# Values, norms and practices in plant biodiversity-based research and innovation commons

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# A contrasted landscape in biodiversity research (1)

- Opportunities
  - Omics sciences, bio-informatics
    - generate, manage, analyze big biological datasets
  - Information Technologies
    - make access to these datasets feasible
- Constraints
  - increasing complexity and uncertainty with regard to the access to, use and exchange of biological material and information.

# A contrasted landscape in biodiversity research (2)

- Number of pooling initiatives (of material, data, technologies)
  - critical mass, added value
  - reduction of public spending on research
  - "Shanghaï Ranking syndrom" (big is beautiful...)
- Two major policy evolutions are disrupting cooperative behavior
  - access and benefit sharing
  - IPR policies

By overemphasizing monetary incentives, these two frameworks inadequately match the needs and expectations of the research community

# How do scientific communities with open sharing norms cope with this context ?

- knowledge-sharing processes
- governance mechanisms
- collective arrangements
  - to promote the widest possible access to scientific information in the research process
  - while maximizing the reciprocal benefits expected in any exchange practice.

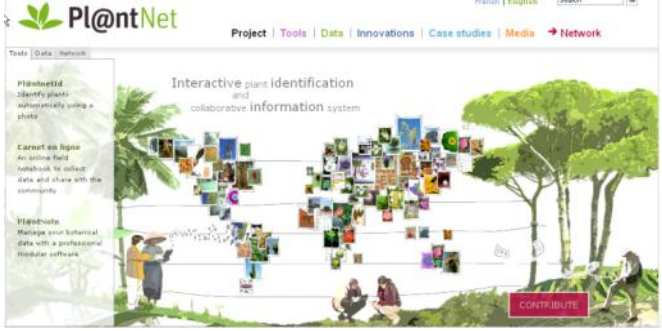
# Comparison of three biodiversity-based initiatives

- that try to increase generation, use and exchange of biological knowledge commons
  - implemented at different governance levels and drawing on different levels of formalization

## Comprehensive assessment

- Institutional Analysis and Development framework
- Social capital theory

# Pl@ntNet




Through transdisciplinary research between botany (*sensu largo*) and computational sciences:

- Develop and provide free, web-based, easy-access software tools and methods for
  - plant identification
  - aggregation, management, sharing and utilisation of all kinds of plant-related data
- Promotes citizens' involvement as a powerful means to enrich databases with new information on plants

www.plantnet-project.org

- DataManager
- Identify
- Community
- Pl@ntNote
- Carnet en ligne
- IDAO

Interactive plant identification and collaborative information system

Available software in **Pl@ntNet** project :

## Pl@ntNet-DataManager → Access tool

**Pl@ntNet data management software**

Pl@ntNet-Datamanager is a distributed data management system dedicated to botany. It allow to manage botanical data locally on your computer. Pl@ntNet-Datamanager is decentralized. The software can be installed on servers but also on personnal computer or on mobile devices.

## Pl@ntNet-Identify → Access tool

**A software for automatic plant identification**

Pl@ntNet-Id is an image-based identification software. It compares automatically a given photo to one large image database. The results allow to find easily a taxon, if it is in of the chosen database. Databases available are :

- the *Pl@ntLeaves* database, with about 2000 images of scans of leaves from French Flora
- the *Tree* database collected as part of the project *Capitalisation d'images de plantes*
- the *Photoflora* database, with 70 000 images of French Flora
- the *Pl@ntRiceWeed* database containing 1000 images of rice weeds

