazilian Biodiversity

## Fruit Species of the Brazilian Savannah – “Cerrado”

Araticum

Cagaita

Baru

Macaúba

Barbatimão

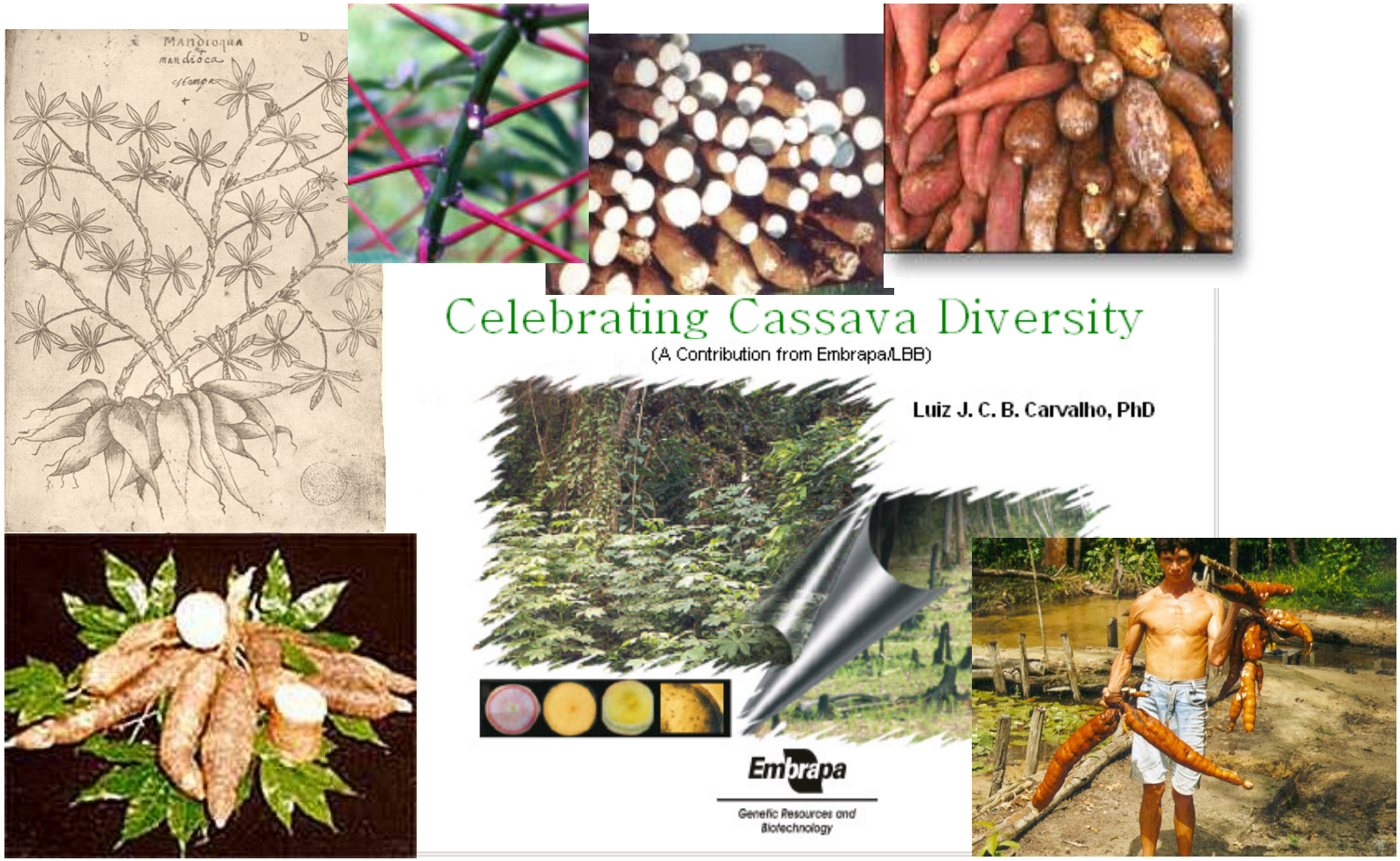
Faveira

Pequi

Mangaba

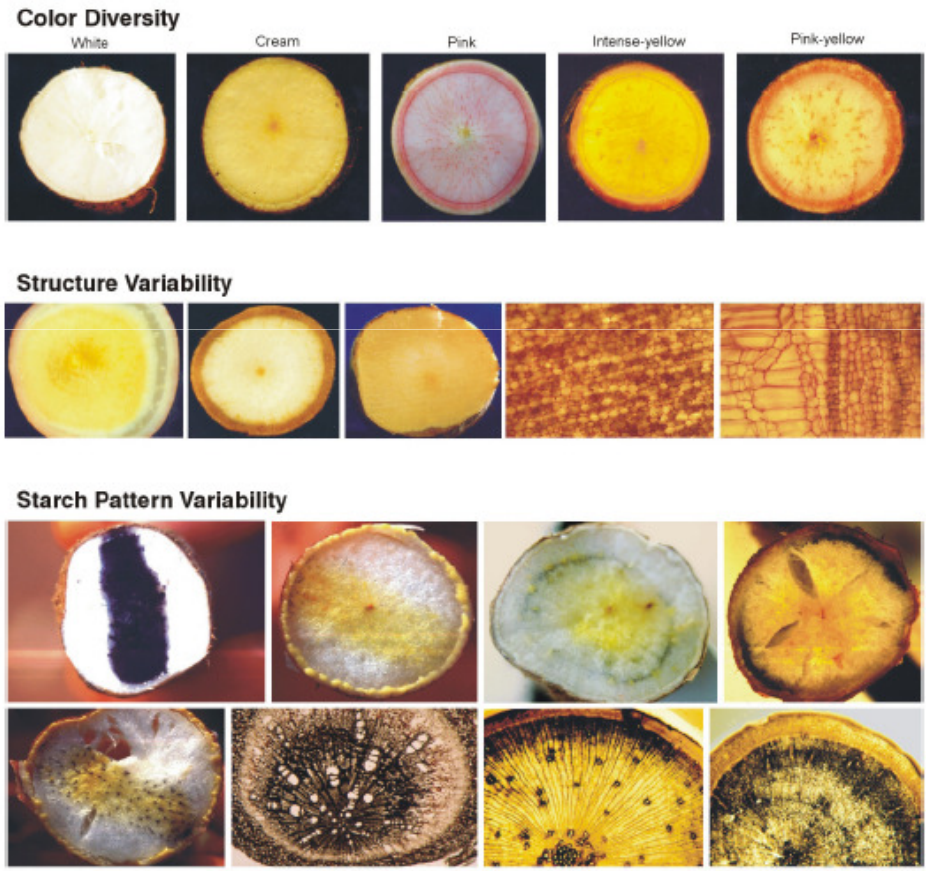
Source: Embrapa Cerrados

# Brazilian Biodiversity

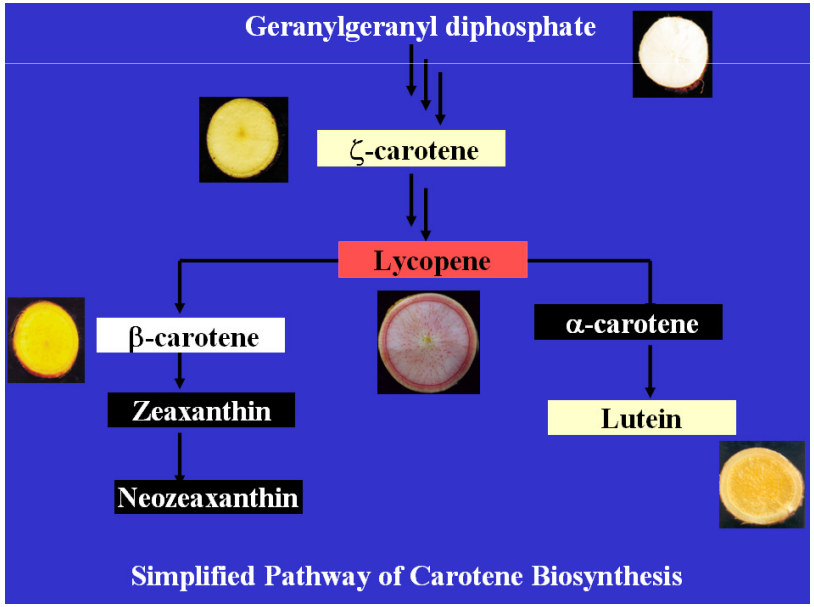



Source: Embrapa Genetic Resources and Biotechnology

# Brazilian Biodiversity




## Cassava Root Mutants
## Starch & Pigments




Source: Embrapa Genetic Resources and Biotechnology

# Brazilian Biodiversity


Source: Embrapa Genetic Resources and Biotechnology

# Brazilian Biodiversity

Brazil has around 100 oil plants in the Cerrado and Amazon Biomes with potential to be developed as oil crops for energy and other industrial purposes

| | |
|---|---|
| ***Acrocomia aculeata*** (macauba palm) | ***Licania rigida*** (oiticica) |
| ***Astrocaryum murumuru*** (murumuru) | ***Mauritia flexuosa*** (buriti palm) |
| ***Astrocaryum vulgare*** (tucumã) | ***Maximiliana maripa*** (inaja palm) |
| ***Attalea geraensis*** (indaiá-rateiro) | ***Oenocarpus bacaba*** (bacaba-do-azeite) |
| ***Attalea humillis*** (pindoba) | ***Oenocarpus bataua*** (patauá) |
| ***Attalea oleifera*** (andaiá) | ***Oenocarpus distichus*** (bacaba-de-leque) |
| ***Attalea phalerata*** (uricuri) | ***Paraqueiba paraensis*** (mari) |
| ***Caryocar brasiliense*** (pequi) | ***Sesamum indicum*** (benneseed) |
| ***Cucumis melo*** (melon) | ***Theobroma grandiflorum*** (cupuassu) |
| ***Jatropha curcas*** (pinhão-manso) | ***Trithrinax brasiliensis*** (carandaí) |
| ***Joannesia princeps*** (cutieira) | |

**Source: Nass et al. (2007)**

# Domestic Animal Diversity in Brazil

Most livestock are not indigenous to Brazil. Periodic introductions resulted in a wide range of genetic diversity that, for centuries, supported domestic animal production in the country;

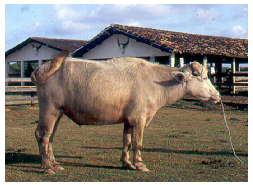
Natural selection → adaptation to biotic and abiotic pressures;

Moxotó goats

Blue goats

Canindé goats

Santa Inês Sheep



Baio type buffalo

Carabao buffalo

Pantaneiro cattle

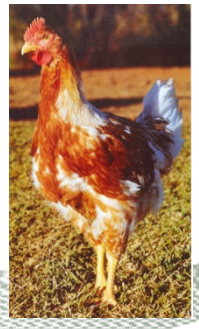
Pantaneiro horse

Curraleiro cattle

Criollo Lanado sheep

Lavradeiro horses

Piau pig



Colonial chicken




Labex Korea

Source: Embrapa Genetic Resources and Biotechnology

# Crop Genetic Diversity in Brazil


**Despite of its rich biological diversity, Brazil is very dependent on exotic diversity for food production and agribusiness operations.**

