Plant Genetic Resources Diversity Gateway – a way forward

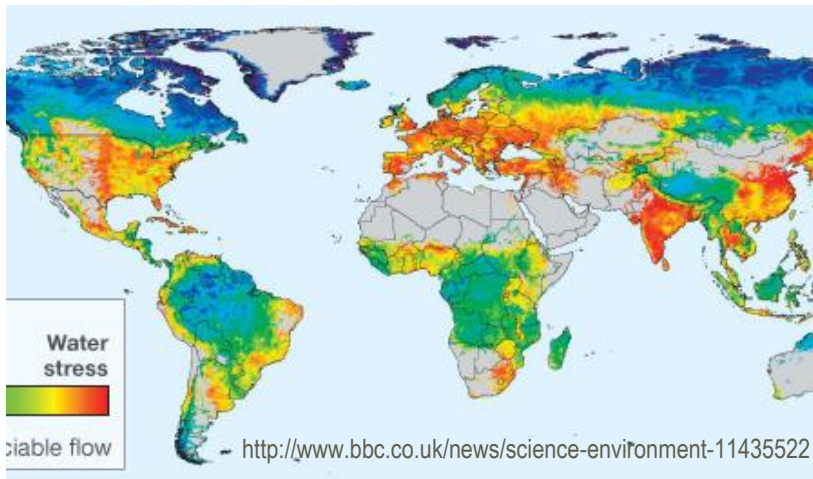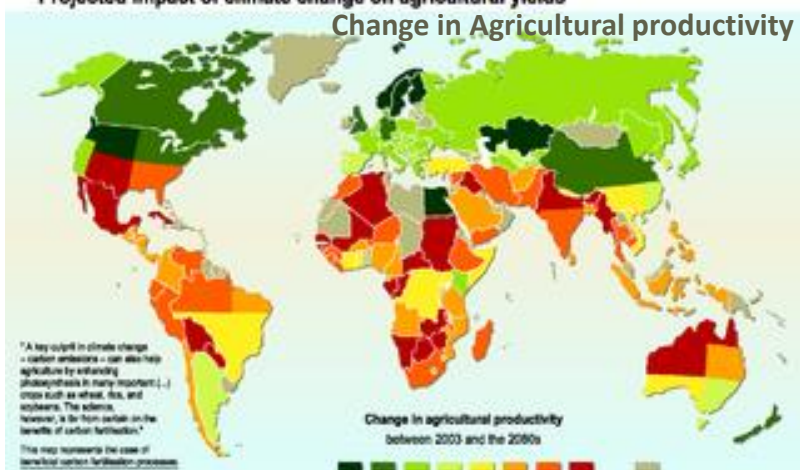Sónia Dias, Milko Skofic, Ehsan Dulloo and Nigel Maxted

International Conference on ENHANCED GENEPOOL UTILIZATION – Capturing wild relatives and landrace diversity for crop improvement
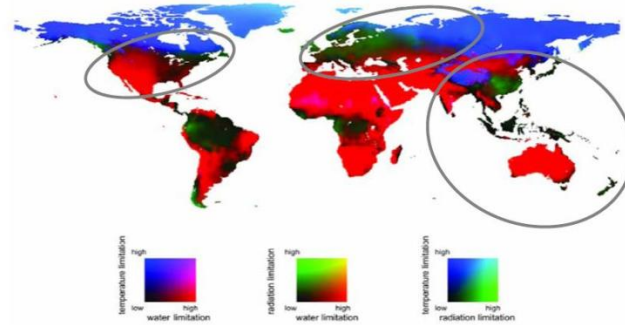Churchill College Cambridge, UK, 19 June 2014

Content

- Challenges we are facing
- Documentation and information paradigm
- Understanding diversity
- Objective
- What has been done
- Watch it - the PGR Diversity Gateway
- Way forward

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Challenges we are facing

Change in Agricultural productivity

Source: Population Reference Bureau. *Photo: SMH*

http://www.bbc.co.uk/news/science-environment-11435522

Global Food Security

BBSRC Food Security

Baldocchi et al. 2004 SCOPE 62 *Courtesy of Ian Crute*

7 BILLION

This is our goal

And time flies…

*"In view of the globally increasing social and economic instabilities resulting from the anticipated rapid climate changes, **we may not have another two decades time** to develop and deploy national complementary conservation strategies and to debate the integration of national plant germplasm programmes with the objective of increasing the overall efficiency and effectiveness of PGRFA conservation and sustainable use. "*

Time flies, but you are the pilot.

KLM flight napkins

From PGR Secure input paper, Authors: Lothar Frese, Chris Kik, Anna Palmé

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D&I changing paradigm

Tired of This?