## Pl@ntNet-Community → Go to website

**A software for collabotarive work**

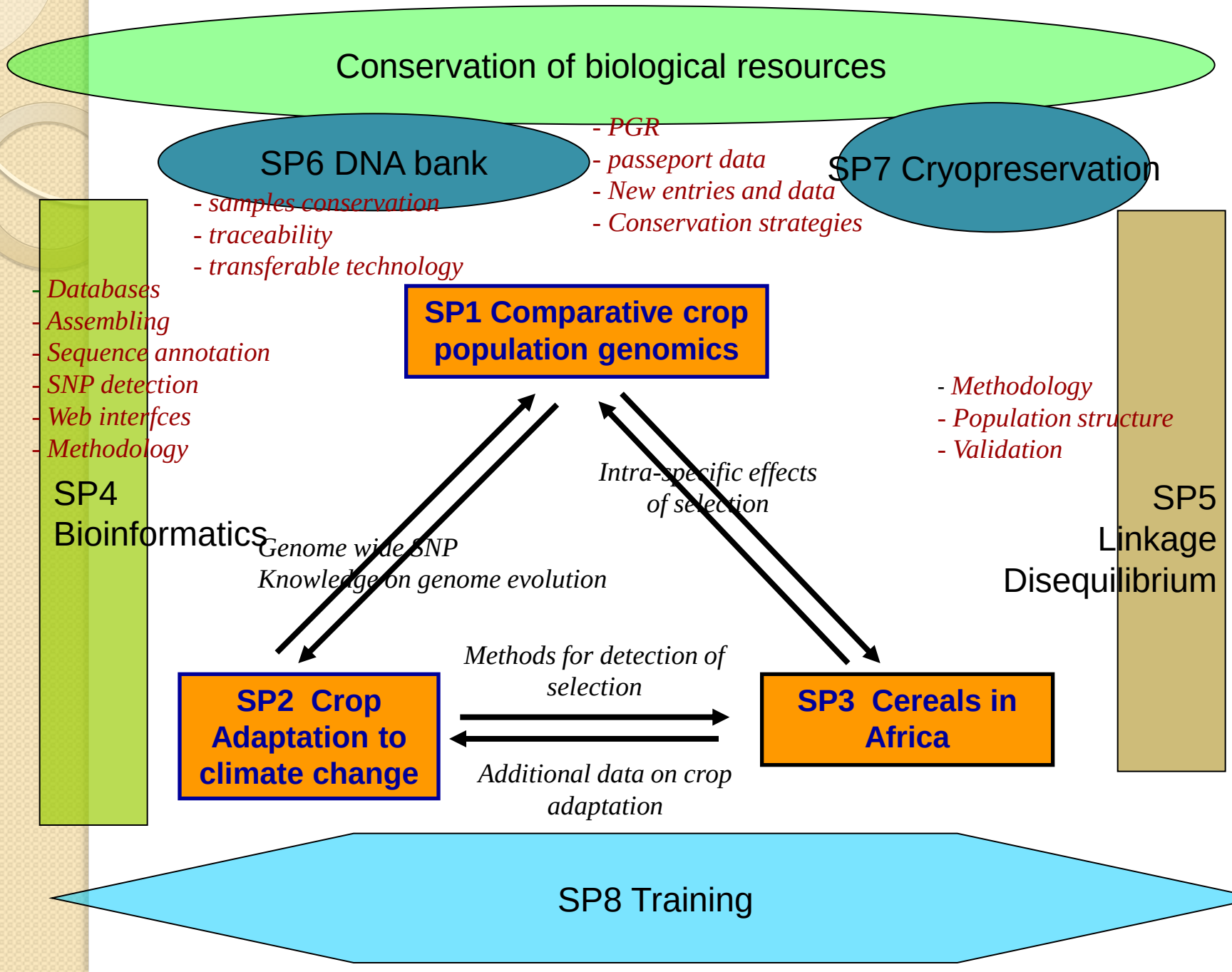
Using the Elgg engine, our social network allows communities to emerge around common projects about botany, then to discuss easily on fora, exchange files, edit wikis and webpages.

## Pl@ntNote → Download the software

**Free software of botanical data management**

- Multi-function platform (conservation, research and training) devoted to the assessment and better use of plant agro-biodiversity in Mediterranean and tropical regions.
- Research focus on the relationship between crop diversity and the processes of domestication and adaptation to the agricultural environment
  - Population genetics, molecular evolution, but also ethnobotany, anthropology
  - Major and underutilized crops

www.arcad-project.org


Conservation of biological resources
SP6 DNA bank
- samples conservation
- traceability
- transferable technology
- PGR
- passeport data
- New entries and data
- Conservation strategies
SP7 Cryopreservation
- Databases
- Assembling
- Sequence annotation
- SNP detection
- Web interfces
- Methodology
SP4 Bioinformatics
SP1 Comparative crop population genomics
- Methodology
- Population structure
- Validation
SP5 Linkage Disequilibrium
Intra-specific effects of selection
Genome wide SNP
Knowledge on genome evolution
Methods for detection of selection
Additional data on crop adaptation
SP2 Crop Adaptation to climate change
SP3 Cereals in Africa
SP8 Training