# Genetic Resources Research Network


## Genetic Resources Research Network


Source: http://plataformarg.cenargen.embrapa.br/pnrg

**Access & Collection**

**Maintenance**

**Regeneration**

**Documentation and Data Management**

**Distribution & Exchange**

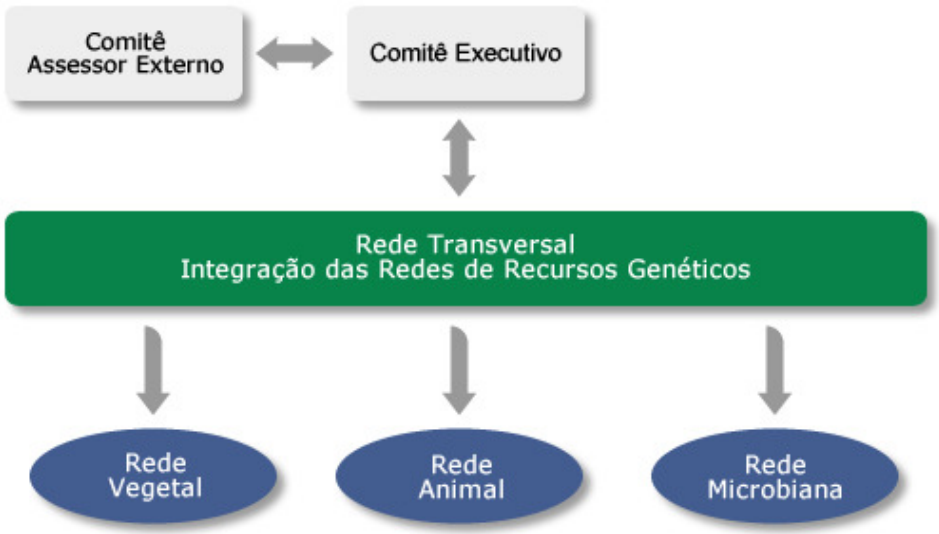
**Characterization**

**Evaluation**

**Pre-Breeding or Enhancement**

# Genetic Resources Research Network

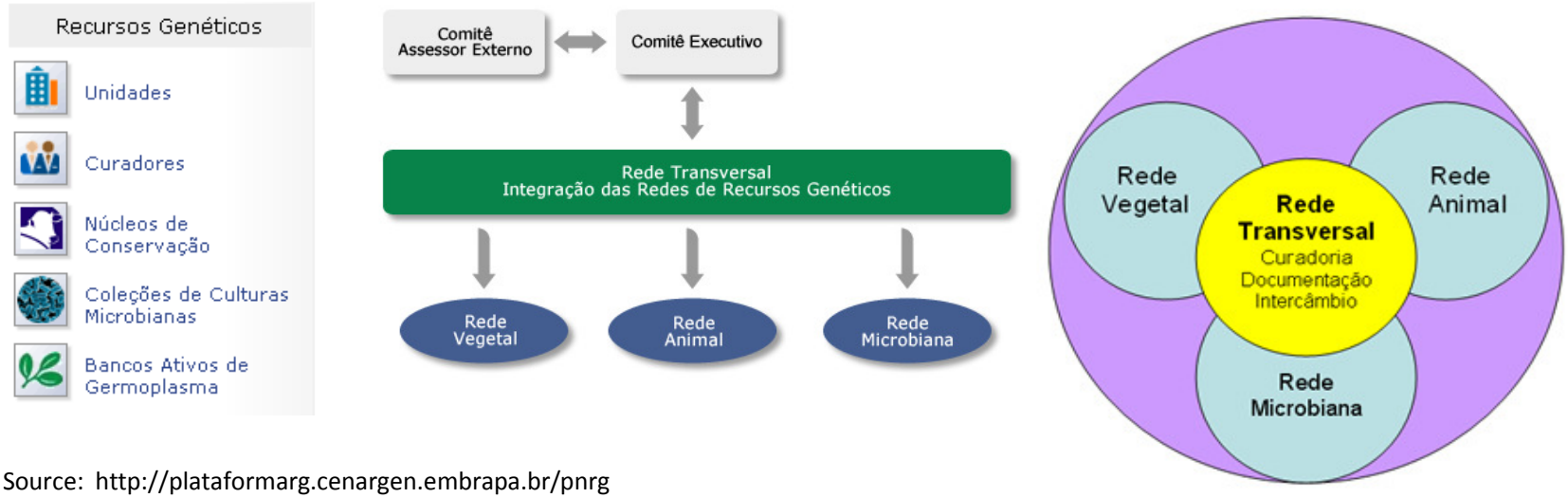

## Genetic Resources Research Network


Source: http://plataformarg.cenargen.embrapa.br/pnrg

# Genetic Resources Research Network

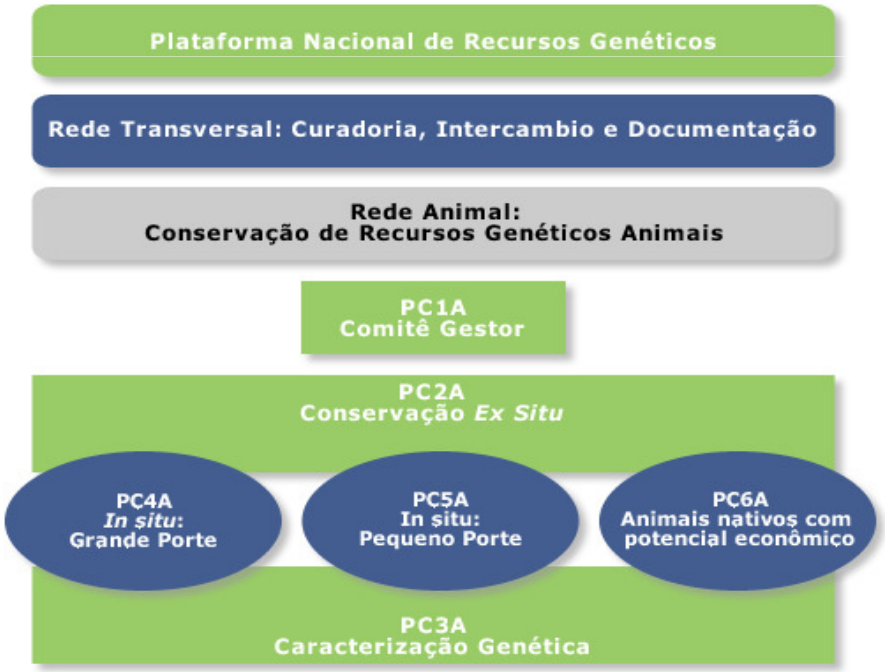

## Genetic Resources Research Network




Source: http://plataformarg.cenargen.embrapa.br/pnrg

# Genetic Resources Research Network

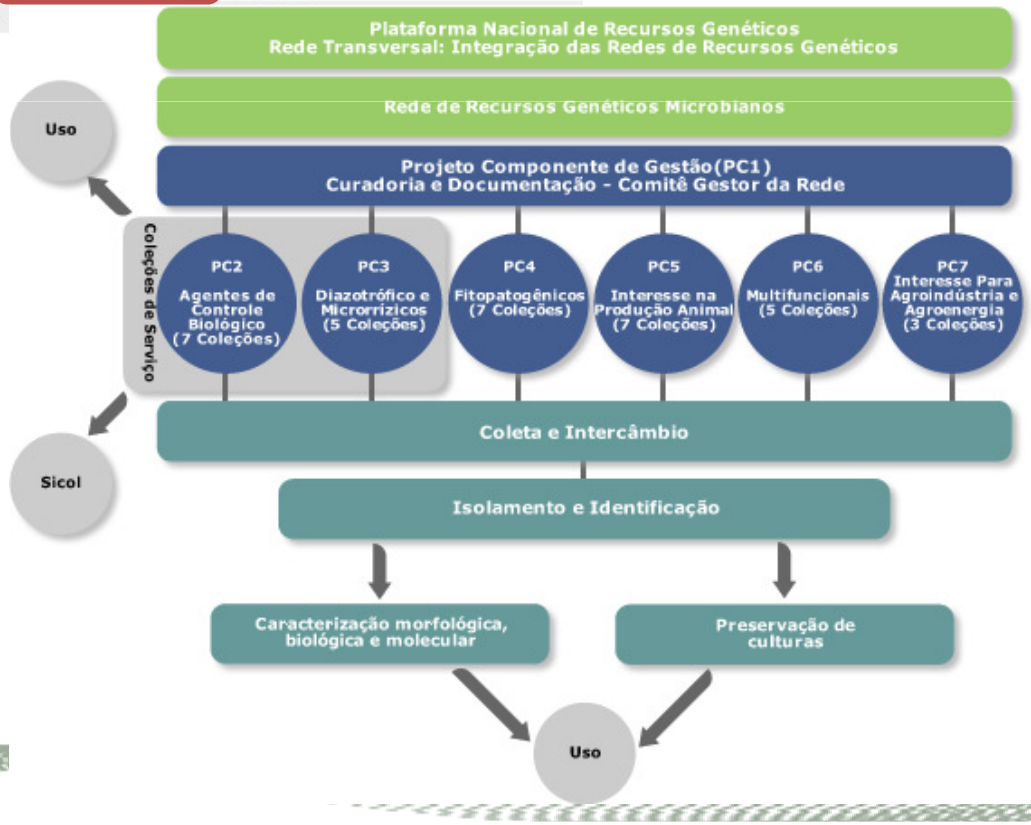

## Genetic Resources Research Network


Source: http://plataformarg.cenargen.embrapa.br/pnrg

# Genetic Resources Research Network


## Genetic Resources Research Network


Source: http://plataformarg.cenargen.embrapa.br/pnrg

# Genetic Resources Research Network


## Genetic Resources Research Network

**Works through a network of 170 genebanks located at Embrapa Centers and partner organizations in different parts of the country**

**This network holds approximately 250 000 accessions of plant , animal and microbial germplasm**


Source: http://plataformarg.cenargen.embrapa.br/pnrg

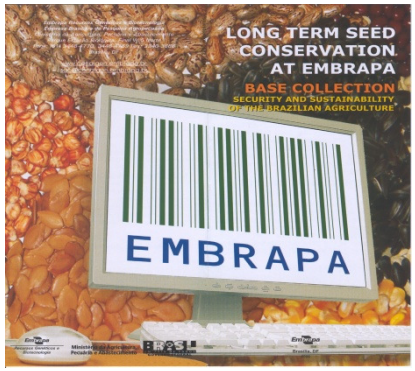
# Genetic Resources Research Network


## Genetic Resources Research Network

**Long term storage facility (Base Collection) located in Brasilia holds 107 000 orthodox seed accessions, representing 661 different species, subspecies or varieties of plants**

**At full capacity this facility can store up to 240 000 accessions**

**In vitro - Cryocollections - Herbaria**




Source: http://plataformarg.cenargen.embrapa.br/pnrg

# Genetic Resources Research Network


## Genetic Resources Research Network

***In situ*** **germplasm conservation has been carried out by a team of botanists and ecologists, whose work has provided the basic guidelines for the delimitation and criation of in situ conservation areas in different regions of Brazil**

***On farm*** **with local and indigenous communities - Etnobiology**

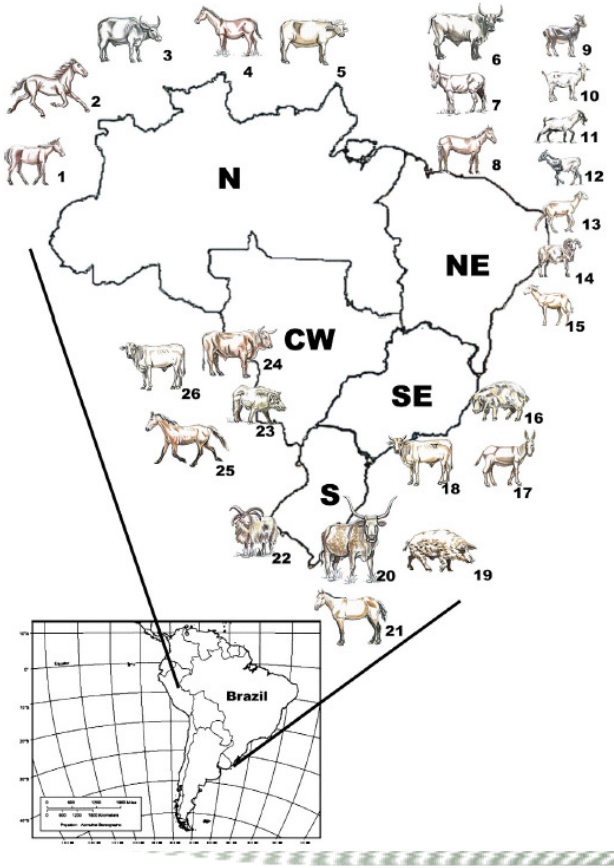

Source: http://plataformarg.cenargen.embrapa.br/pnrg

# Genetic Resources Research Network


## Genetic Resources Research Network

***Ex situ*** **animal genetic resources conservation: cryopreserved semen and embryos**

***In situ*** **conservation is carried out in nucleus herds (Conservation Nuclei), maintained in the habitats where the animals have been naturally selected**




Source: http://plataformarg.cenargen.embrapa.br/pnrg

# Pre-Breeding and Breeding Programs

## Pre-Breeding

**Assessing new genetic variability from wild relatives**

### Pre-breeding of autoctonous species

***Ananas* spp.**: introgressão de genes de espécies silvestres de *Ananas* e *Pseudoananas* visando à obtenção de abacaxi ornamental

***Arachis* spp.**: ampliar a base genética de *A. hypogaea* com introgressão de genes de resistência a doenças fúngicas de espécies silvestres diplóides, recorrendo à formação de linhas alotetraplóides sintéticas para cruzamentos com a espécie cultivada

***Capsicum* spp.**: explorar espécies silvestres e semidomesticadas brasileiras visando disponibilizar novas fontes para os programas de melhoramento

***Manihot* spp.**: estudar a cruzabilidade de espécies silvestres de *Manihot* com a mandioca cultivada, visando à seleção de clones com resistência a doenças e deficiência hídrica

### Pre-breeding of landraces

***Citrullus lanatus*:**
- Identificar germoplasma resistente a pulgões, tripes, mosca-minadora e mosca-branca;
- Identificar germoplasma resistente a podridão de micosferela, mancha aquosa, patógenos do solo e aos vírus PRSV-W, ZYMV e WMV-2;
- Sintetizar populações base e linhagens recombinantes e contrastantes para os patógenos acima citados;
- Definir grupos heteróticos;
- Associar marcadores SSR e RAPD a gene de resistência a vírus.

***Cucumis melo*:**
- Sintetizar populações base e linhagens recombinantes e contrastantes para resistência a mancha aquosa.

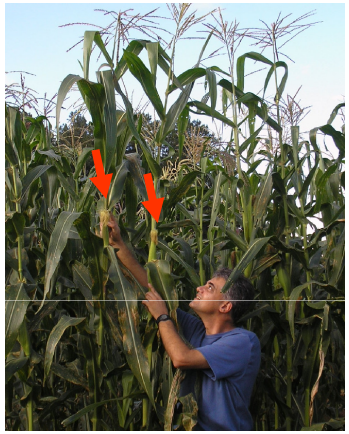
***Cucurbita* spp.:**
- Diagnóstico sobre a conservação *on farm* e *ex situ* para definição de estratégias de pré-melhoramento.