1980s

- PGR and associated information regarded as common heritage
- Little use of standards and Mostly public PGR collections
- Documentation of PGR maintained *ex situ*
- FAO IU on PGR
- Little access and exchange of information
- Stand alone documentation systems

2000s

- PGR and associated information subject to national sovereignty
- Generalized use of standards and Public and private PGR collections
- Documentation of PGR maintained *ex situ*, *in situ* and on-farm
- CBD, WTO, ITPGRFA, Nagoya Protocol
- Increasing access and exchange of information
- Web based documentation and information systems...

Understanding Diversity

Centers of Origins

Olive

Rice

Genebanks

Maize

Potato
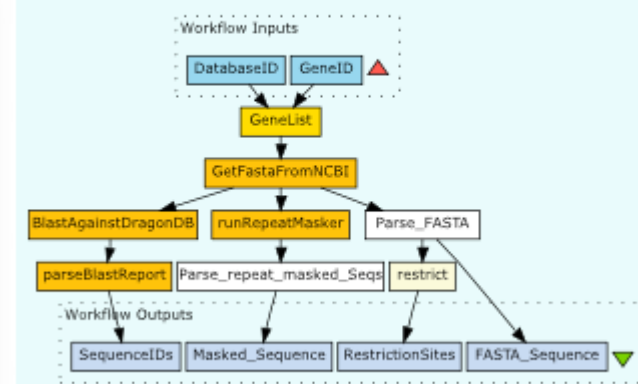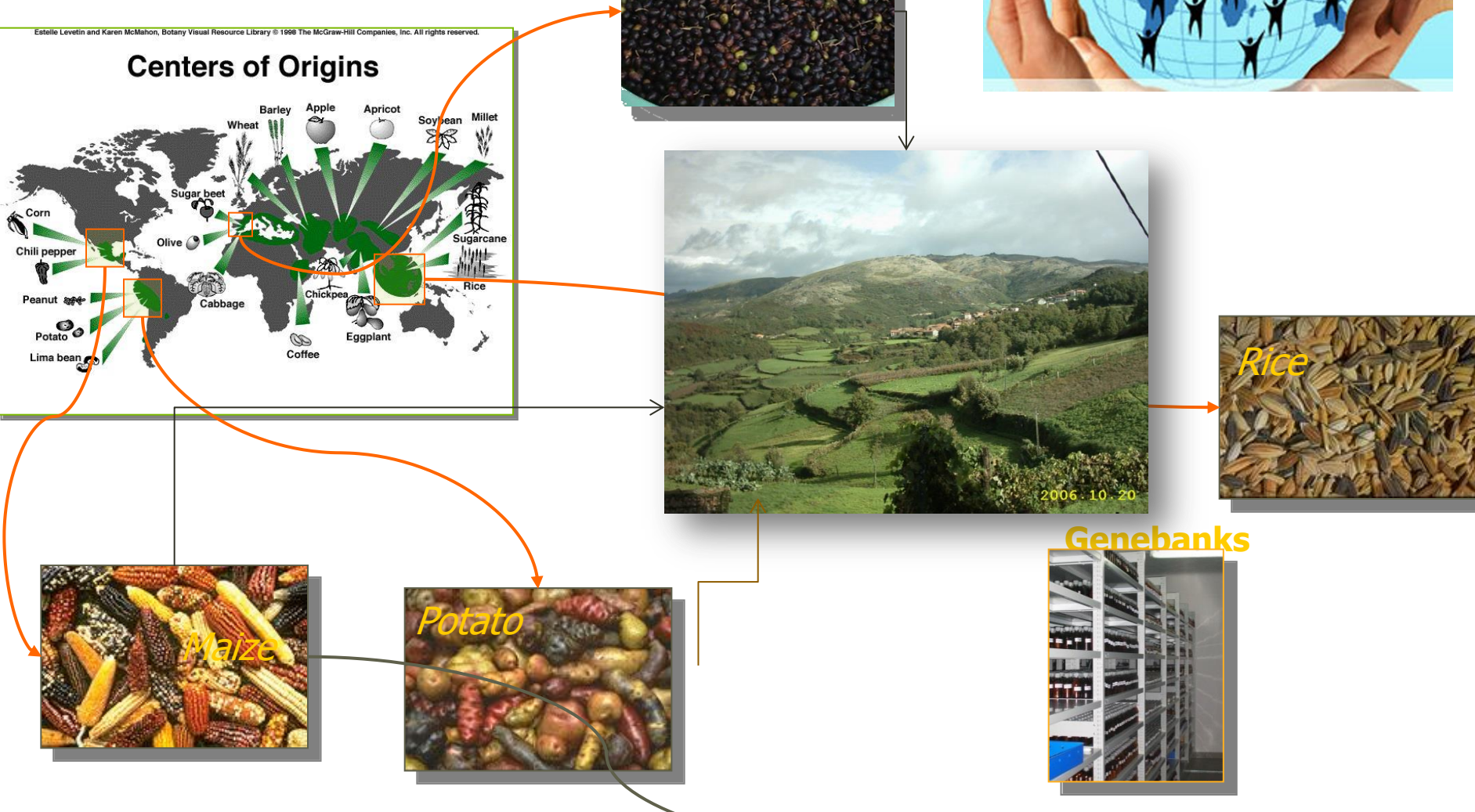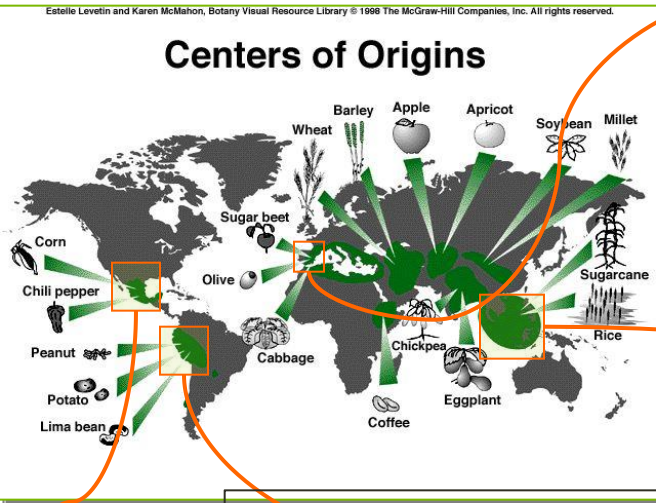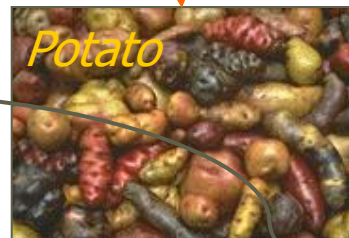
Build knowledge to select materials

