Conservation and use of Agrobiodiversity for better food systems: The banana case study

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Agrobiodiversity is important across our global food system

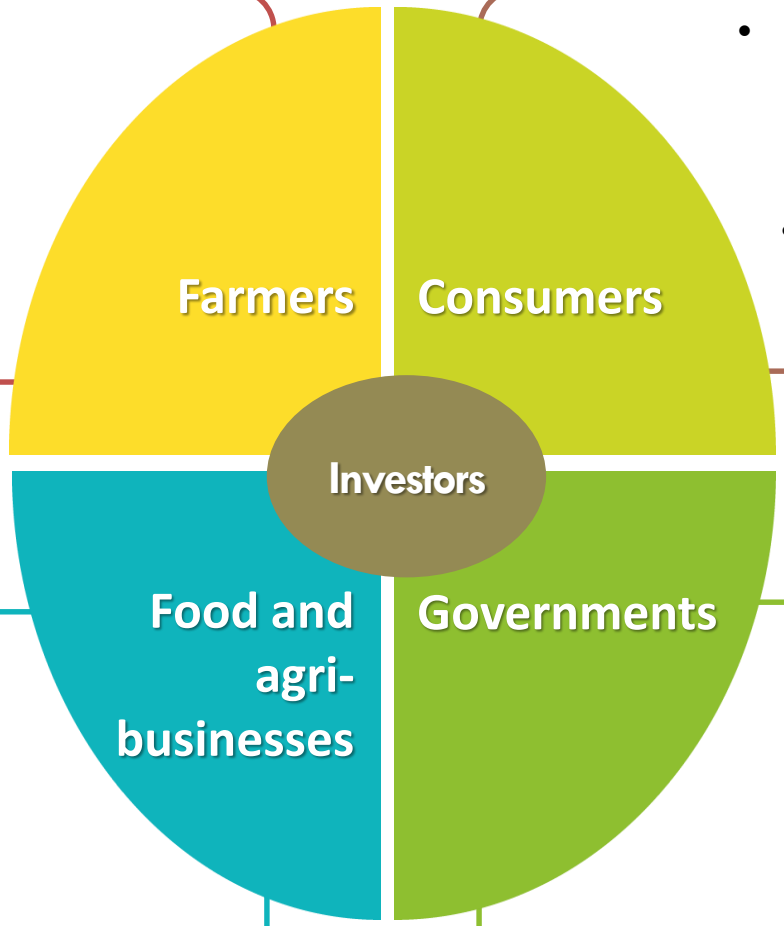
In consumption:
contributing to healthy diets

In markets:
contributing to better livelihoods & resilient economies

In seed systems & genetic resources:
contributing to options for adaptation and innovation

In production:
contributing to sustainable agriculture and ecosystem services

Drivers of demand for agrobiodiversity across stakeholders



- **Operational risk:** pests, climate, livelihoods
- **Reputational risk:** limiting future options
- **Opportunities:** income diversification, long-term yield

- **Operational risk:** health, culture
- **Reputational risk:** limiting future options
- **Opportunities:** choice, nutrition security

- **Operational risk:** supply chain
- **Reputational risk:** environment, health
- **Opportunities:** innovation, brand-building, SDGs

- **Operational risk:** economy, health, social stability
- **Reputational risk:** environment, health
- **Opportunities:** SDGs, jobs

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The banana case study

- 8th most important crop globally
- ~40% of total production is Cavendish
- Erosion of biodiversity is increasing
- = higher vulnerability to pest and disease
- Urgent need to broaden the genetic base

Disease in a monoculture

- Fusarium wilt R1 (Panama disease), a lethal fungal disease, devastated the banana export industry in the 20th century
- R1-resistant Cavendish became the dominant export banana
- A new strain (TR4) is wiping out Cavendish in Asia/Pacific/Africa and threatening other regions such as export-dominant Latin America
- EU markets help drive the demand and contribute to the dependence on monocultures