***Zea mays*:**
- Uso de raças locais e variedades tradicionais no melhoramento participativo.

# Pre-Breeding and Breeding Programs

## Strong emphasis in breeding for stress tolerance

Tropical corn had poor agronomic performance



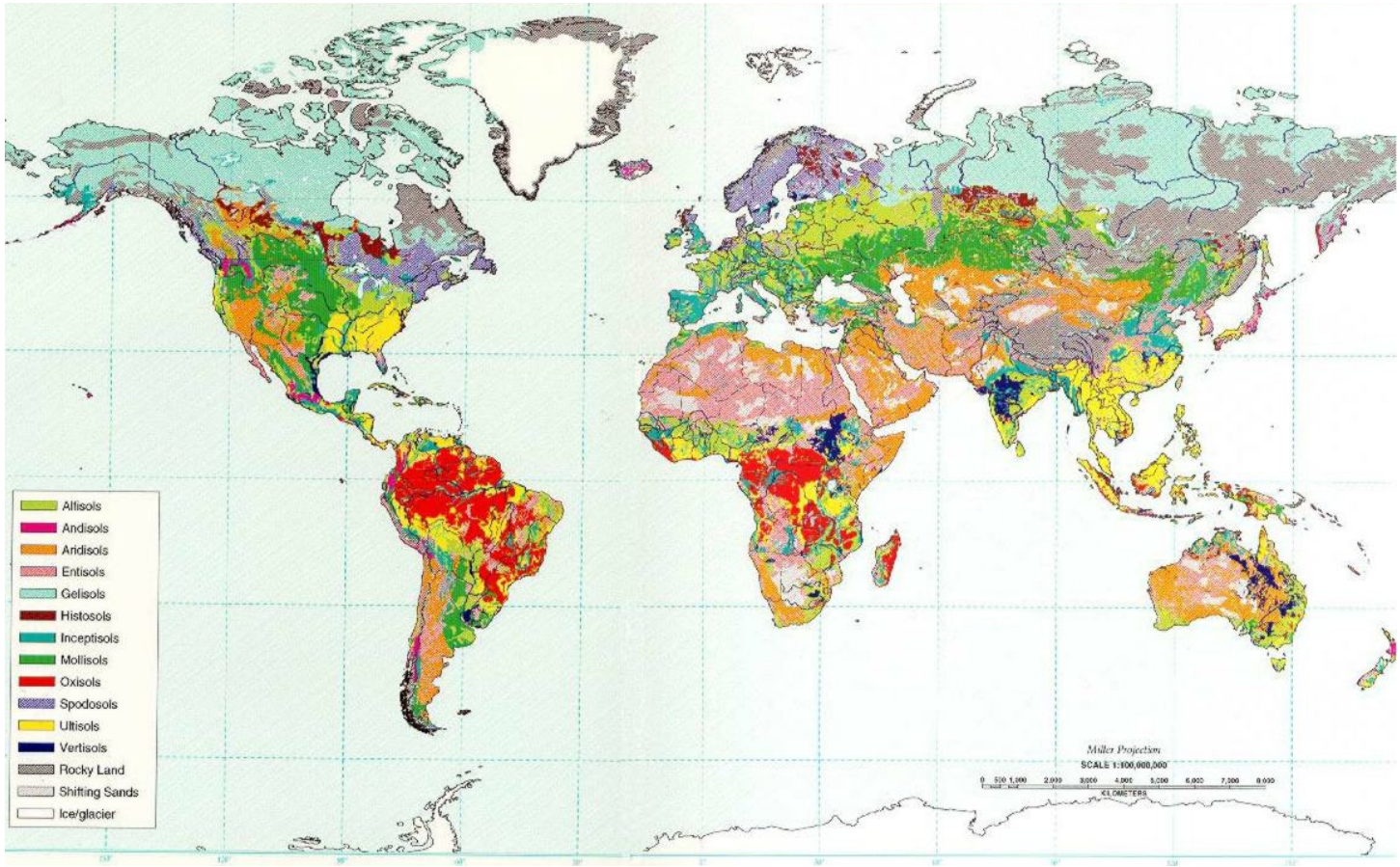
Fonte: Parentoni & Teixeira, 2006

New materials

# Pre-Breeding and Breeding Programs

## Strong emphasis in breeding for stress tolerance

### World Distribution of Soils



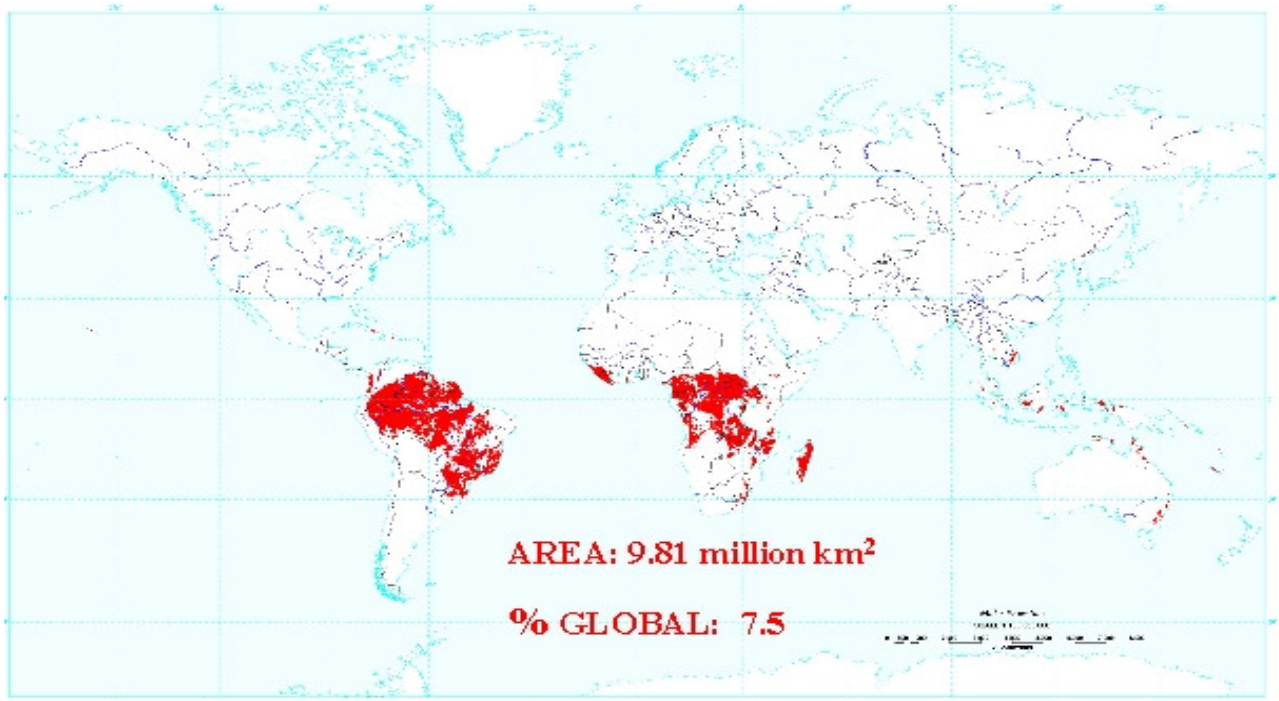

Labex Korea

http://www.nhq.nrcs.usda.gov/WSR/mapindx/metadata/Maps/ORDERS.JPG

# Pre-Breeding and Breeding Programs

## Strong emphasis in breeding for stress tolerance

### World Distribution of Oxisols

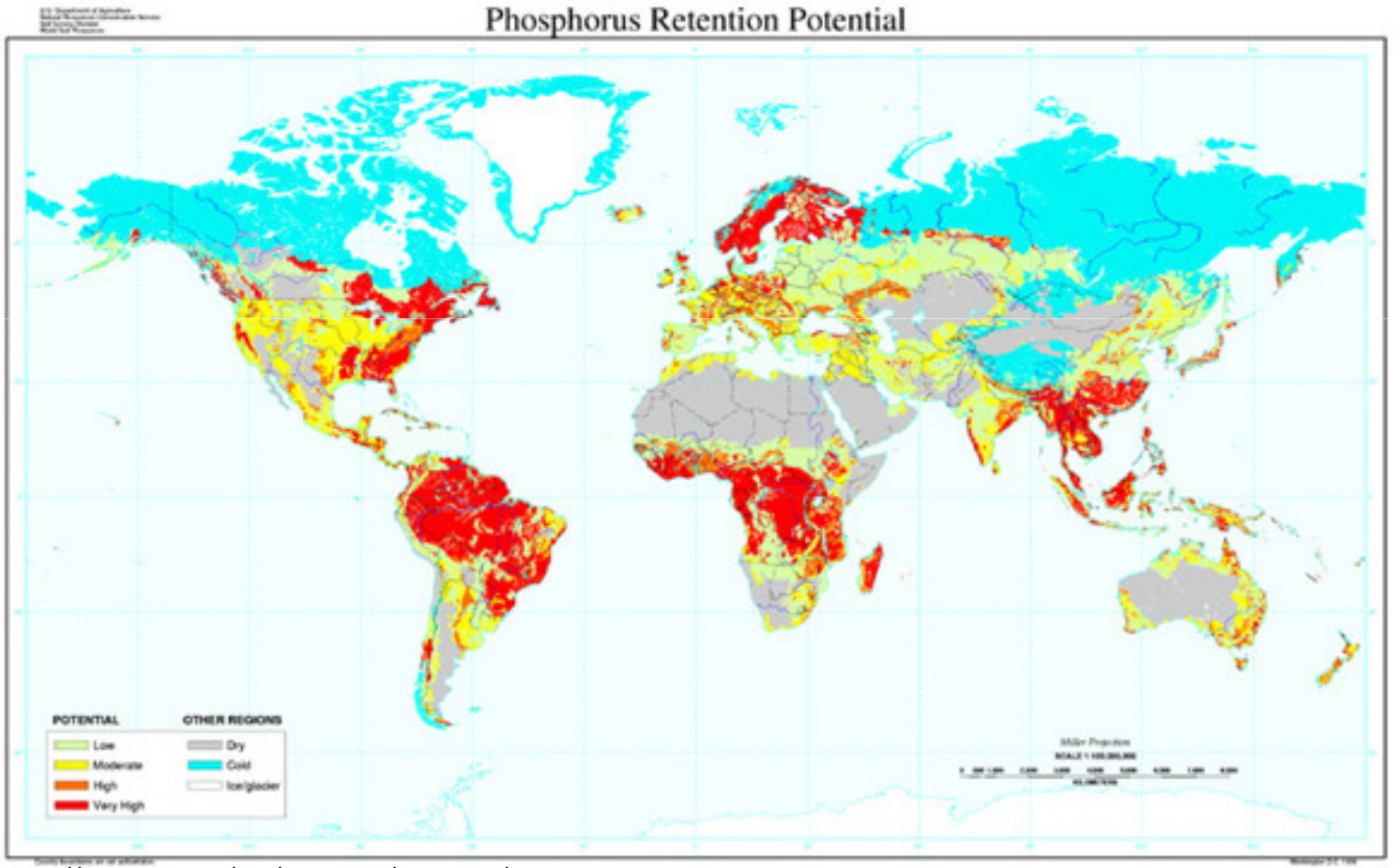





http://www.nhq.nrcs.usda.gov/WSR/mapindx/metadata/Maps/ORDERS.JPG

# Pre-Breeding and Breeding Programs

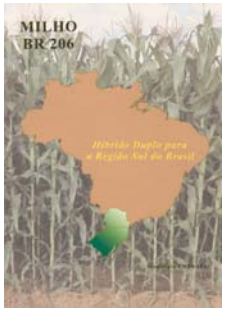
## Strong emphasis in breeding for stress tolerance

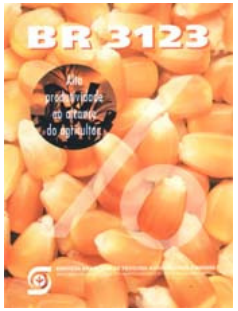


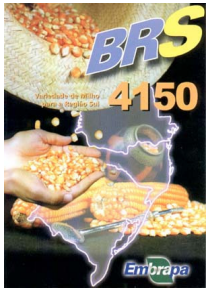

http://soils.usda.gov/use/worldsoils/mapindex/

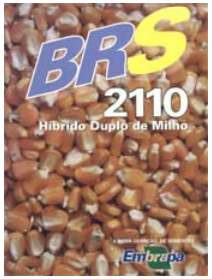
# Pre-Breeding and Breeding Programs

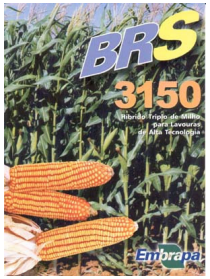
## Maize and Sorghum Varieties Adapted to Tropical Savannahs

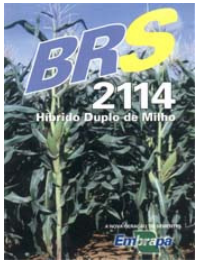



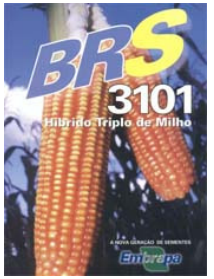


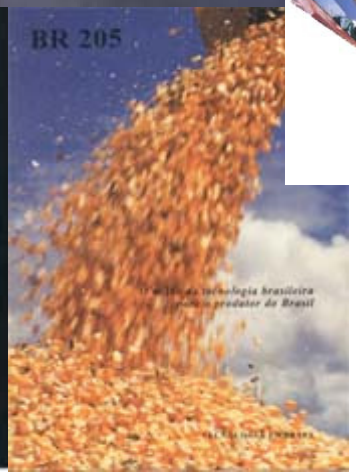


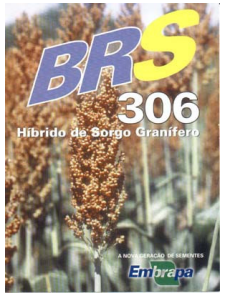


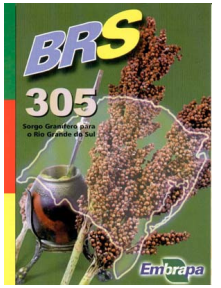








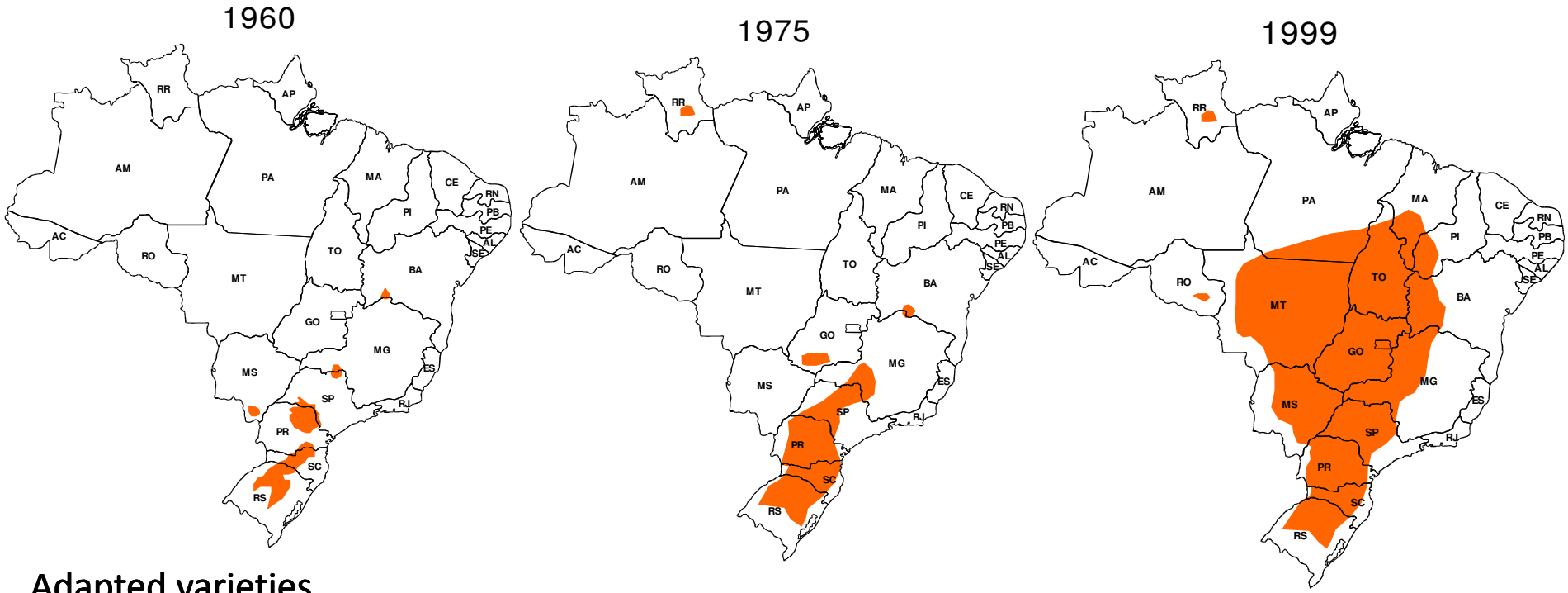




# Pre-Breeding and Breeding Programs

## Tropical soybeans

### Technological evolution and crop expansion in Brazil




Adapted varieties

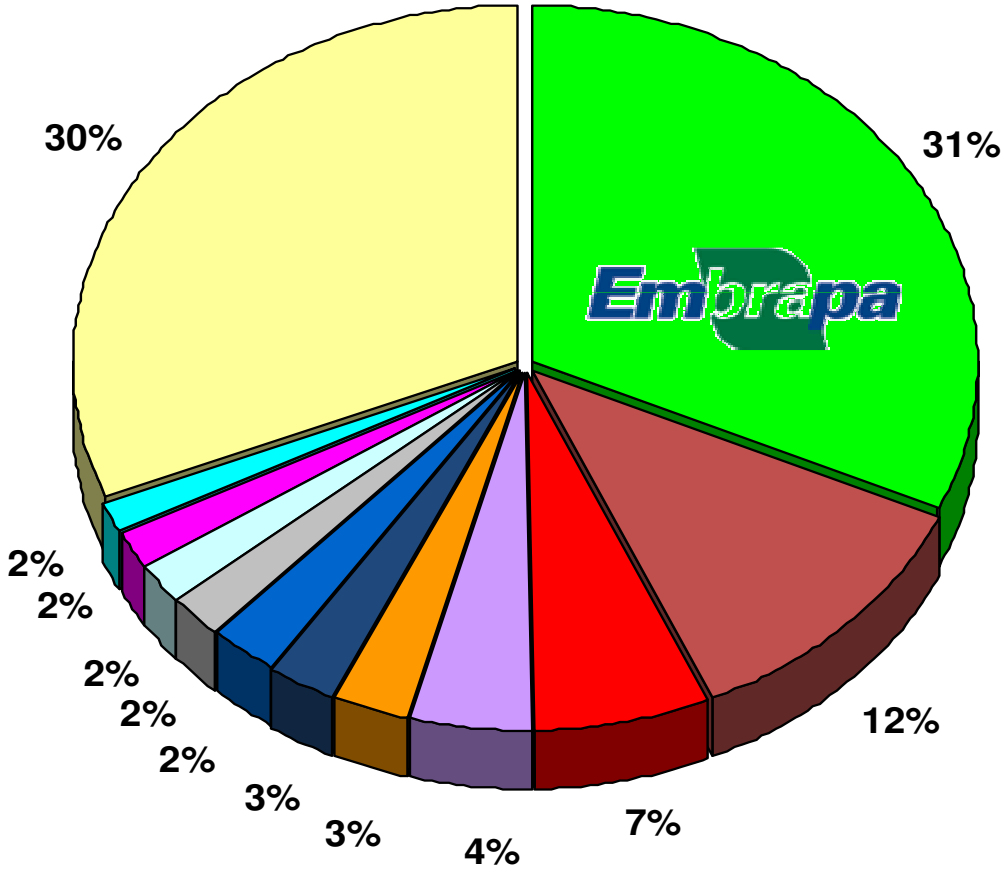
Biological nitrogen fixation

Minimum tillage - mechanization

Source: Embrapa Soybean

# Pre-Breeding and Breeding Programs

## Embrapa´s Share in Crop Variety Protection in Brazil (em %)

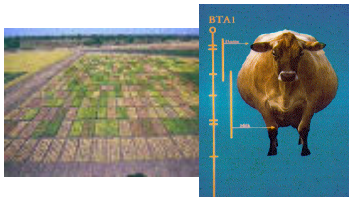



- Embrapa (219)
- MONSOY (81)
- COODETEC (46)
- COPERSUCAR (29)
- FECOTRIGO (20)
- UFV (18)
- Naturalle Agromercantil (16)
- Fundação Mato Grosso (14)
- IAPAR (13)
- BRETAGNE-PLANTS (12)
- OR MELHORAMENTO (11)
- Outros 68 ( <11 cultivares cada)

(August 2005)

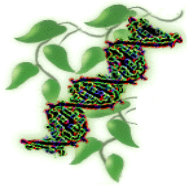
**Total protected cultivars: 699**

# Genetic Resources and Advanced Biology



## MOLECULAR TOOLS

## GENETIC ENGINEERING



## GENOMIC SCIENCES

## ADVANCED REPRODUCTION

### MOLECULAR BREEDING

Molecular Markers/Maps
Genetic Resources Charc.
Gene/Trait Mapping
Function Characterization

### TRANSGENIC TECHNOLOGY

Biotic Stress Tolerance
Abiotic Stress Tolerance
Quality/Functionality
New Bioproducts

### GENOMICS PROTEOMICS

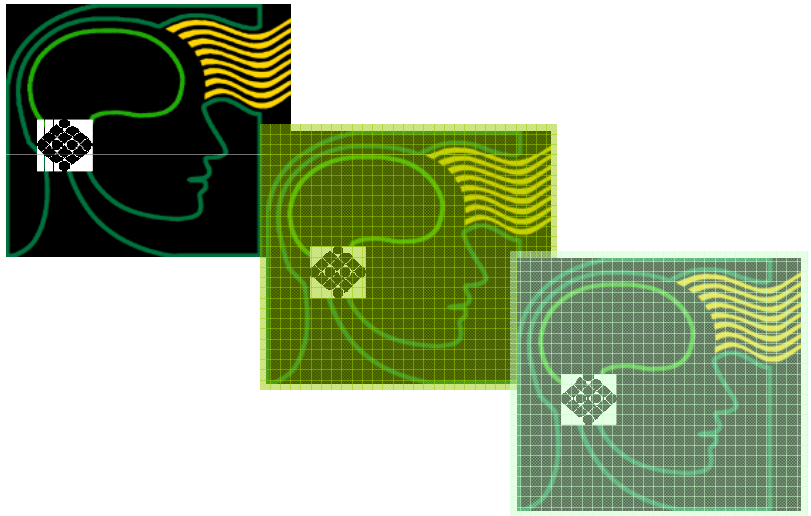
Coffee
Eucalyptus
Banana/Rice
Bovine & Others

### CLONING IN-VITRO FERTILIZATION

Animal Breeding
GR Conservation
Germplasm Enhancement
Biofactories

# Future…

## Challenges and Opportunities



Sustainable development is one of the most challenging goals for mankind, and is vital to Brazil!