In situ & On-farm
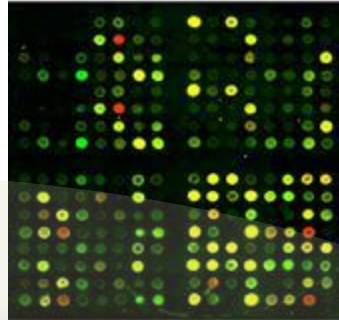
Characterization

Evaluation
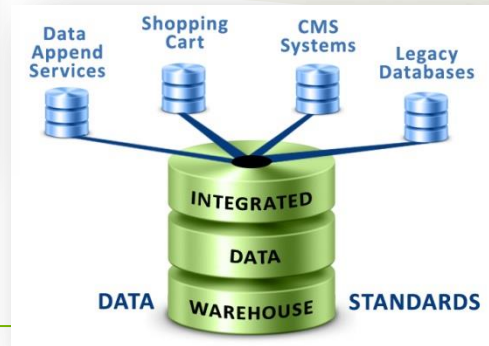
Genebanks

Data management

Breeding

Distribution/Use

DATA - a growing torrent

PGR data and information

- Lack of institutional capacity

- Scarce data mobilization

- Outdated or inappropriate
  - documentation
  - Standards

- Limited free or easy tools

- Lack of long term holistic management strategies

- Rare continuous data assessments

- Institutional and individuals barriers to share

Data not yet available

Peter Ryan

PGR Secure

Novel characterization of crop wild relative and landrace resources as a basis for improved crop breeding

"…there remain two critical areas where progress has been limited: (a) the use of conserved agrobiodiversity by breeders and (b) the systematic conservation of crop wild relative (CWR) and landrace (LR) diversity…."

……

To achieve these goals, PGR Secure has four research themes:

...Informatics development, including:

    (4a) CWR and LR inventory information web availability,

    (4b) Novel characterization information web availability,

    (4c) Inter-information system operability.

Objectives

Task 2.1

To produce a web-based CWR and LR Trait Information Portal
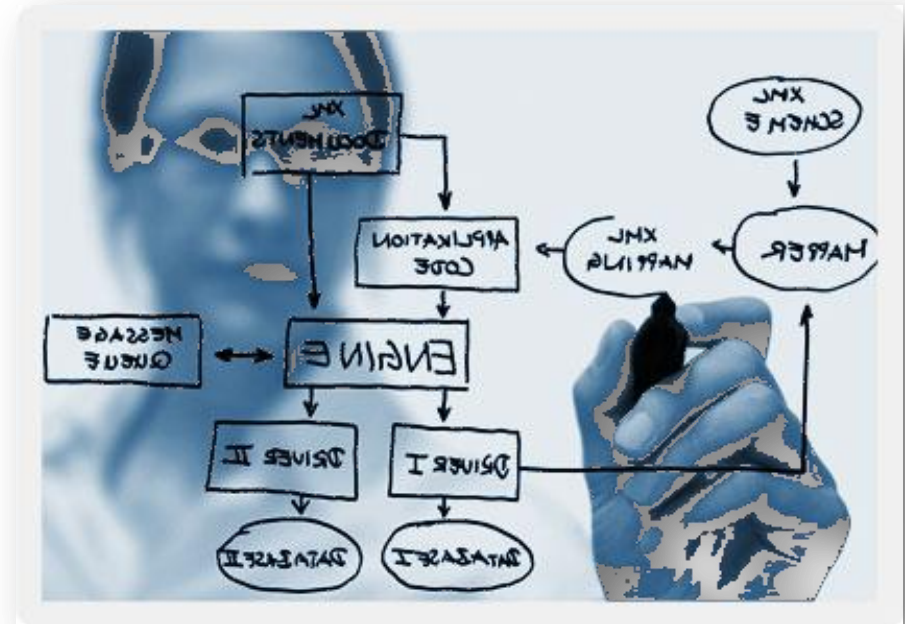
The challenges