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The banana boat to Europe

Belgium is the largest importer and (re-)exporter of bananas in Europe – a nearly 1 billion USD industry involving over 40 companies

Below are the 15 countries that exported the highest dollar value worth of bananas during 2016:

1. Ecuador: US$2.7 billion (23.3% of total banana exports)
2. Guatemala: $1.2 billion (10.5%)
3. Costa Rica: $996.8 million (8.5%)
4. Belgium: $940.9 million (8%)

www.worldstopexports.com

Europe-based scientists

Bioversity Leuven, Belgium (the ITC)

Bioversity HQ, Rome, Italy

Bioversity Scientists based in Spain

Bioversity Montpellier, France

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Conservation and safe movement of germplasm

Bioversity's International *Musa* Germplasm Transit Centre (ITC), the global banana *ex situ* collection hosted by KULeuven:

- Over 1,550 accessions *in vitro*
- 1,060 accessions cryopreserved → expanding to safeguard other vegetatively-propagated crops
- Lyophilized leaf samples for DNA analyses
- Free distribution of germplasm via an easy online tool (*Musa* Germplasm Information System (MGIS))

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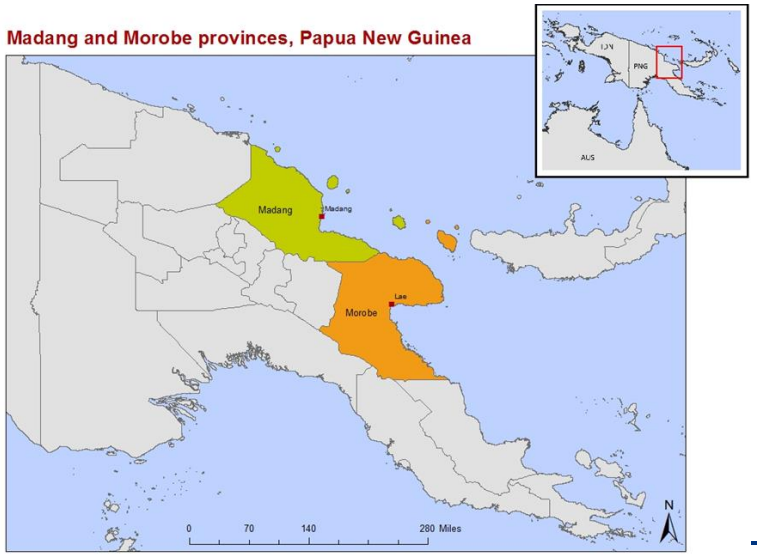
Global *Musa* Genetic Resources Community

- More than 100 members and 60 *Musa* collections around the world

Diversity gap filling through collecting missions

Collecting missions to Indonesia, Papua New Guinea, Myanmar and East Africa with national partners focused on gathering suckers, leaves and seeds



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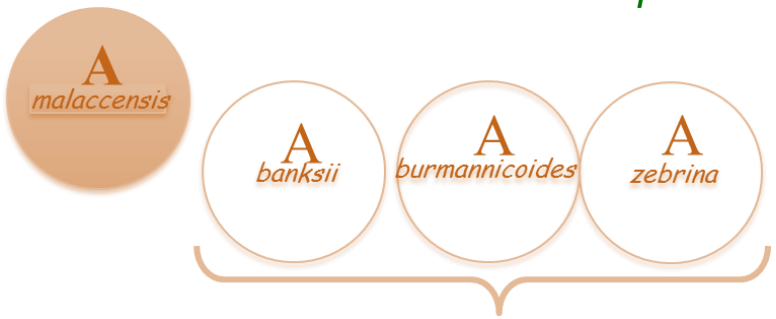
Global Seedbank development