# Challenges and Opportunities

## Better understanding of the impacts of agricultural innovation

### Good:

- High Performance Genetics
- Highly Specialized Production Systems
- Sustainable Growth in Productivity
- Highly Competitive Agriculture - Exports
- Generates Needed Resources for Development

### Bad:

- Environmental Impacts
- Social Inequities
- Regional imbalances
- Pressure over fragile biomes

Embrapa

# Challenges and Opportunities

## We need a new knowledge-intensive revolution to address:

- The raising cost of energy and the need to reduce the use of petrochemical inputs in agriculture;

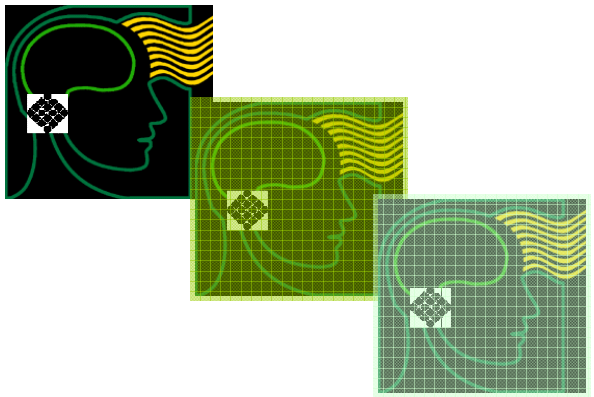
- The vulnerability of agricultural systems to global environmental change and to biological threats;

- The need to increase the productivity of environmental services and natural resources, and to protect fragile biomes;

- The need to promote the multi-functional roles of agriculture;

- The need to reduce the technological divide between social groups & regions;

- The growing demand for traceability and certified sustainable production …



# Challenges and Opportunities

## Key challenges in the next 10 to 20 years:

-To intensify genetic resources research and the use of advanced biology in genetic improvement;

- To pursue the development of a strong and sustainable Brazilian bio-economy;

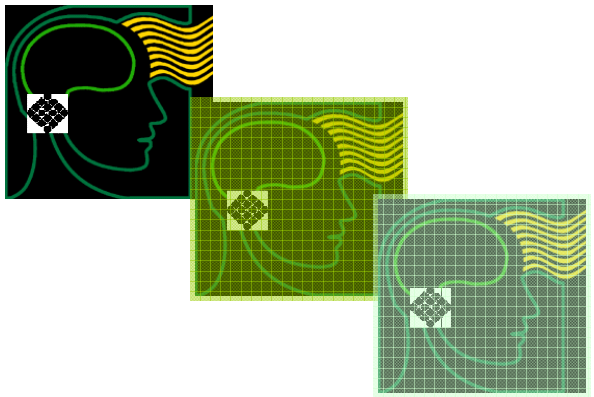
- To develop further and intensify the use of precision farming and new tools for safety and pest monitoring and control;

- To improve and intensify the use of integrated systems (agro-animal-forest);

- To generalize the use of IT as a tool to reduce trade costs, especially by small-scale producers;

- To accelerate the integration of value chains;

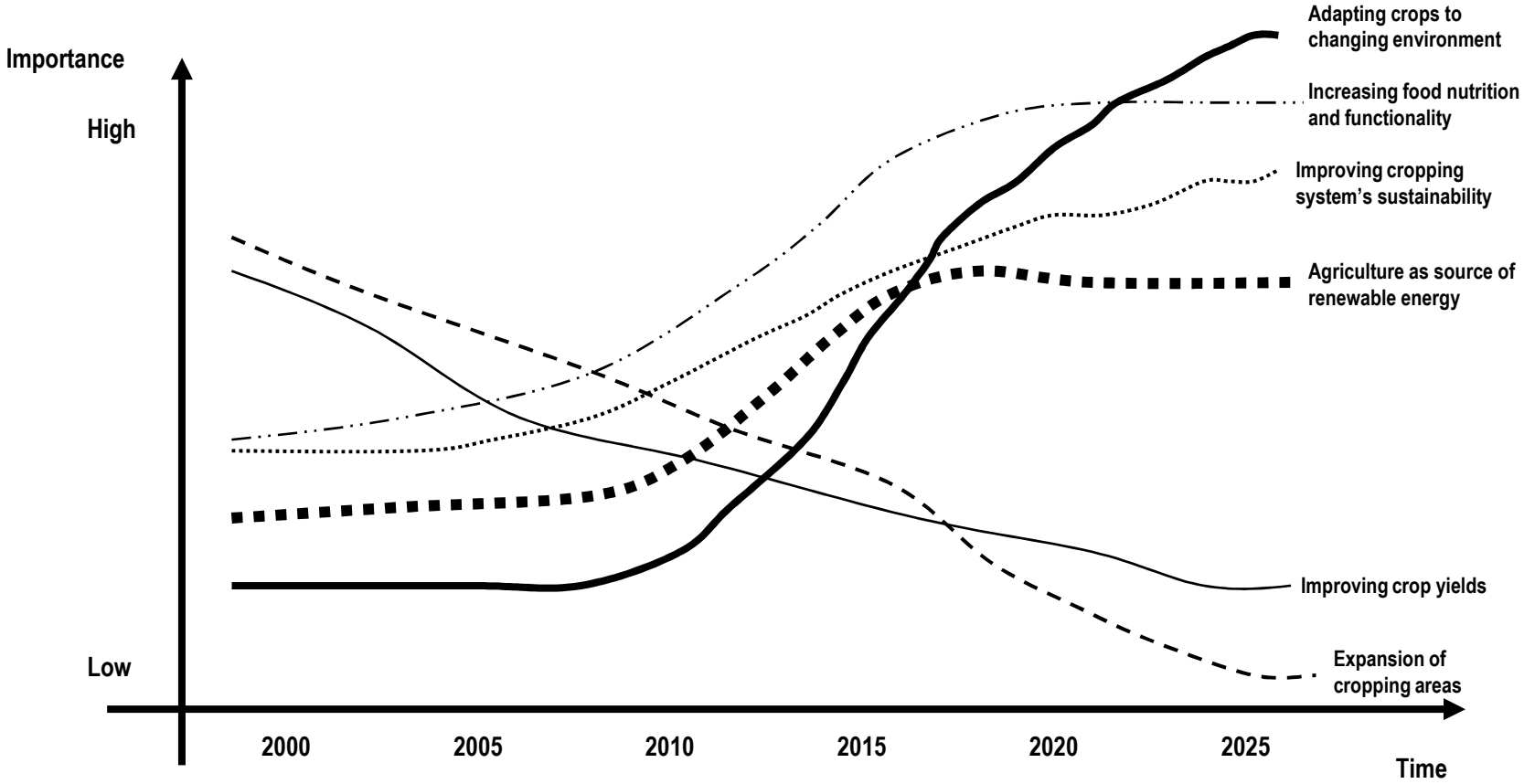
- To promote sustainable overall increases in production and productivity;



Embrapa

# Challenges and Opportunities

## Issues and trends expected to impact utilization of PGRFA in the near future

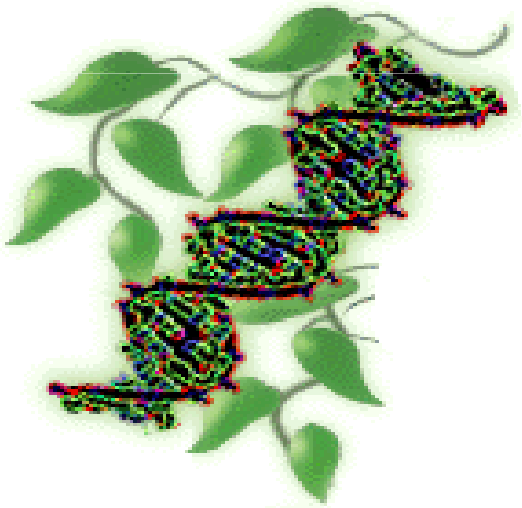


# Challenges and Opportunities

## Agriculture and the Emerging Bioindustry (“Global Green Growth”)

**Food**

**Chemical**



**Fiber**

**Pharma**

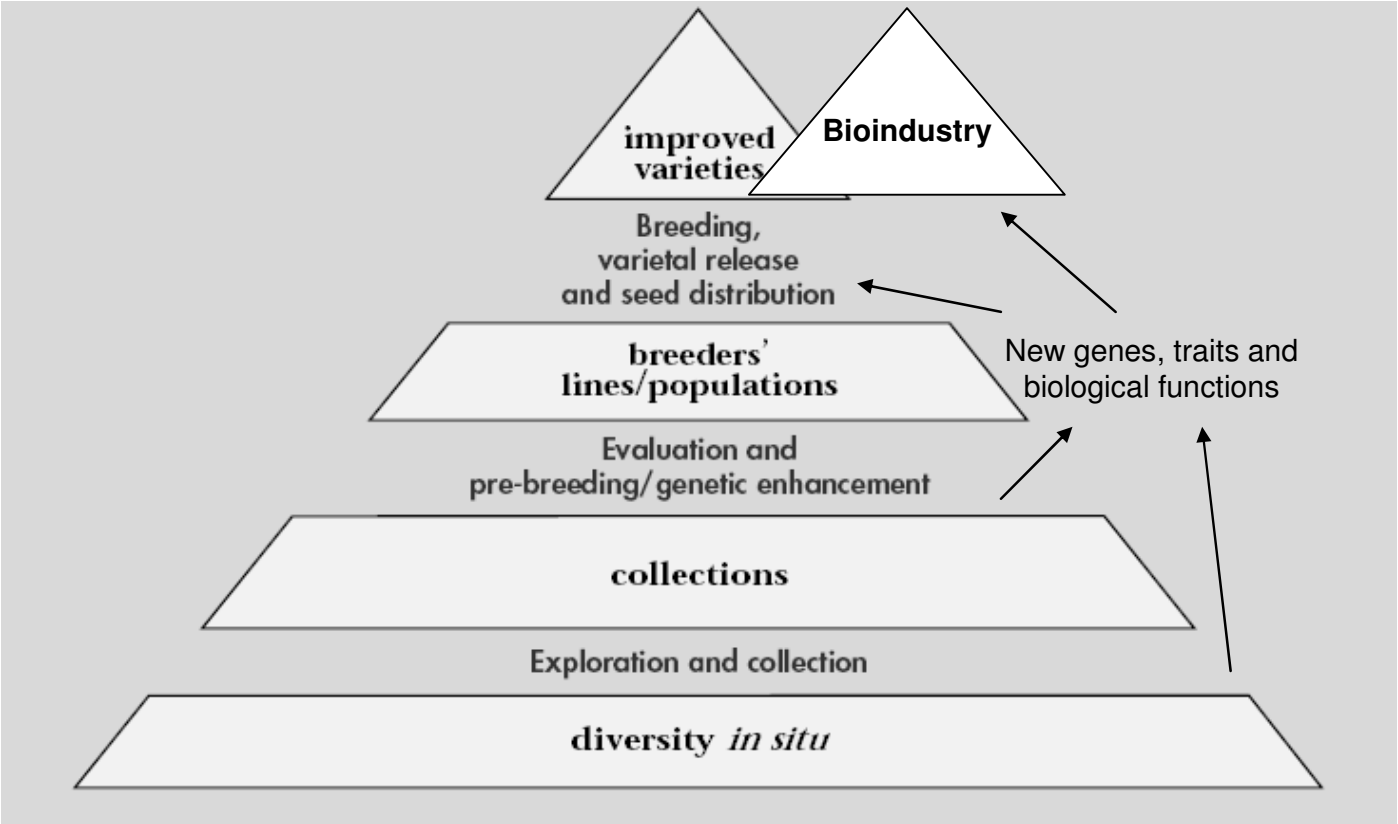
**Energy**

**Biomaterials**

# Challenges and Opportunities

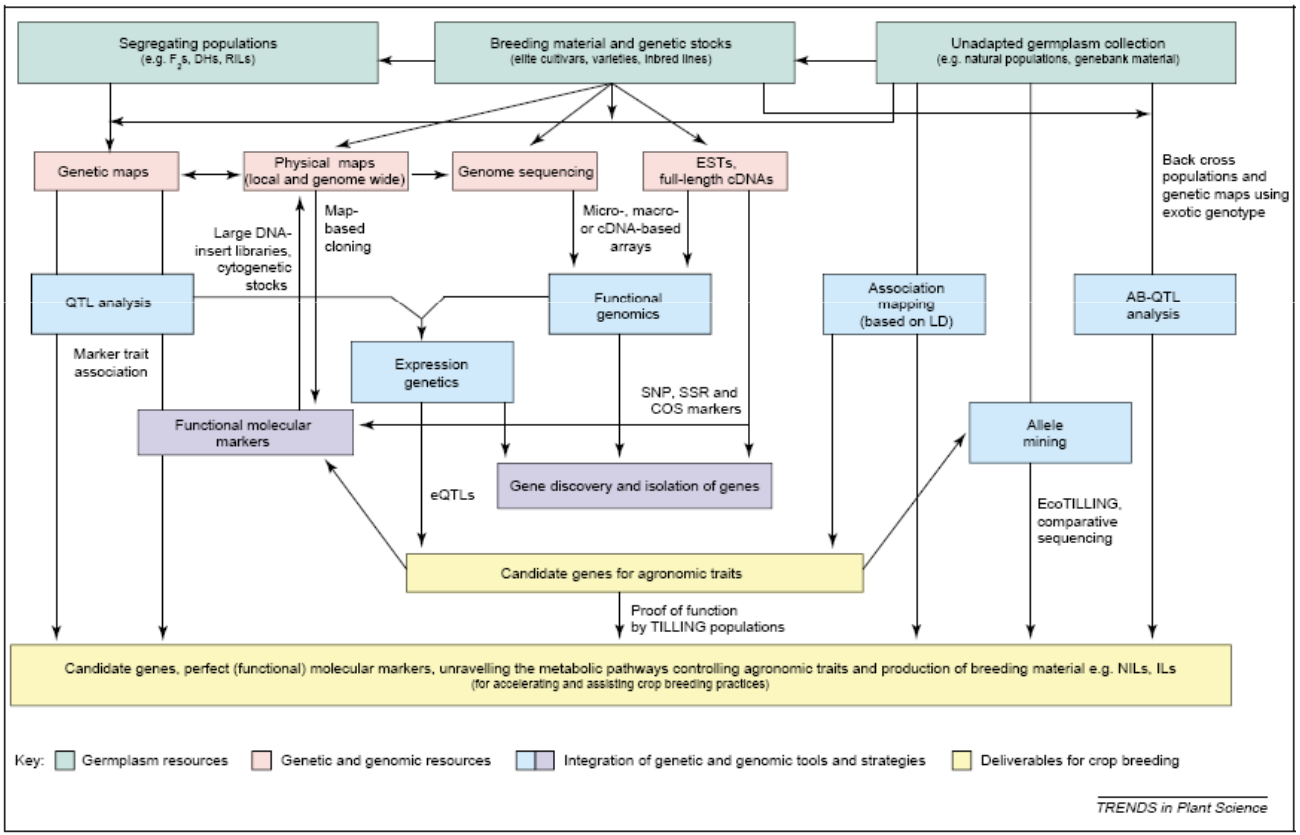
## A new Vision of the Breeder's Diversity Triangle to Accommodate the New Clients of Genetic Diversity

The nascent bioindustry will be interested in new genes, traits and biological functions stored in germplasm banks.