- How to build a system allowing constant adaptation and flexibility?

- How to develop a suite of technologies that are technically powerful and challenging and at the same time user friendly?

- How to drive the system based on easy solutions?

  Allowing and facilitating

  - Data sharing

  - Publishing

  - Retrieval

The challenge

- Understand the *users-you*

- *Capturing* needs and views?

- What information are *you* looking for?

- How do *you* look for information?

- What are *your* needs?

- What are the traits *you* are interested in?

- What information are *you* willing to share?

what, where and how?

Questions users make to a system

Which are the CWR/LR of X crops that have a specific trait?

Where are they maintained? Are seed samples freely available?

Who is the contact person for information or seed samples?

Where does the material originate? Location of origin (map)

How to find material with specific traits (diseases, pests etc.)? Phenotype (photo)

Any self incompatibility (seed testing) . Cross compatibility

Used in genetic studies (genetic maps available?)

Surveying users:DIAS

Examples of traits mentioned by users
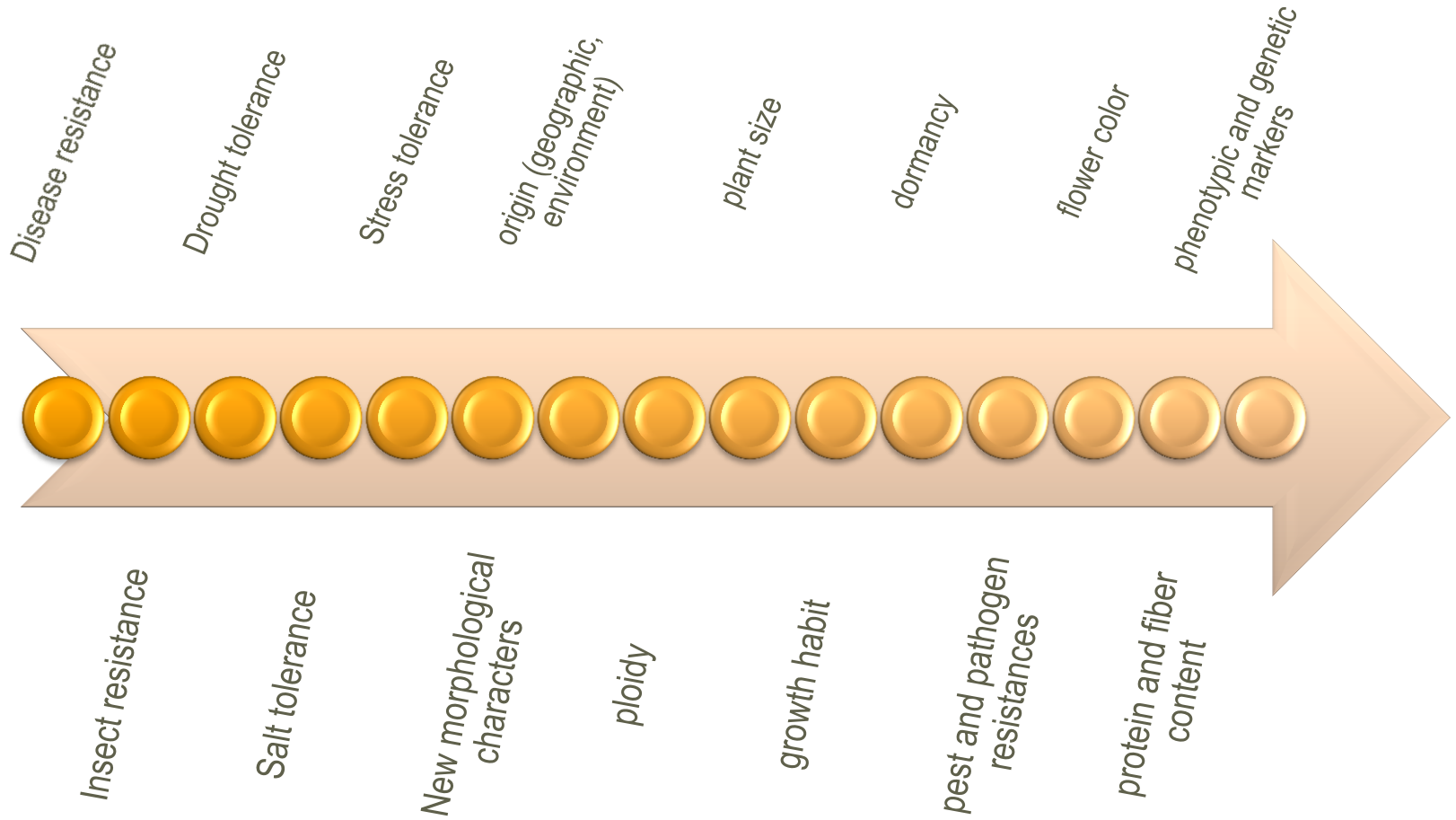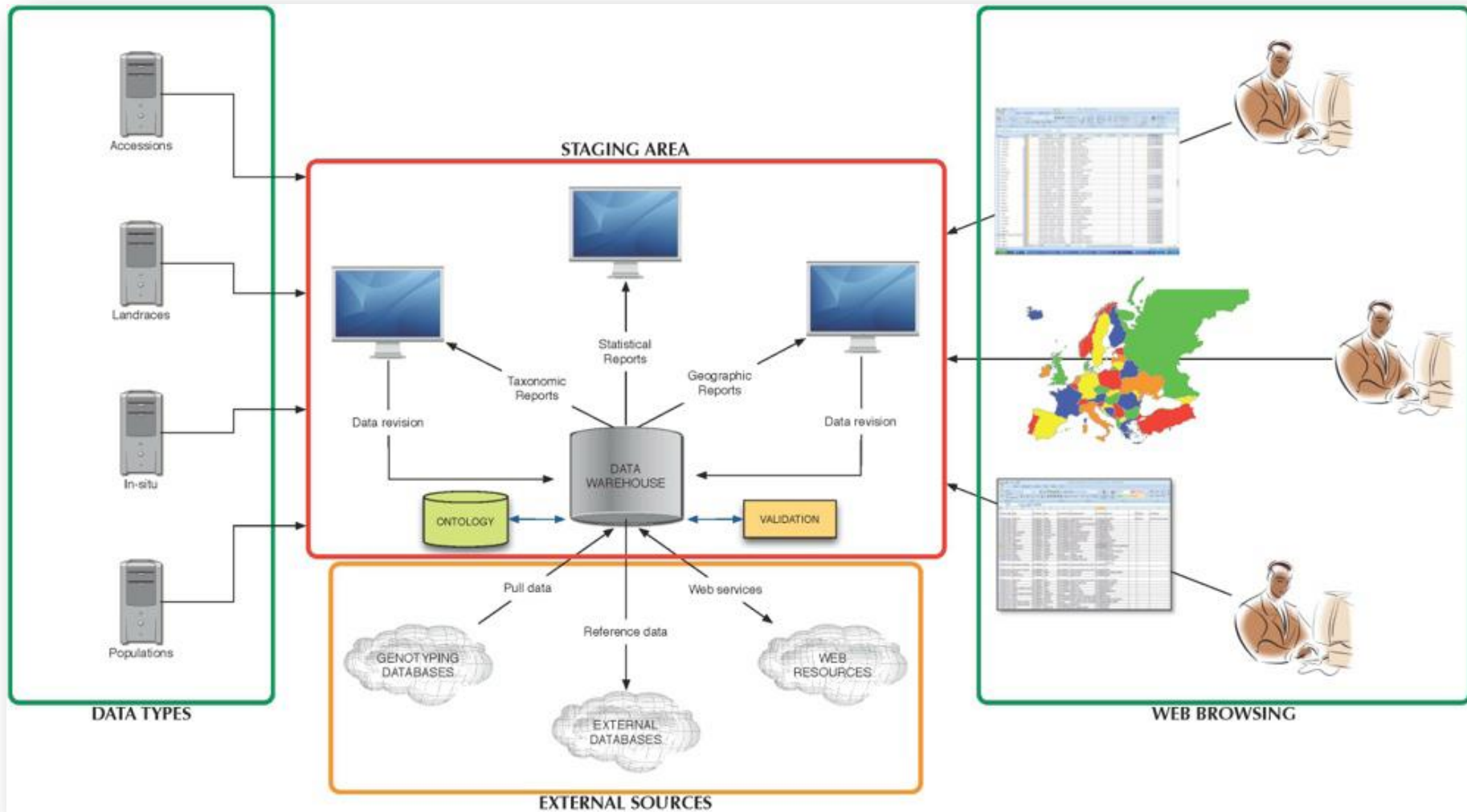
Disease resistance