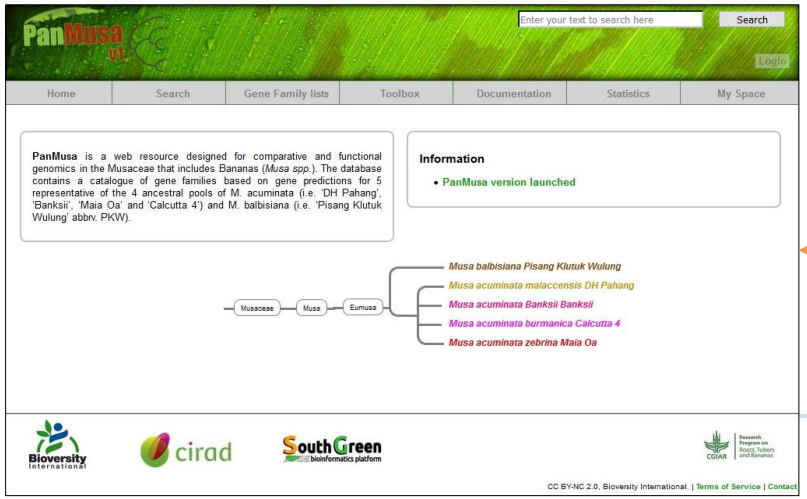
Studying gene diversity of CWR

M. acuminata subspecies



Pan-genome: The set of all genes present in the genomes of a group of organisms

Pan-genome Portal



Sequencing & analyses

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Genomic sequence data applications

Early detection of somaclonal variations

Normal plant

Off-type plant

- Repetitive in-vitro culture induces genomic aberrations in plants (Off-types)
- Every 10 years, accessions are sent to the field to check if normal
- Pipeline to detect these aberrations in in-vitro plantlets using DNA
- To improve the conservation of banana genetic resources

Genes identification for targeted traits

A selected subset > 100 accessions of the ITC

Seedless trait

Comparison trait – sequence data

- **Abiotic stress**: Drought *(Cenci et al, 2014; Zorilla, Rouard et al, 2016)*
- **Biotic stress**:
  - Black Leaf Streak
  - Fusarium Wilt

13 Candidate genes

Sardos et al, (2016) Plos One

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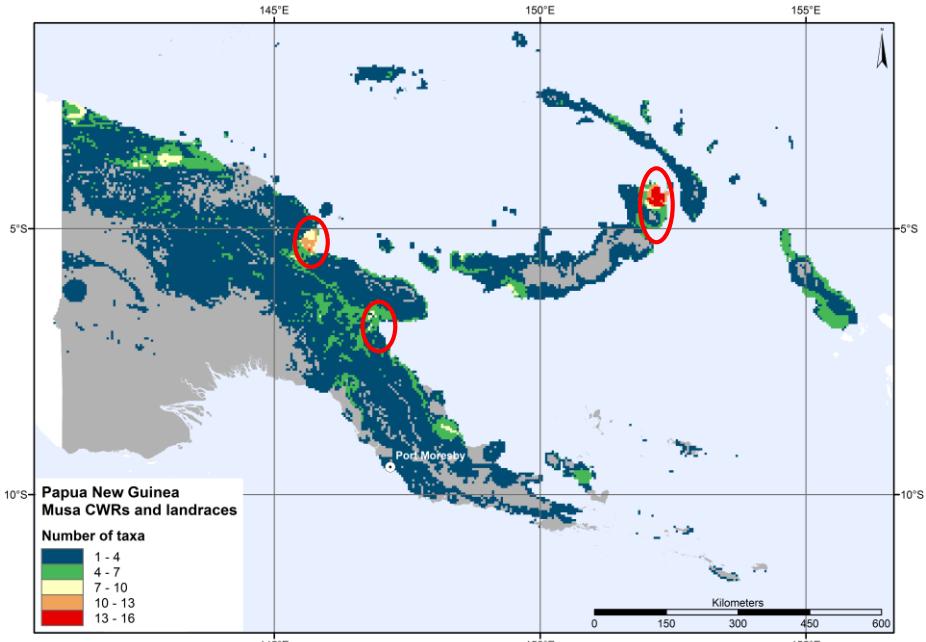
Monitoring of *in situ*/on-farm banana diversity