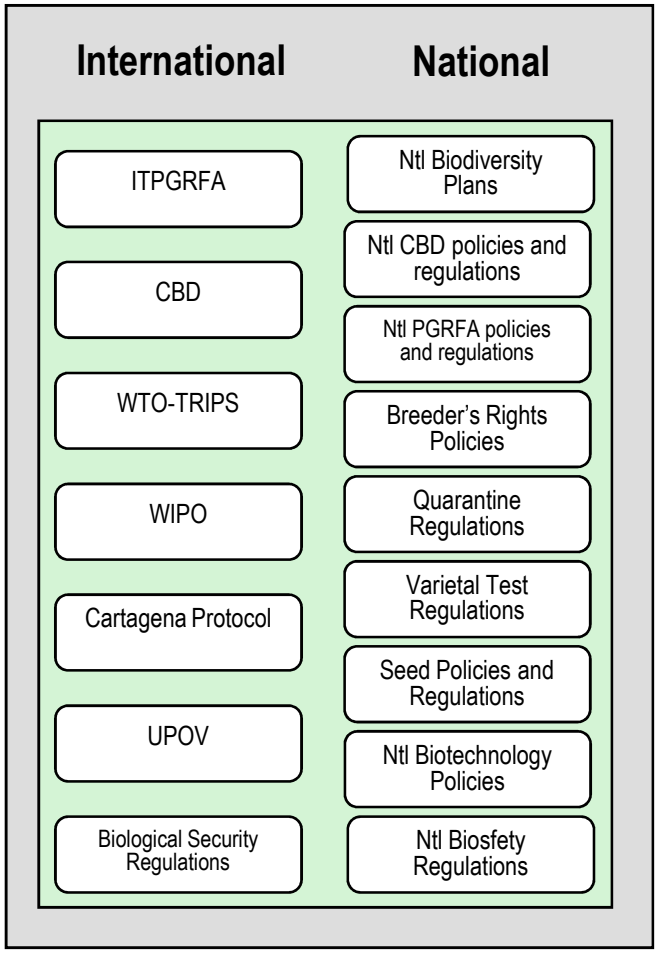
# Challenges and Opportunities

## Strategies for Integration of Genomics, Genetic Resources and Crop Improvement




*From Varshney et al. TRENDS in Plant Science Vol.10 No.12 December 2005*

# Challenges and Opportunities



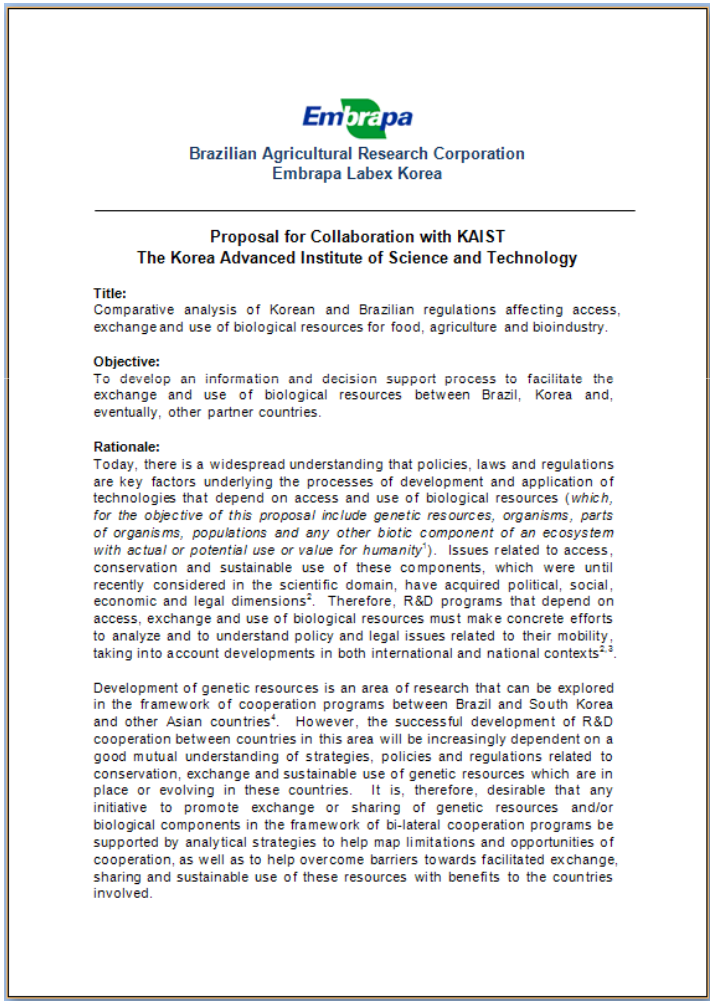

## Major Limitation to Cooperation

**Complexity of norms and regulations affecting access, exchange and use of biological resources for food, agriculture and bioindustry.**

Today, there is a widespread understanding that policies, laws and regulations are key factors underlying the processes of development and application of technologies that depend on access and use of biological resources;

Issues related to access, conservation and sustainable use of biological resources, which were until recently considered in the scientific domain, have acquired political, social, economic and legal dimensions.

# Challenges and Opportunities



Embrapa

Brazilian Agricultural Research Corporation
Embrapa Labex Korea

**Proposal for Collaboration with KAIST**
**The Korea Advanced Institute of Science and Technology**

**Title:**
Comparative analysis of Korean and Brazilian regulations affecting access, exchange and use of biological resources for food, agriculture and bioindustry.

**Objective:**
To develop an information and decision support process to facilitate the exchange and use of biological resources between Brazil, Korea and, eventually, other partner countries.

**Rationale:**
Today, there is a widespread understanding that policies, laws and regulations are key factors underlying the processes of development and application of technologies that depend on access and use of biological resources (*which, for the objective of this proposal include genetic resources, organisms, parts of organisms, populations and any other biotic component of an ecosystem with actual or potential use or value for humanity*[1]). Issues related to access, conservation and sustainable use of these components, which were until recently considered in the scientific domain, have acquired political, social, economic and legal dimensions[2]. Therefore, R&D programs that depend on access, exchange and use of biological resources must make concrete efforts to analyze and to understand policy and legal issues related to their mobility, taking into account developments in both international and national contexts[2,3].

Development of genetic resources is an area of research that can be explored in the framework of cooperation programs between Brazil and South Korea and other Asian countries[4]. However, the successful development of R&D cooperation between countries in this area will be increasingly dependent on a good mutual understanding of strategies, policies and regulations related to conservation, exchange and sustainable use of genetic resources which are in place or evolving in these countries. It is, therefore, desirable that any initiative to promote exchange or sharing of genetic resources and/or biological components in the framework of bi-lateral cooperation programs be supported by analytical strategies to help map limitations and opportunities of cooperation, as well as to help overcome barriers towards facilitated exchange, sharing and sustainable use of these resources with benefits to the countries involved.

## A Collaboration Labex – KAIST- GIPB/FAO

**School of Innovation and Technology Management - KAIST**

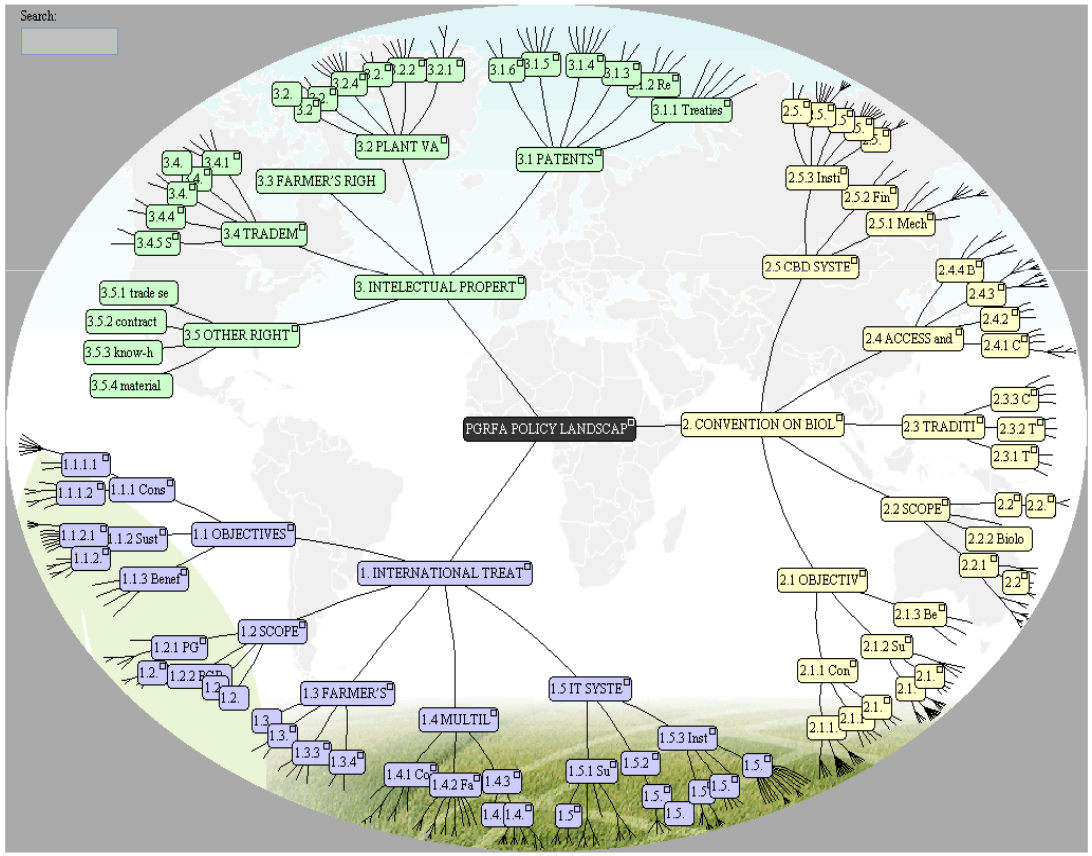
**Comparative analysis of Korean and Brazilian regulations affecting access, exchange and use of biological resources for food, agriculture and bioindustry.**

Policy research aimed at developing an information and decision support process to facilitate the exchange and use of biological resources between Brazil, Korea and, eventually, other partner countries.

Anticipating information to support future collaboration programs between the two countries, especially in areas related to bioindustrial development.

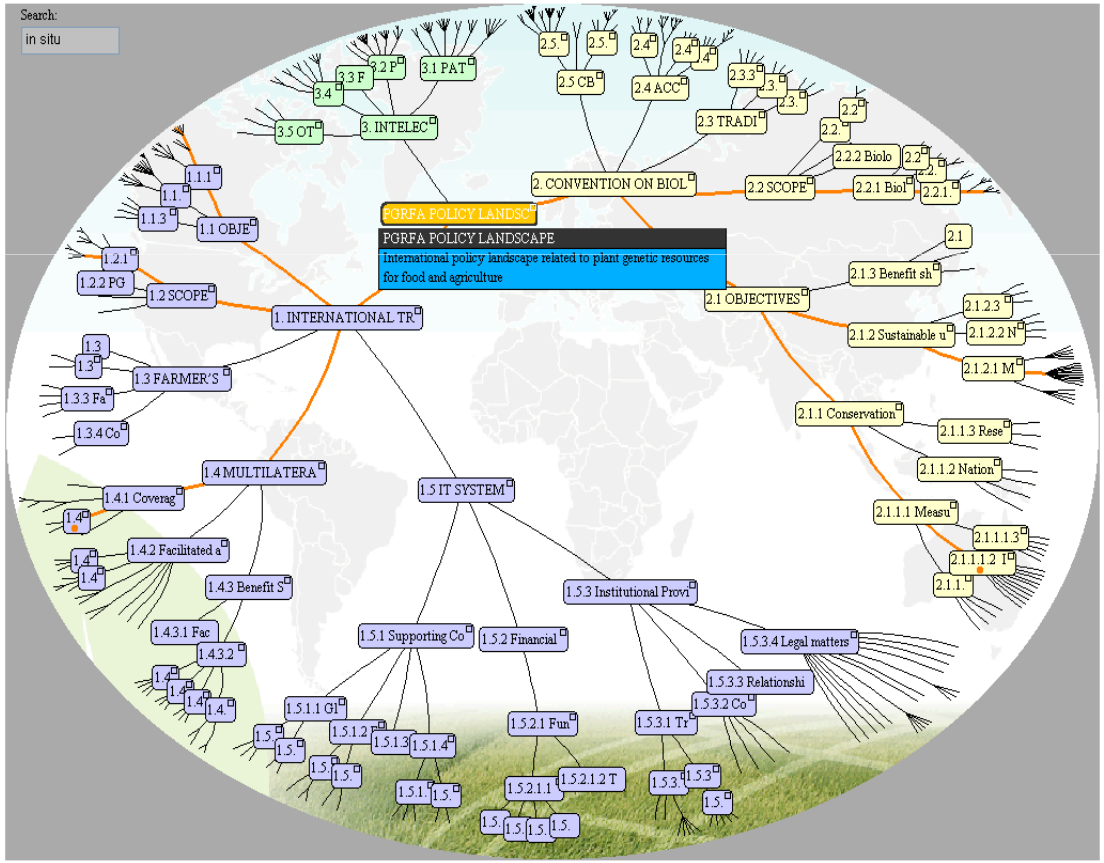
# Challenges and Opportunities

## Knowledge Tree of PGRFA-related Policy Landscape



# Challenges and Opportunities

## Knowledge Tree of PGRFA-related Policy Landscape




Labex Korea

# Challenges and Opportunities

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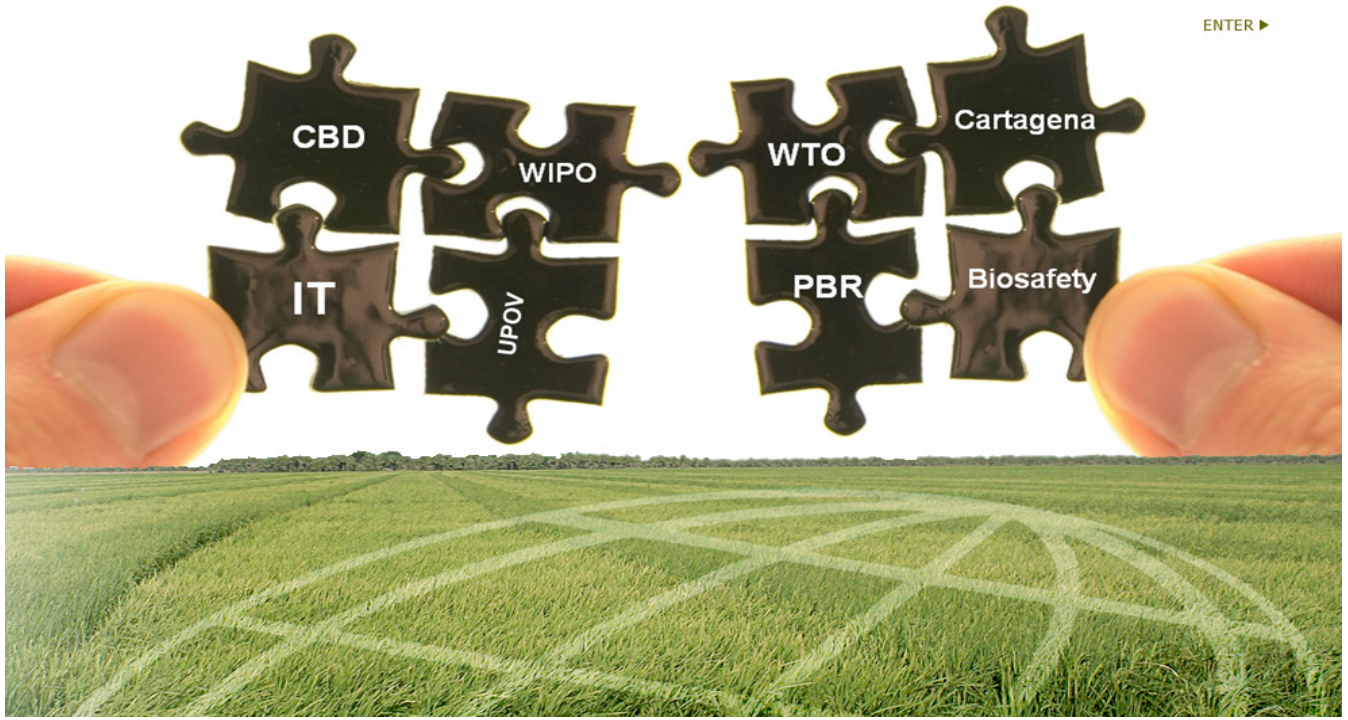
## Decision Support Toolbox for PGRFA