Drought tolerance

Stress tolerance

origin (geographic, environment)

plant size

dormancy

flower color

phenotypic and genetic markers

Insect resistance

Salt tolerance

New morphological characters

ploidy

growth habit

pest and pathogen resistances

protein and fiber content

Infrastructure schema

Scientific Standards

- **Data standards that were added to the system**
  - Darwin Core,
  - EUFGIS standards for forest gene conservation units,
  - various ISO standards,
  - IUCN red list standards
  - FAO/Bioversity Multi-Crop Passport descriptors V2
  - …

The beta version - Plant Genetic Resources Diversity Gateway

- The beta version of the system was presented at the WP5 stakeholder workshop "**conservation and sustainable use of plant genetic resources in Europe: a stakeholder analysis",** in November 2013

- The system was tested with passport, characterization and evaluation data from other information systems, as follows:
  - 2,289,876 records;
  - 11,207,808 characterization and evaluation data records;
  - 2,284,056 accessions;
  - 454,080 sites;
  - data from 238 countries

2M, 1400 trial, 2000 forest units

Climate data with160 million records

- And was available for testing and feedback.

Now- Plant Genetic Resources Diversity Gateway

- **Since the beta version publication, the PGR Diversity Gateway technology has been updated**

- **The database has been enriched with a map service**

- **The data portal and search has been further developed**

- **It has been tested for scalability**

- **Data standards were added to the system**

- **Available project data added to the system**

- US Forest service:Wild buckwheat.

- NHM, UK\ *Solanum huaylasense*

…relevance to science/research and policy!

Climate change · Mitigation · Food security · Breeding & Research · Traits of interest · Evaluation/measurement · Scales and methods · Diversity · Genetic resources

Accessions Ex situ CWR In situ Landraces On farm Traits ontologies Genotype

Linking with other external initiatives

Contributing to
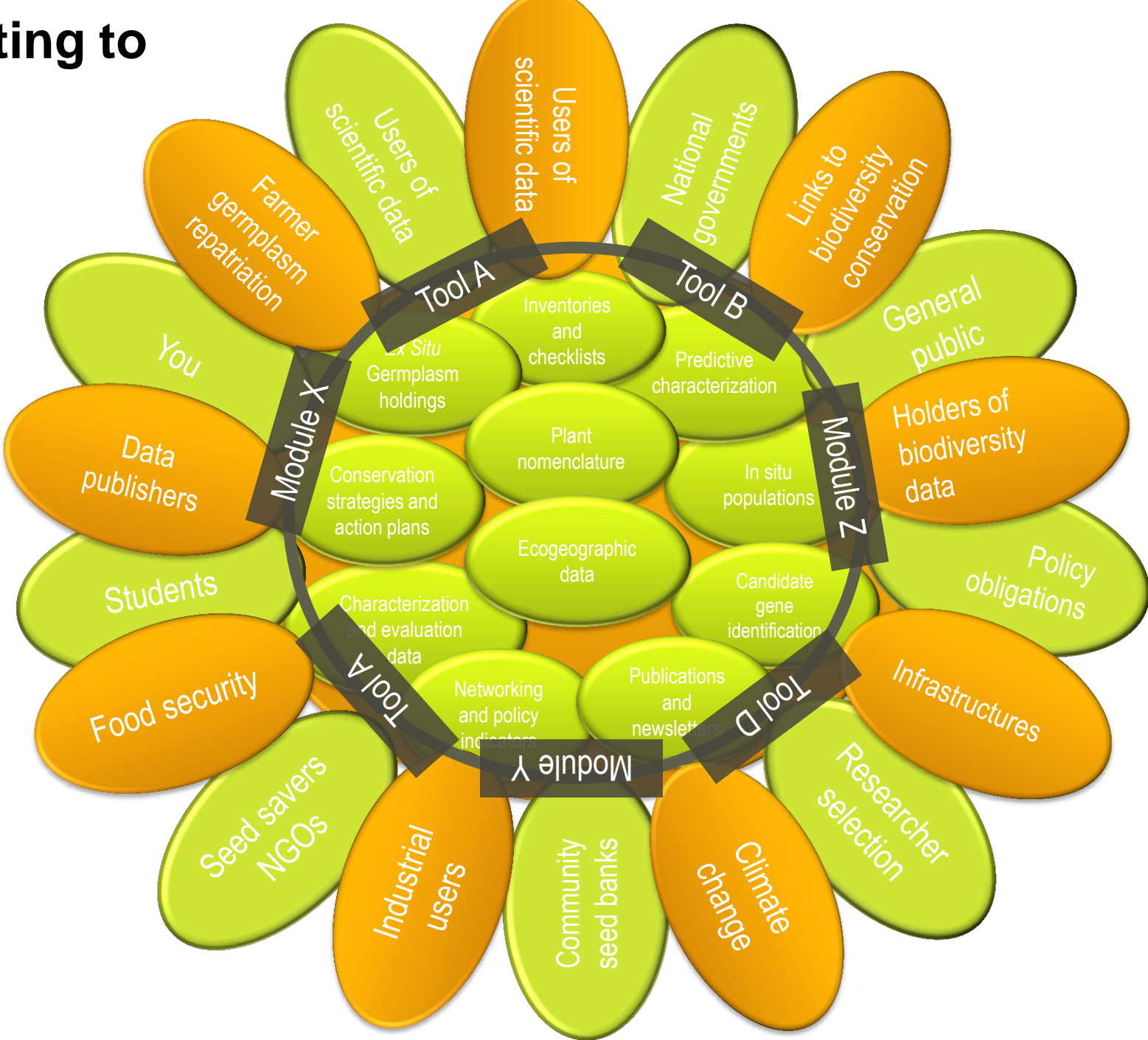
IF I COULD SEE THE FUTURE AND HOW THIS PLAYS OUT I BET IT'S BETTER THAN WHERE WE ARE NOW