GENESYS
Gateway to Genetic Resources

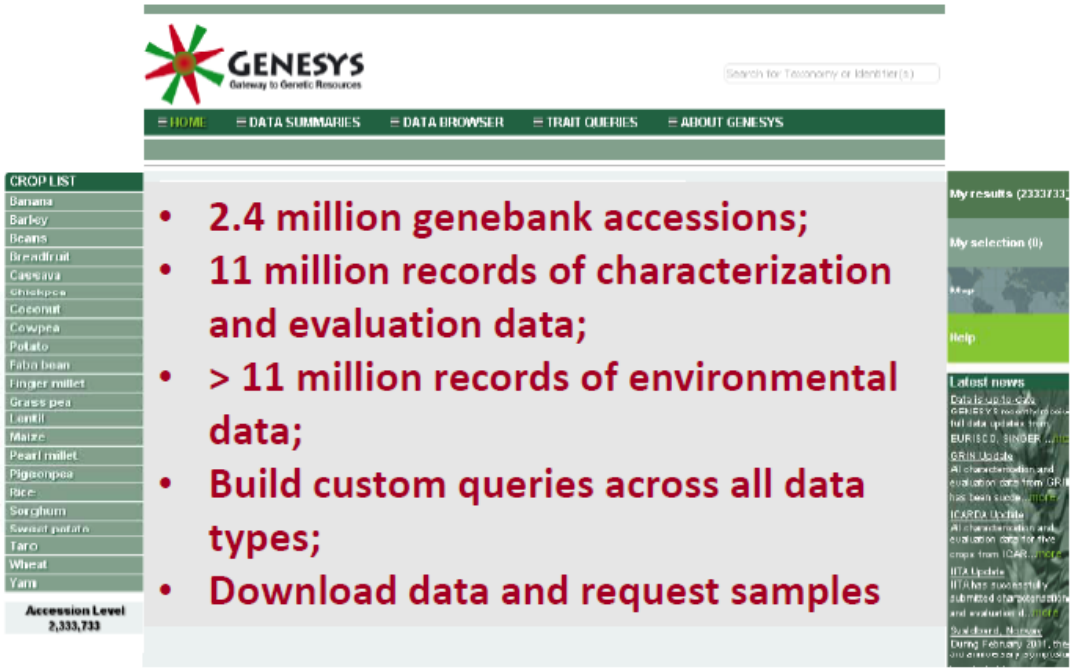
- a treaty-based international information system
- a world-wide meta-information system on plant genetic resources for food and agriculture
- compiles data from existing national, regional or international genebank information systems in support of the International Treaty on Plant Genetic Resources for Food and Agriculture
- Among first data compiled, are those of CGIAR, USDA and the European Network for Plant Genetic Resources

www.genesys-pgr.org

Bioversity International

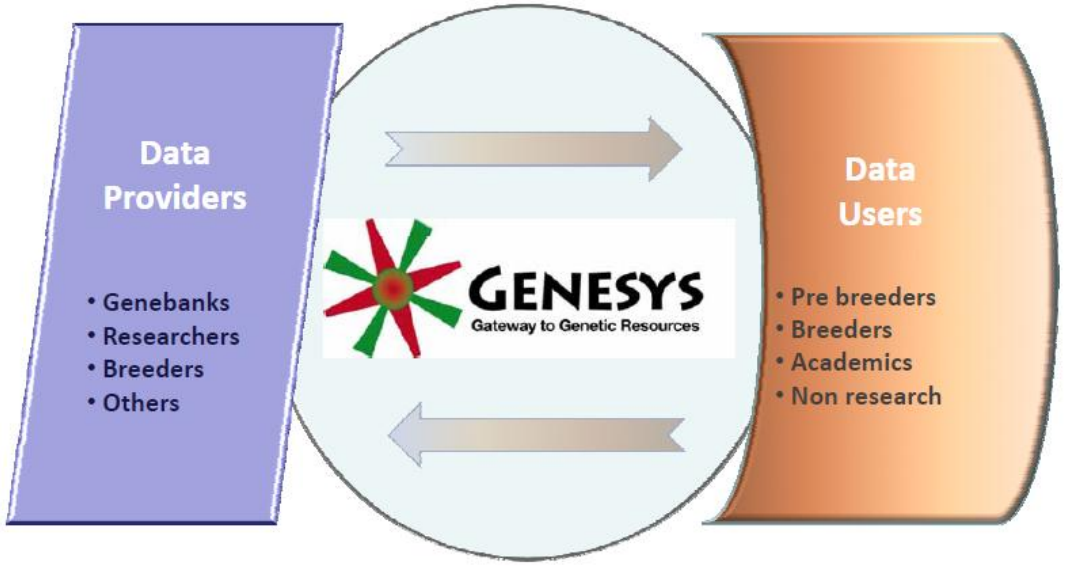
The International Treaty
ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