Policy Dialogue, Coordination and Implementation

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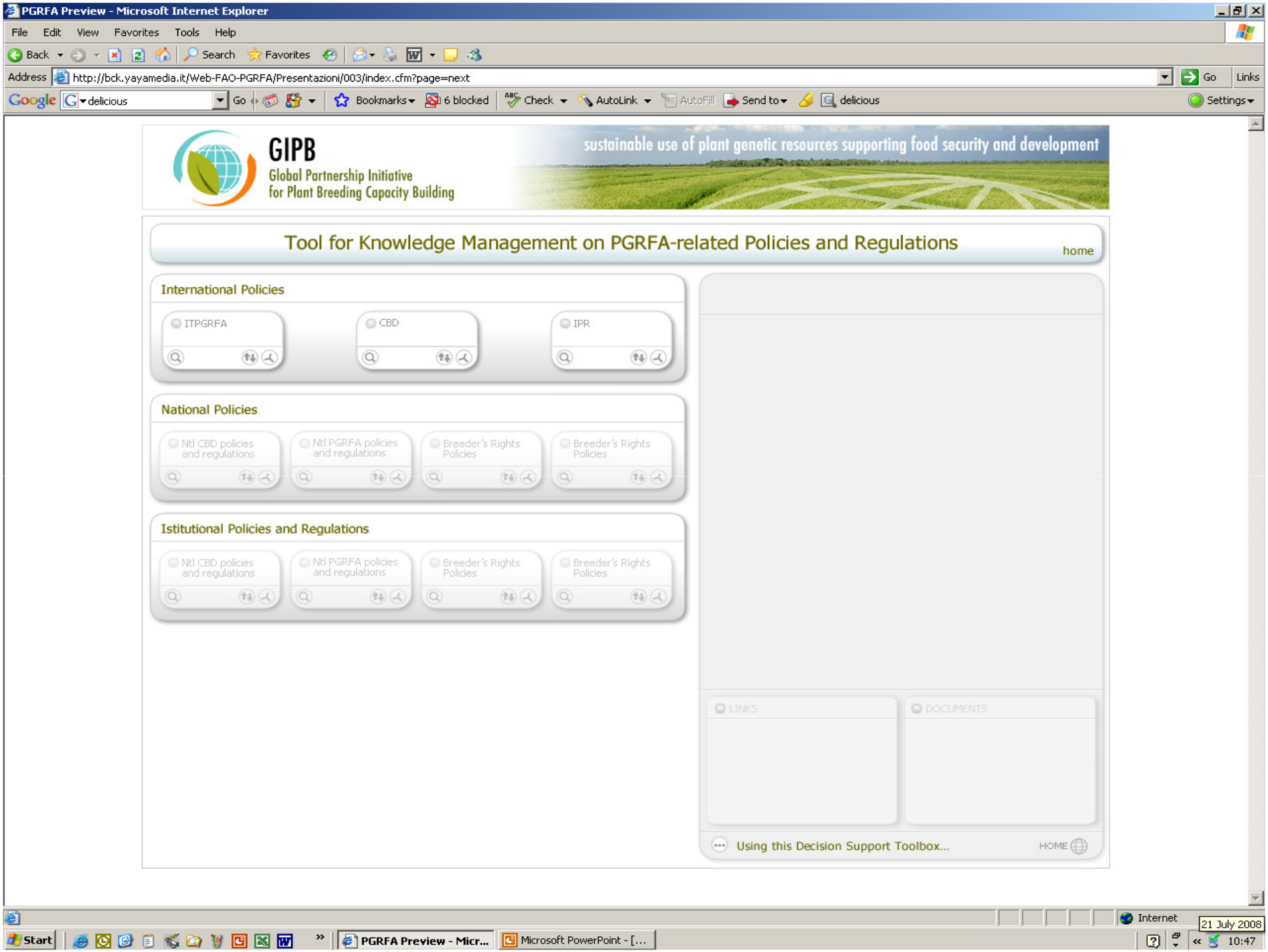
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GIPB
Global Partnership Initiative
for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
International Policies
ITPGRFA
CBD
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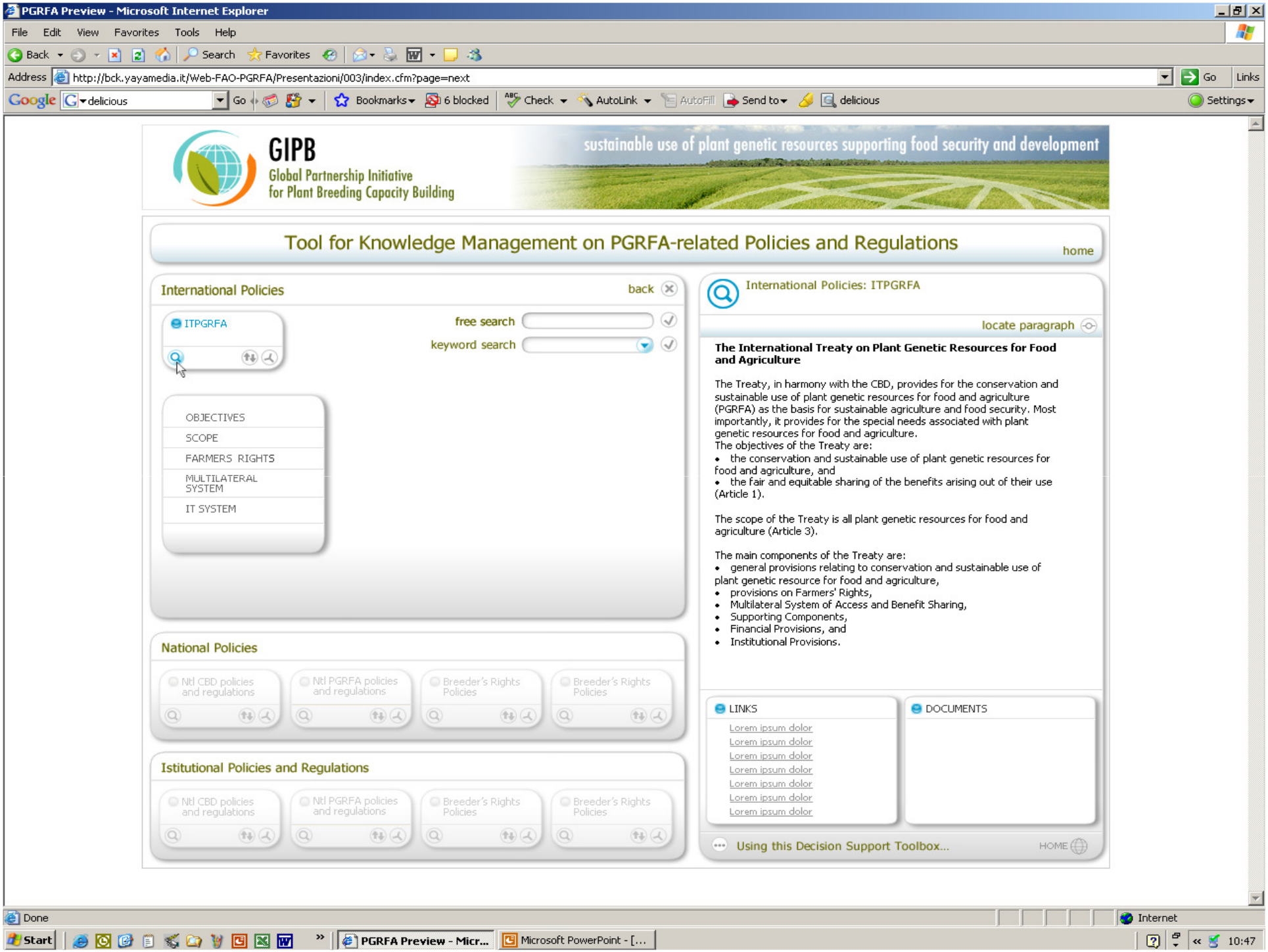
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GIPB
Global Partnership Initiative
for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
International Policies
back
ITPGRFA
free search
keyword search
OBJECTIVES
SCOPE
FARMERS RIGHTS
MULTILATERAL SYSTEM
IT SYSTEM
National Policies
Ntl CBD policies and regulations
Ntl PGRFA policies and regulations
Breeder's Rights Policies
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The International Treaty on Plant Genetic Resources for Food and Agriculture
The Treaty, in harmony with the CBD, provides for the conservation and sustainable use of plant genetic resources for food and agriculture (PGRFA) as the basis for sustainable agriculture and food security. Most importantly, it provides for the special needs associated with plant genetic resources for food and agriculture.
The objectives of the Treaty are:
• the conservation and sustainable use of plant genetic resources for food and agriculture, and
• the fair and equitable sharing of the benefits arising out of their use (Article 1).
The scope of the Treaty is all plant genetic resources for food and agriculture (Article 3).
The main components of the Treaty are:
• general provisions relating to conservation and sustainable use of plant genetic resource for food and agriculture,
• provisions on Farmers' Rights,
• Multilateral System of Access and Benefit Sharing,
• Supporting Components,
• Financial Provisions, and
• Institutional Provisions.
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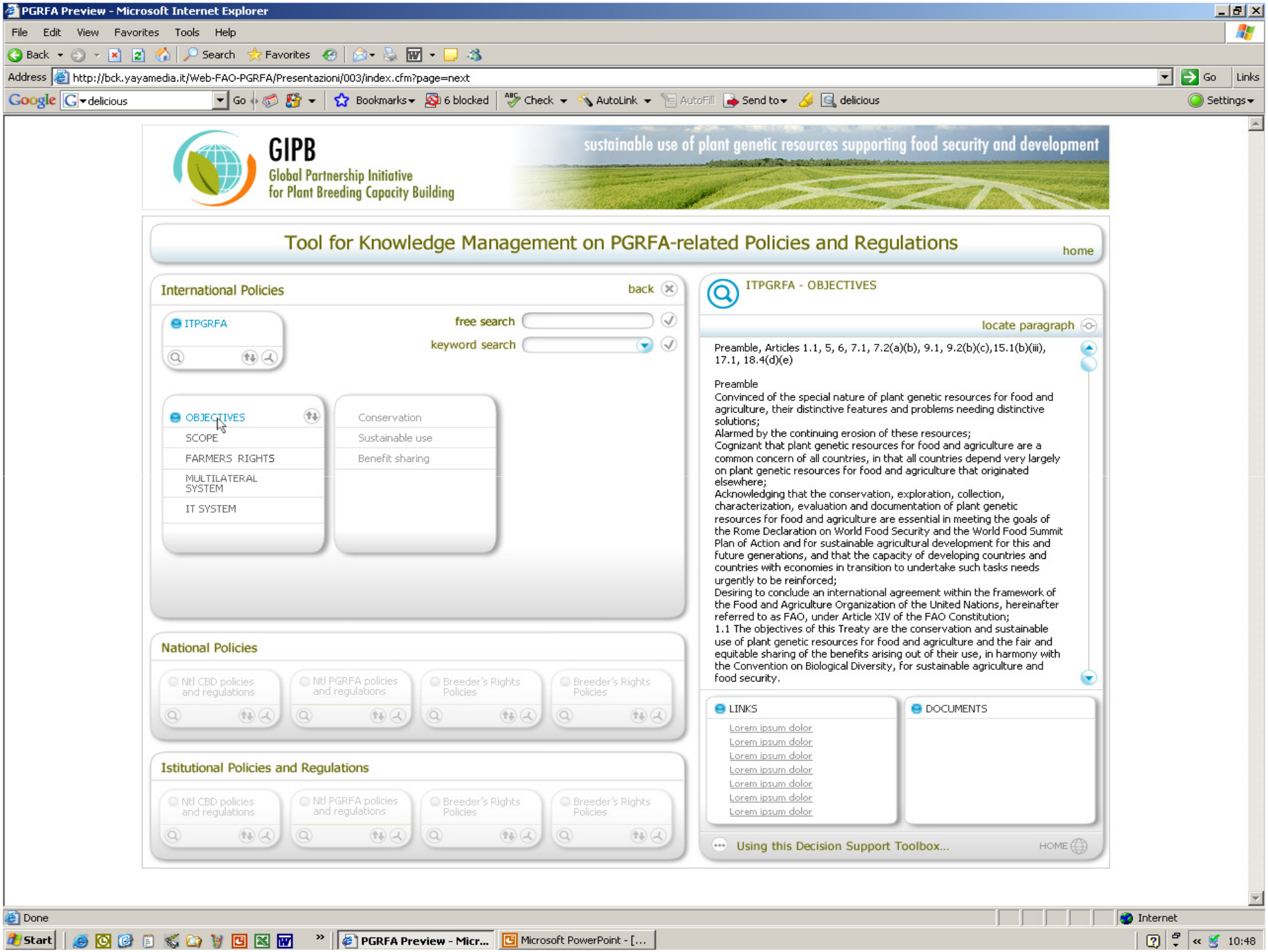
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GIPB
Global Partnership Initiative
for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
International Policies
back
ITPGRFA
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OBJECTIVES
SCOPE
FARMERS RIGHTS
MULTILATERAL SYSTEM
IT SYSTEM
Conservation
Sustainable use
Benefit sharing
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Preamble
Convinced of the special nature of plant genetic resources for food and agriculture, their distinctive features and problems needing distinctive solutions;
Alarmed by the continuing erosion of these resources;
Cognizant that plant genetic resources for food and agriculture are a common concern of all countries, in that all countries depend very largely on plant genetic resources for food and agriculture that originated elsewhere;