The PGR Diversity Gateway

Plant Genetic Resources Diversity Gateway for the conservation and use of crop wild relative and landrace traits'

The vision

Facilitate access to in situ and on farm crop wild relatives (CWR) and landraces (LR) information

Why are crop wild relatives important?

They are a source of resistance against **pests and diseases**

They can enhance the **nutritional quality** of crops

Their traits can provide tolerance to:

Extreme temperature   Drought   Salinity

It will enable the identification of the users most likely sources of priority traits and how users can access material for utilization.

It has been estimated that the contribution of crop wild relatives to improving food production has an annual value of **US$115-120** billion worldwide

Crop wild relatives are under threat

Facilitate and assist countries in meeting their national and international commitments and responsibilities BUT also promotes PGR conservation and sustainable use of CWR and LR diversity.

Crop wild relatives are under threat

In Europe, **27-42%** of crop wild relatives are predicted to be **lost by 2080** due to climate change

Bioversity International works to support and enable effective and efficient local, national and global *in situ* conservation and use strategies of crop wild relatives.

Strengthen networks and biodiversity conservation , essential for variety development in face of climate change and to ensure food security

http://pgrdiversity.bioversityinternational.org/

And after the project

After the project ends

- **Funding sources for continuity are needed**

  Using the Gateway platform infrastructure for other projects
  - EU-ACP
  - OTHERS proposals under development

- **Hosting and continuity of development and management**
  Bioversity will continue to host the PGR Diversity Gateway and further develop it subject to funds available

- **Addition of tools and modules to meet future needs**

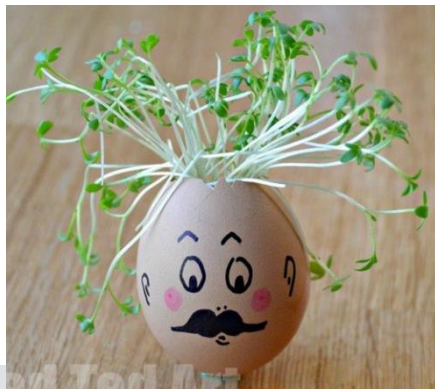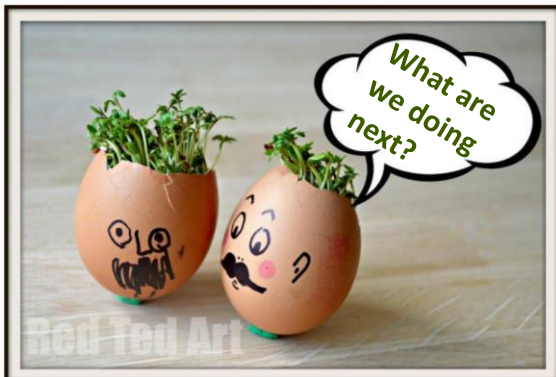Bioversity
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PGR Gateway - a way forward