GLOBAL CROP DIVERSITY TRUST
A FOUNDATION FOR FOOD SECURITY




- 2.4 million genebank accessions;
- 11 million records of characterization and evaluation data;
- > 11 million records of environmental data;
- Build custom queries across all data types;
- Download data and request samples

## *Dynamic Interface*
## linking data providers and users




**A global system for access and benefit sharing**

*From Mackay, 2011*

# Institutional Analysis and Development framework

| | Pl@ntNet | arcad | GENESYS Gateway to Genetic Resources |
|---|---|---|---|
| **Type of knowledge commons** | Ideas, databases, software | Ideas, databases, research tools | Database |
| **Attributes of community** | Wide geographical and statutory scope with strong open-sharing norms | Club of researchers with strong open sharing norms | Open-sharing norms with high national sensitivities about data sharing |
| **Rule-in-use** | Formalised through open access regime | Formalised in very broad terms through institutional framework agreement between partnering institutions but, practically speaking, very informal procedures amongst researchers | Reference to international legal framework (ITPGRFA) |
| **Actors** | University researchers, ARIs for development, initiated citizens, NGO, herbarium managers, natural park managers | University researchers, ARIs for development, NARS, teachers/trainers, genebank managers, farmers | University researchers, ARIs for development, NARS; Breeders, genebank managers, decision-makers/administrative representatives, regional professional networks, NGOs |

# Desired features of the arrangements

- Foster internal partnership
  - Promote the exchange of resources (genetic, research tools, knowledge, information)
- Favour integration of newcomers (individuals, groups or institutions)
- Contribute to the initiative sustainability

- Three dimensions of social capital are considered to analyse pattern of interactions for knowledge and data sharing
  - Structural dimension: who shares knowledge and how is knowledge shared? *Structural opportunity to share knowledge*
  - Cognitive dimension: what knowledge is shared? *Cognitive ability to share knowledge*
  - Relational dimension: why and when is knowledge shared? *Relation-based motivation to share knowledge*

| Patterns of interaction | Pl@ntNet | arcad | GENESYS Gateway to Genetic Resources |
|---|---|---|---|
| **Structural opportunity to share knowledge** | •Distributed system of exchange through an IT common platform.<br>•Distributed/decentralised peer production system of knowledge production | •Central place of researchers.<br>•Hierarchical structure with division of labour by sub-networks (work-packages). | •Hierarchical<br>•Importance of national structures as nodes.<br>•Centralised control of data management and distribution. |
| **Cognitive ability to share knowledge** | •Shared codes for species description and photo interpretation | •Shared academic language | •Shared codes (Multi-Crop Passport descriptors) but cognitive dissonance between genebank managers and breeders about what knowledge to be shared |
| **Relation-based motivation to share knowledge** | •Generalised reciprocity | •Trust<br>•Similarities of values (shared goals and interests)<br>•Identification to project | •International norms & obligations |
| **Outcomes** | •Increased identification of species | •Increased capacities of collaboration<br>•increased coverage of species phenotyped and genotyped<br>•new research ideas | •Increased use and exchange of material worldwide |

# Conclusions (1)

- These 3 projects deal with « old » objects or disciplins (genetic resources, taxonomy) but they would not exist without recent breakthrough in computer science, IT, bioinformatics, molecular biology.
- What particularly impacts new collective arrangements is :
  - the amount of data, their speed of generation, their analysis through new research tools, their actual or potential availability to the world community
  - the nature and diversity of communities associated to the projects

# Conclusions (2)

- Three contrasting strategies to increase scientists' cooperative capacities in sharing knowledge and data:
  - Open science and generalized reciprocity approach (Pl@ntNet)
  - Club approach/self-regulation through strong identification strategy (Arcad)
  - Formal rules backed by inter-governmental agreement establishing non-exclusive rights (International Treaty) (Genesys)

# Conclusions (3)

## Importance of (non-monetary) benefits derived from the knowledge commons

- A limited number and group homogeneity increase the short-term efficiency (quality and quantity of information shared) of knowledge commons management but weaken its long term sustainability unless some benefits are more widely shared
- Conversely, open access system ensures wider inclusiveness (ever-expanding system) but requires continuous efforts to demonstrate its efficiency (in providing benefits that create enough incentive to contribute)
- More formal rules established by multilateral agreements are potentially universal in scope but suffer from ever incomplete rules that limit their efficiency

# Thank you

Rice harvest, Guinea, 2007