Acknowledging that the conservation, exploration, collection, characterization, evaluation and documentation of plant genetic resources for food and agriculture are essential in meeting the goals of the Rome Declaration on World Food Security and the World Food Summit Plan of Action and for sustainable agricultural development for this and future generations, and that the capacity of developing countries and countries with economies in transition to undertake such tasks needs urgently to be reinforced;
Desiring to conclude an international agreement within the framework of the Food and Agriculture Organization of the United Nations, hereinafter referred to as FAO, under Article XIV of the FAO Constitution;
1.1 The objectives of this Treaty are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security.
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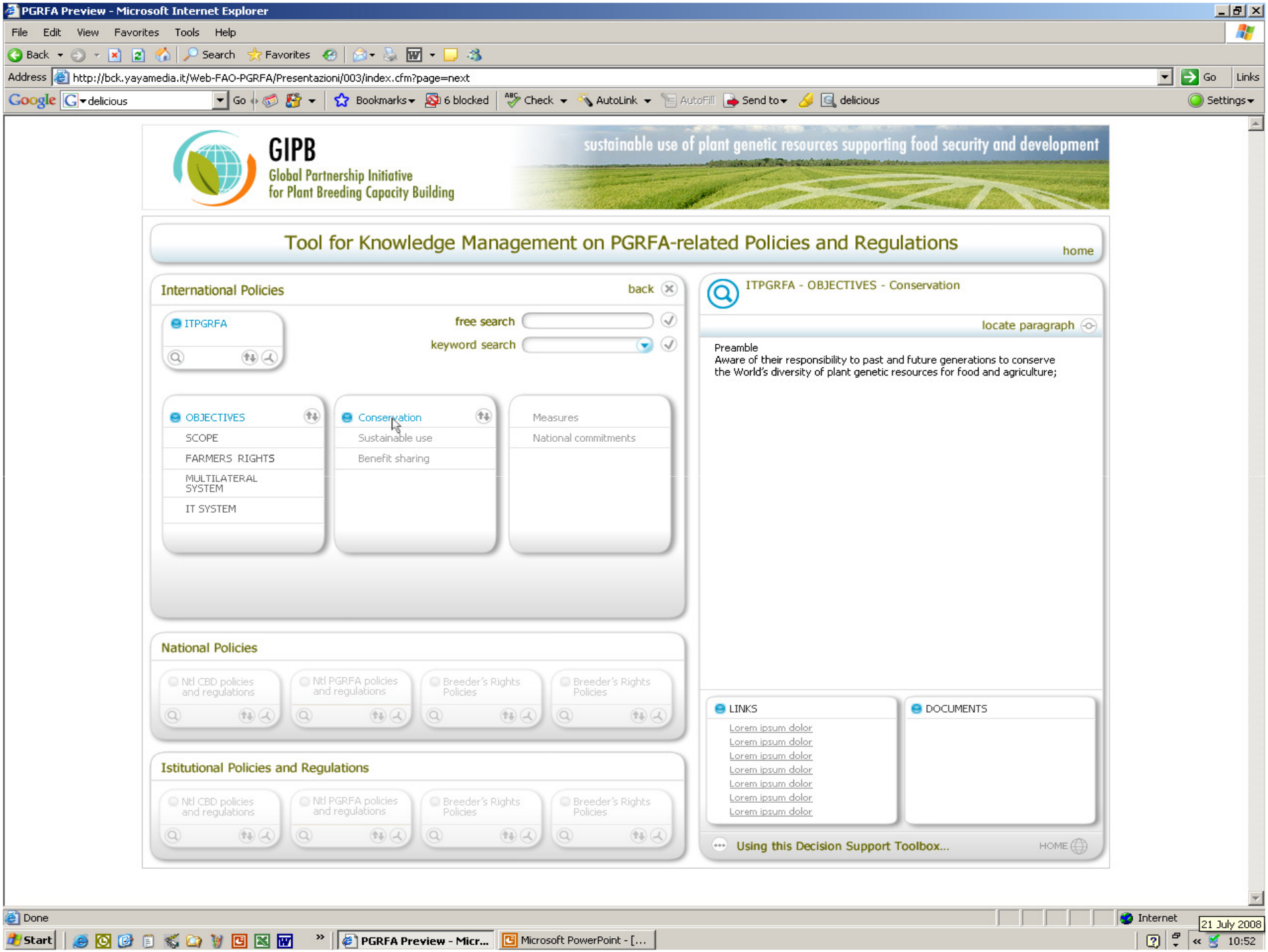
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for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
International Policies
back
ITPGRFA
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OBJECTIVES
SCOPE
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MULTILATERAL SYSTEM
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Conservation
Sustainable use
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Aware of their responsibility to past and future generations to conserve the World's diversity of plant genetic resources for food and agriculture;
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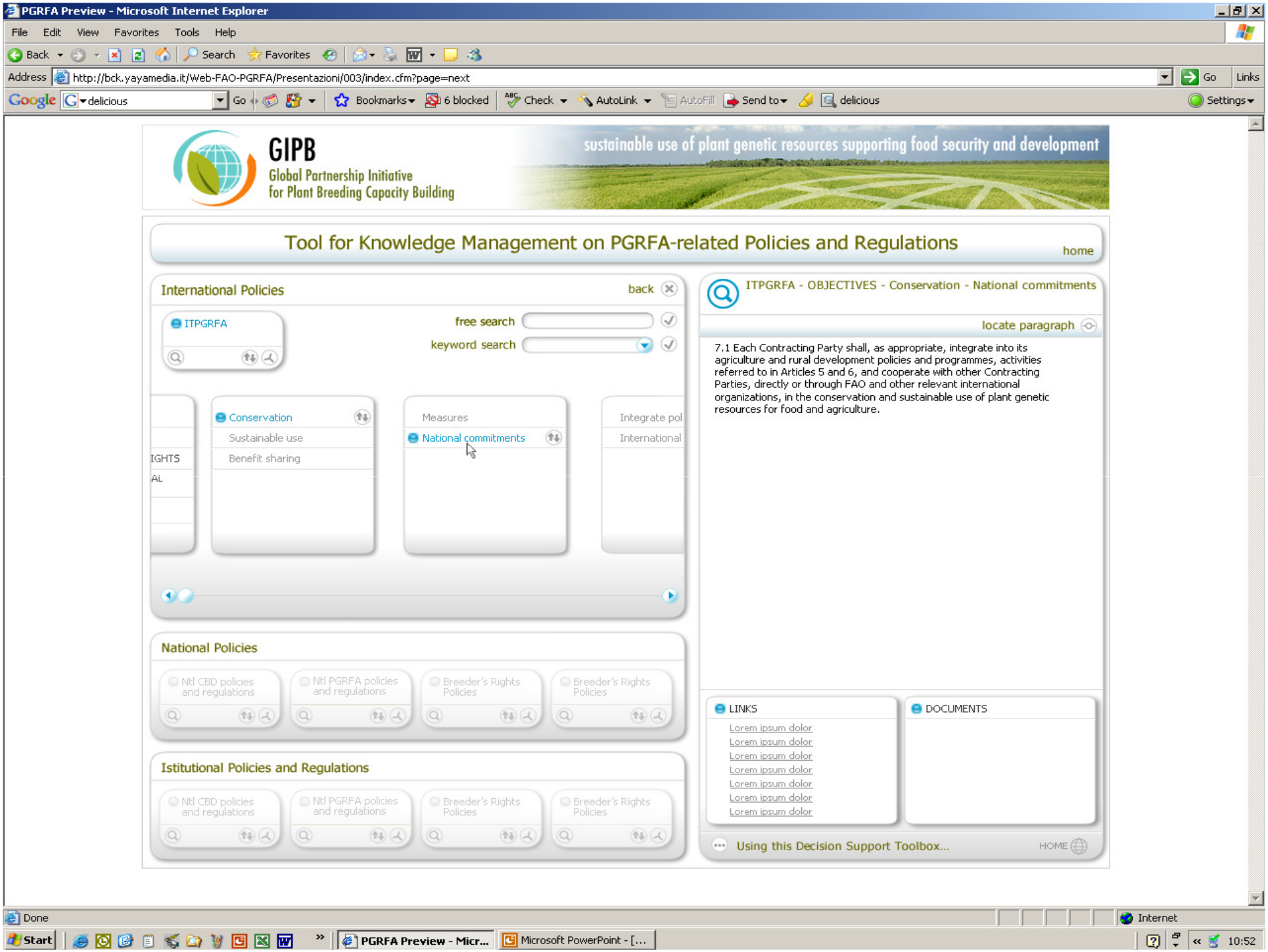
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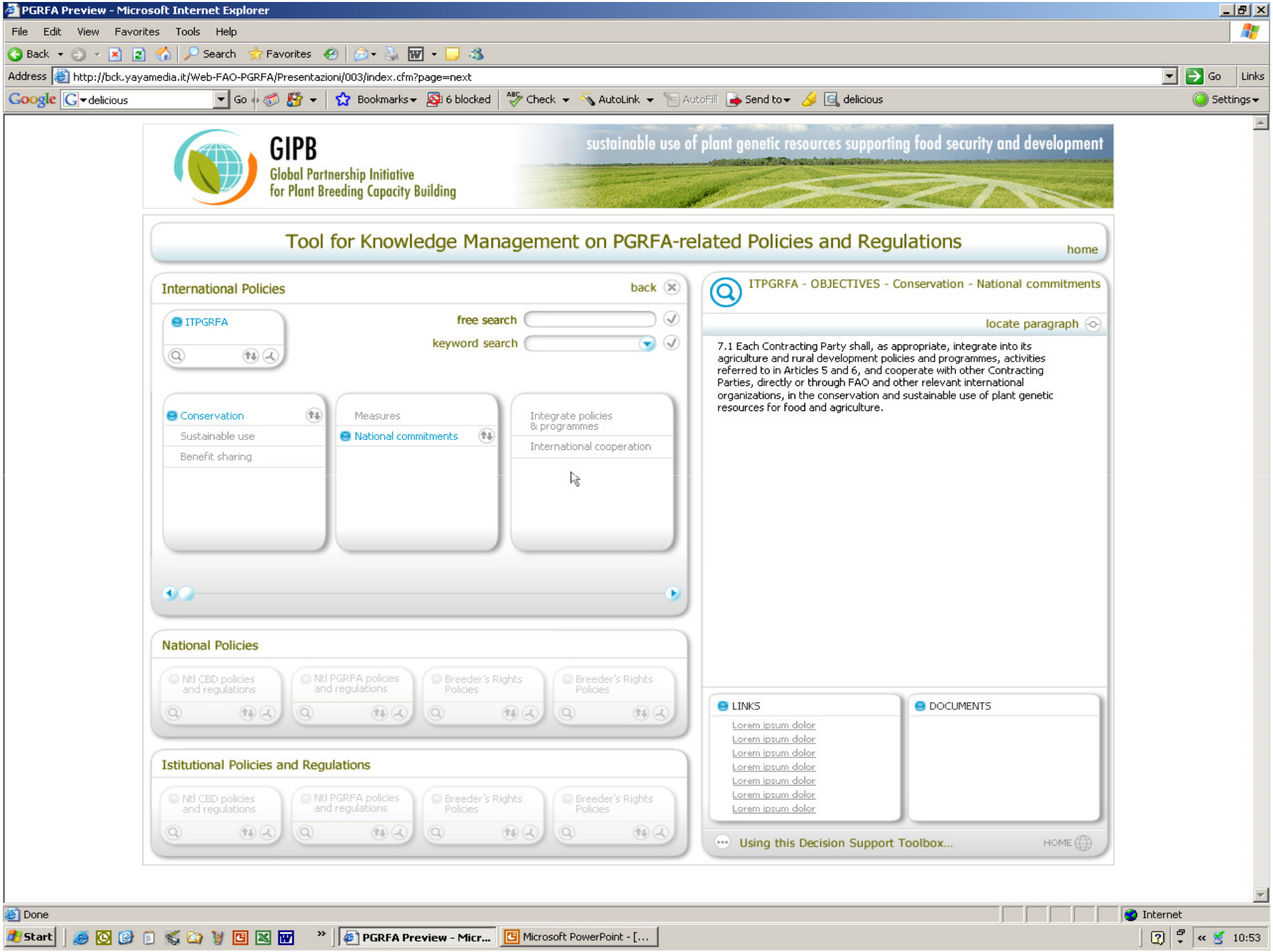
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for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
International Policies
back
ITPGRFA
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Conservation
Sustainable use
Benefit sharing
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International cooperation
ITPGRFA - OBJECTIVES - Conservation - National commitments
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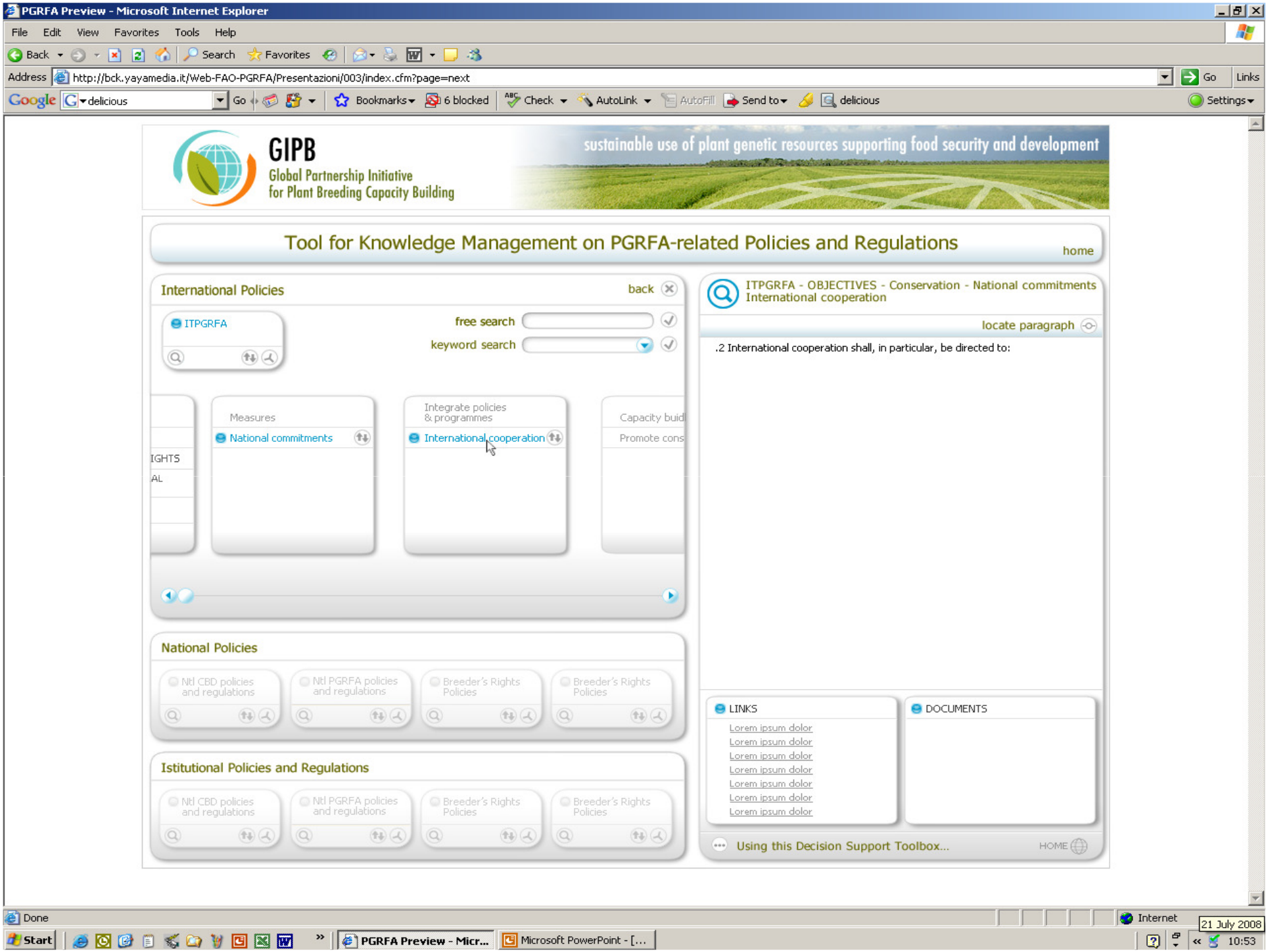
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for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
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home
International Policies
back
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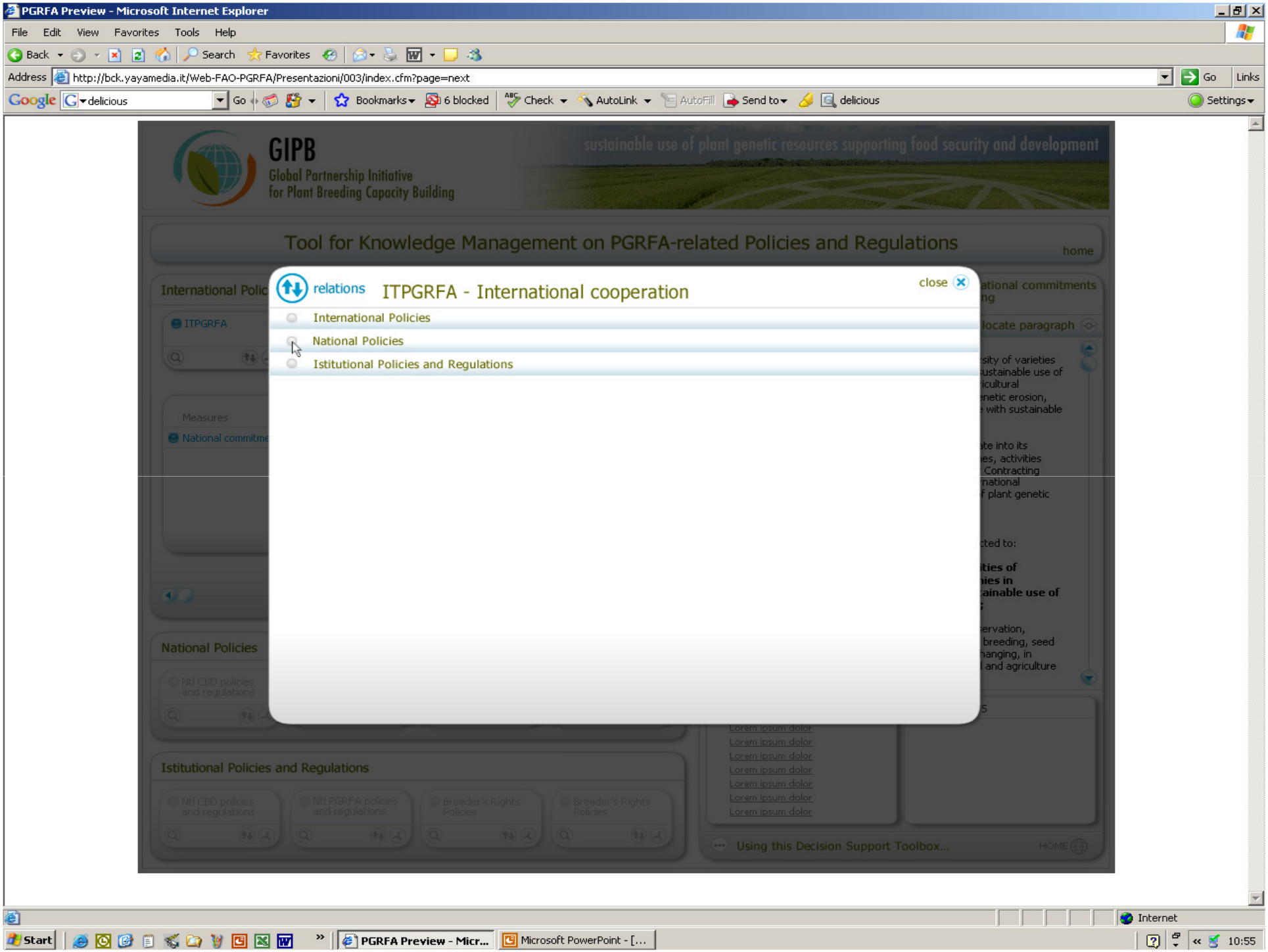
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GIPB
Global Partnership Initiative
for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
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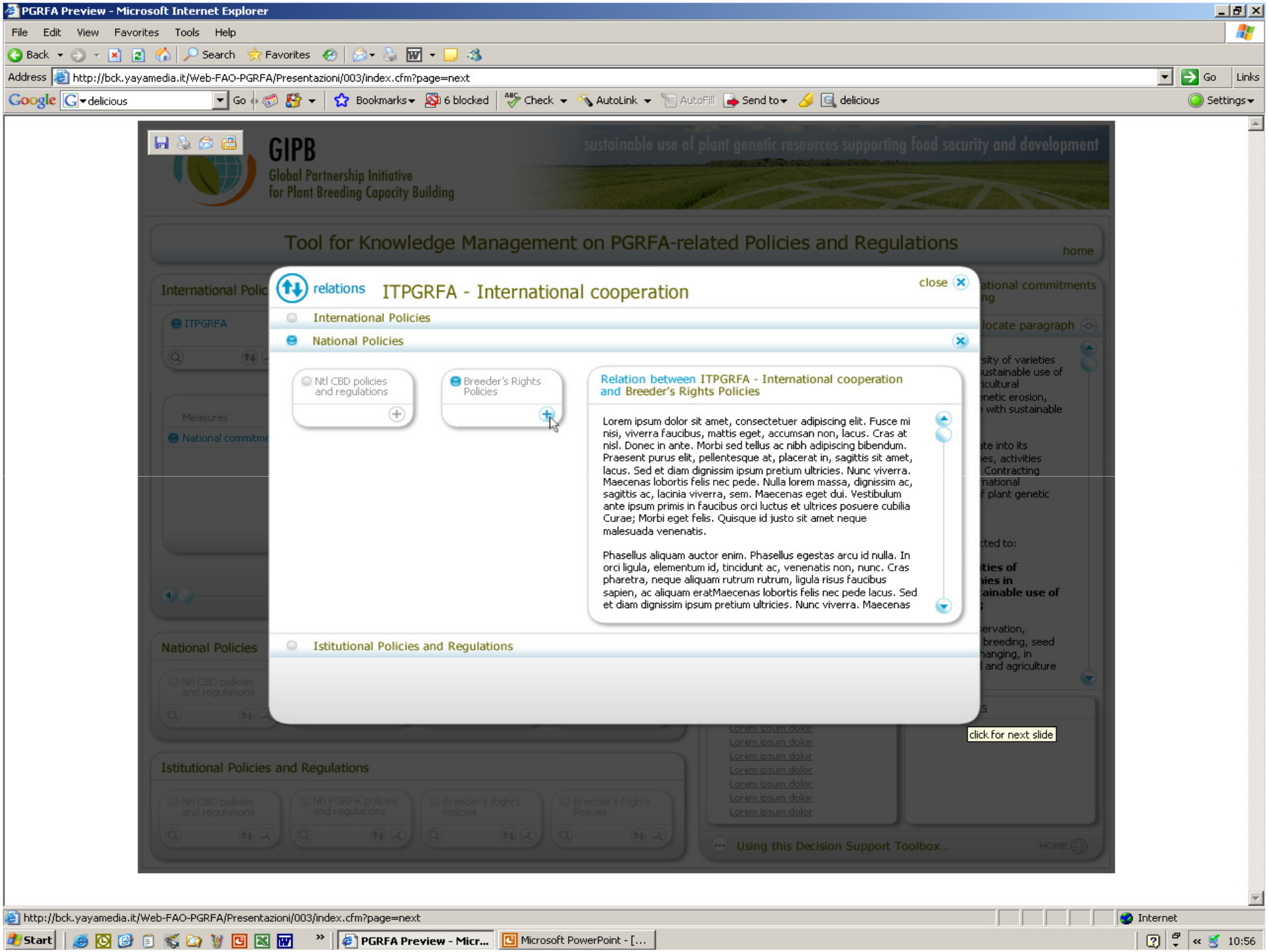
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GIPB
Global Partnership Initiative
for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
relations
ITPGRFA - International cooperation
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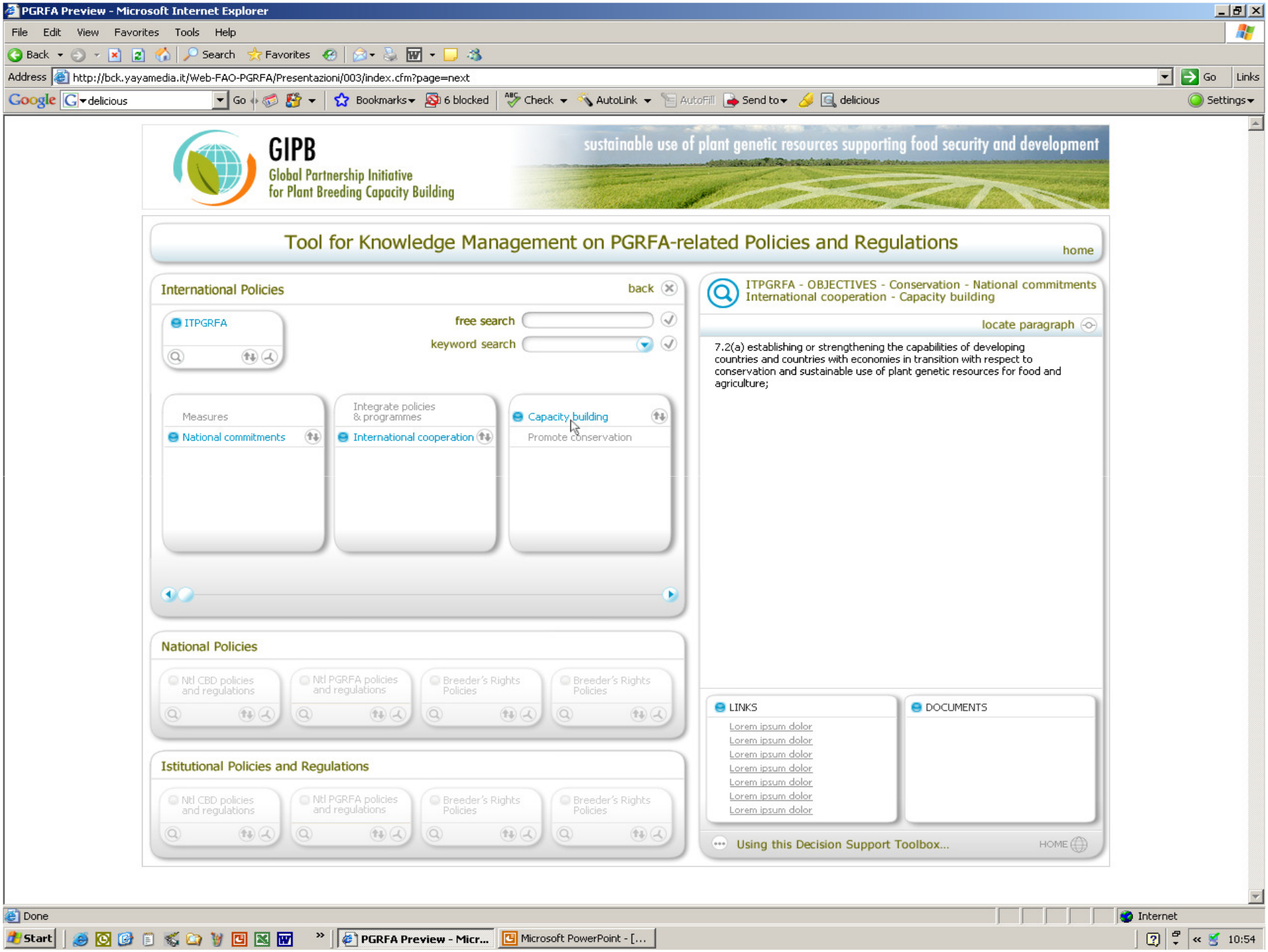
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GIPB
Global Partnership Initiative
for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