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- Template generator

- Upload system

- Dynamic forms

- Project data entry

- Data, data, data

- Mapping and /visualization

- Website information content and presentation

- Integrate predictive characterization

Key areas to focus

- Content
- Field
- Farm
- Herbarium

Mobilisation

- users
- Providers

Engagement

- National,
- regional levels

Support

- ITPGRFA
- CBD
- Nagoya

International Policy

- **policy**
- **international cooperation**
- Training
- mentoring
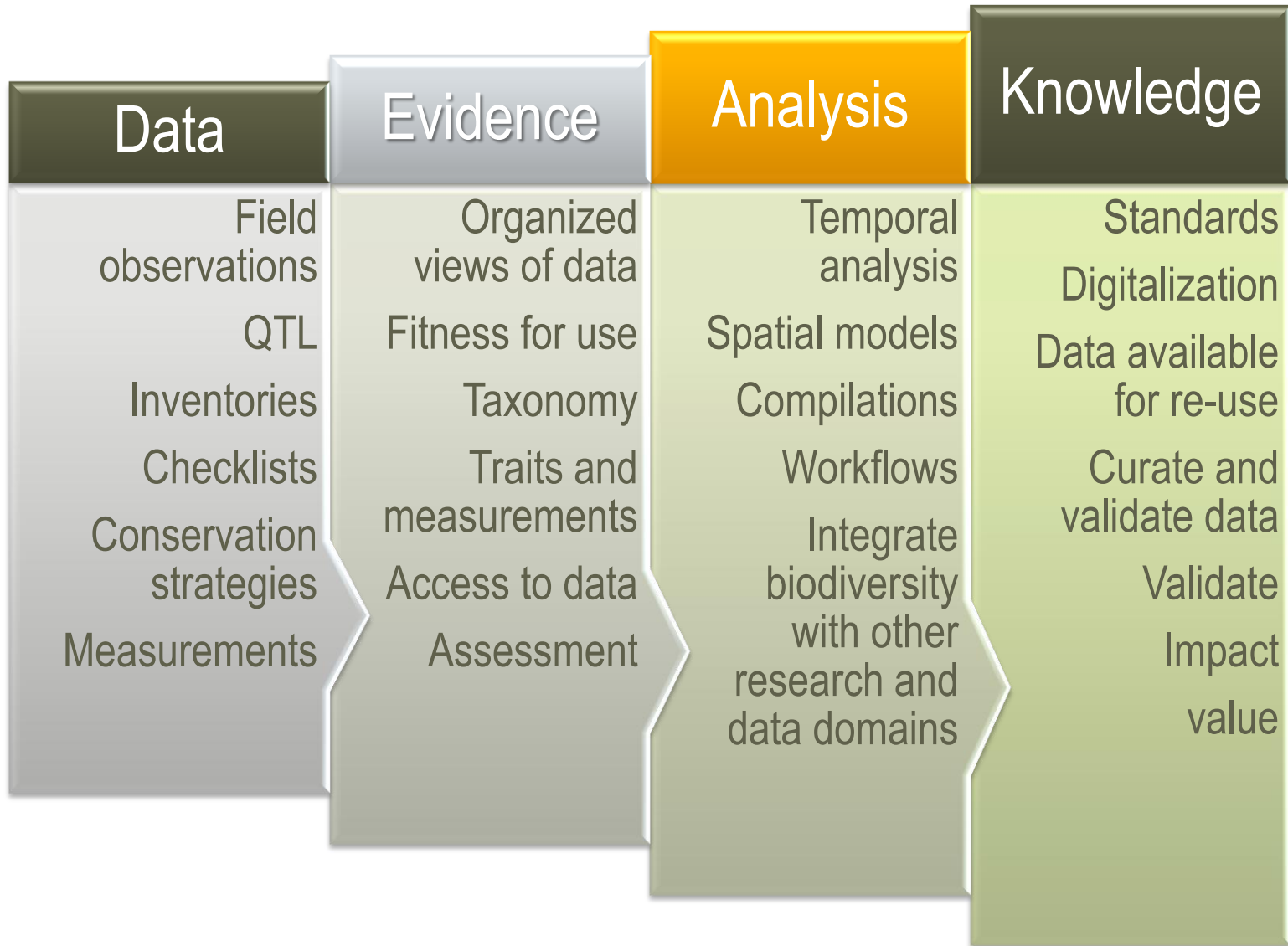
Research infrastructures

- Temporal data
- Sentinel sites/Reference sites
- Indicators

Assessment and Monitoring

- Institutional
- National,
- Regional
- Global

Reporting

…and the five pillars are

Data	Evidence	Analysis	Knowledge
Field observations	Organized views of data	Temporal analysis	Standards
QTL	Fitness for use	Spatial models	Digitalization
Inventories	Taxonomy	Compilations	Data available for re-use
Checklists	Traits and measurements	Workflows	Curate and validate data
Conservation strategies	Access to data	Integrate biodiversity with other research and data domains	Validate
Measurements	Assessment		Impact value

Creating added value to the Gateway

Creating transparency
Simply making data more easily accessible to relevant stakeholders in a timely manner
Making relevant data more readily accessible across to sharply reduce search and processing time
Integrating data, significantly cuts time to improve quality

Segmenting information to customize actions
Allows to create segmentations and to tailor results to meet needs

Supporting human decision-making with better information
Sophisticated analytics can substantially improve decision making that would otherwise remain hidden. Such analytics have applications to flag candidates for further selection that can use optimize decision processes

Innovating models, products, and services
Enables the creation of new models and services, enhance existing ones
The identification of observations and selection based on where, who and what, and perceived needs.

The Plant Genetic Resources Diversity Gateway is ready to receive the data

Access to data is critical and increasingly we will need to integrate information from multiple data sources, often from third parties, and the incentives have to be in place to enable this.

Acknowledgements

Milko Skofic

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To all PGR Secure partners and breeders

Thank you

www.bioversityinternational.org