International Policies
back
ITPGRFA
free search
keyword search
Measures
National commitments
Integrate policies & programmes
International cooperation
Capacity building
Promote conservation
ITPGRFA - OBJECTIVES - Conservation - National commitments
International cooperation - Capacity building
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7.2(a) establishing or strengthening the capabilities of developing countries and countries with economies in transition with respect to conservation and sustainable use of plant genetic resources for food and agriculture;
National Policies
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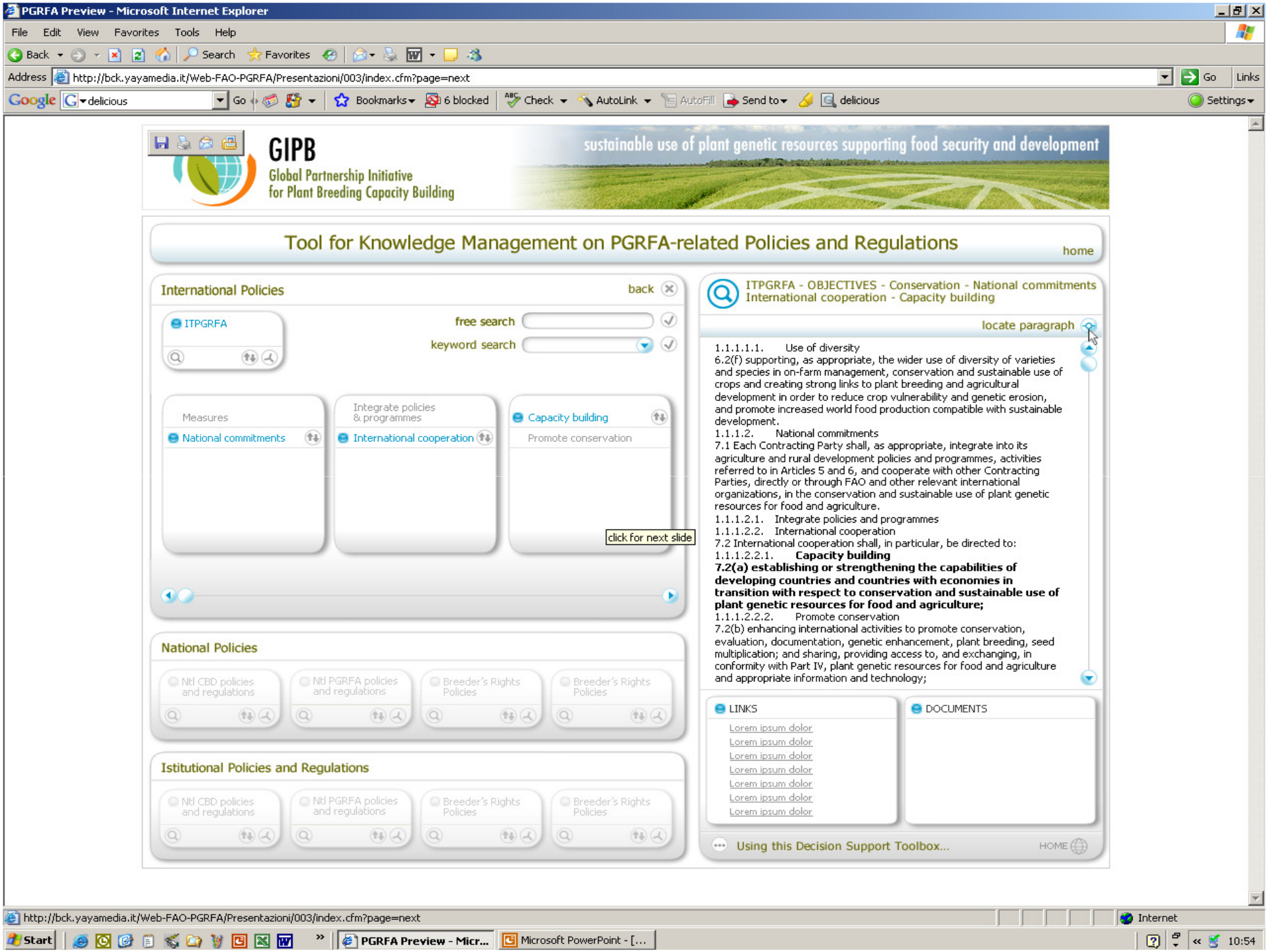
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GIPB
Global Partnership Initiative
for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
International Policies
back
ITPGRFA
free search
keyword search
Measures
National commitments
Integrate policies & programmes
International cooperation
Capacity building
Promote conservation
click for next slide
ITPGRFA - OBJECTIVES - Conservation - National commitments
International cooperation - Capacity building
locate paragraph
1.1.1.1.1. Use of diversity
6.2(f) supporting, as appropriate, the wider use of diversity of varieties and species in on-farm management, conservation and sustainable use of crops and creating strong links to plant breeding and agricultural development in order to reduce crop vulnerability and genetic erosion, and promote increased world food production compatible with sustainable development.
1.1.1.2. National commitments
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1.1.1.2.1. Integrate policies and programmes
1.1.1.2.2. International cooperation
7.2 International cooperation shall, in particular, be directed to:
1.1.1.2.2.1. Capacity building
7.2(a) establishing or strengthening the capabilities of developing countries and countries with economies in transition with respect to conservation and sustainable use of plant genetic resources for food and agriculture;
1.1.1.2.2.2. Promote conservation
7.2(b) enhancing international activities to promote conservation, evaluation, documentation, genetic enhancement, plant breeding, seed multiplication; and sharing, providing access to, and exchanging, in conformity with Part IV, plant genetic resources for food and agriculture and appropriate information and technology;
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Global Partnership Initiative
for Plant Breeding Capacity Building
sustainable use of plant genetic resources supporting food security and development
Tool for Knowledge Management on PGRFA-related Policies and Regulations
home
International Policies
back
ITPGRFA
free search
keyword search
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ITPGRFA - OBJECTIVES - Conservation - National commitments
International cooperation - Capacity building
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