- Hotspot mapping of landraces and CWR diversity
- Surveys of cultivated on-farm diversity
- Assess the impact of an emerging disease (phytoplasma)



To manage agrobiodiversity, we need to measure it

European Commission

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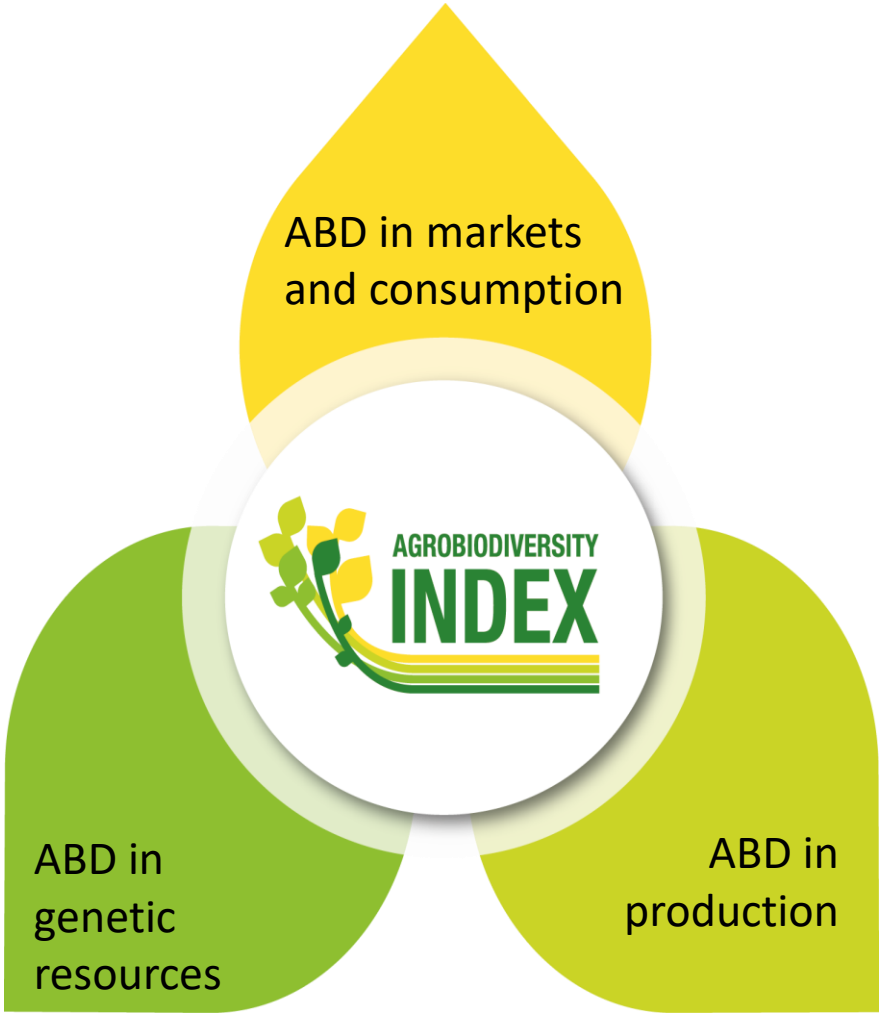
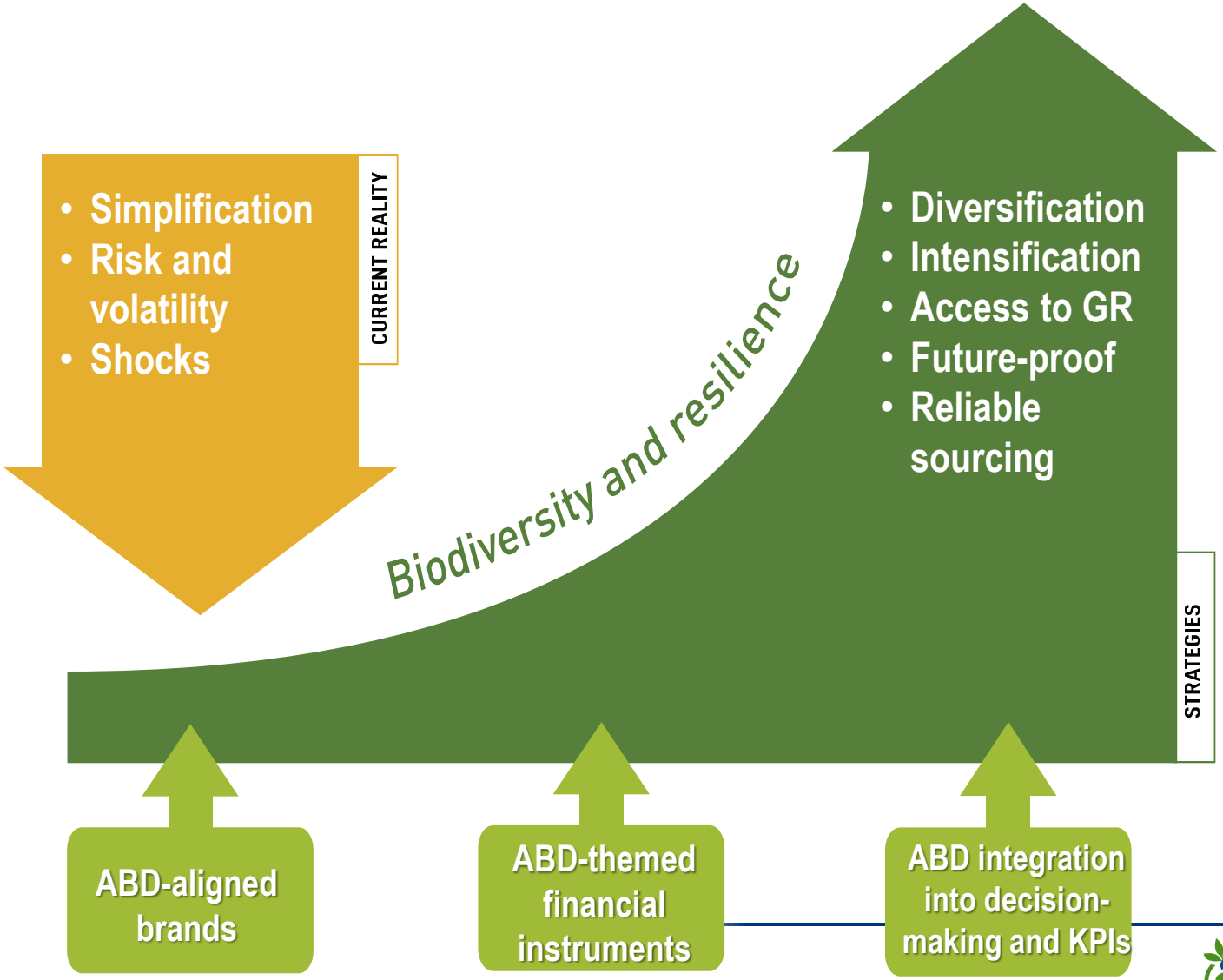


Public and Private sector opportunities for incentivizing and benefiting from more biodiverse food systems



Four Take Away Messages

1. Agrobiodiversity is also part of the Biodiversity erosion at all levels (from species to food systems)
2. To conserve agrobiodiversity, we need to measure it, manage it and use it.
3. There is a need for an integrated approach involving all stakeholders across our global food system.
4. Bioversity International is working in key areas in Europe and with the ABD index towards global food and nutrition security.

Thank you

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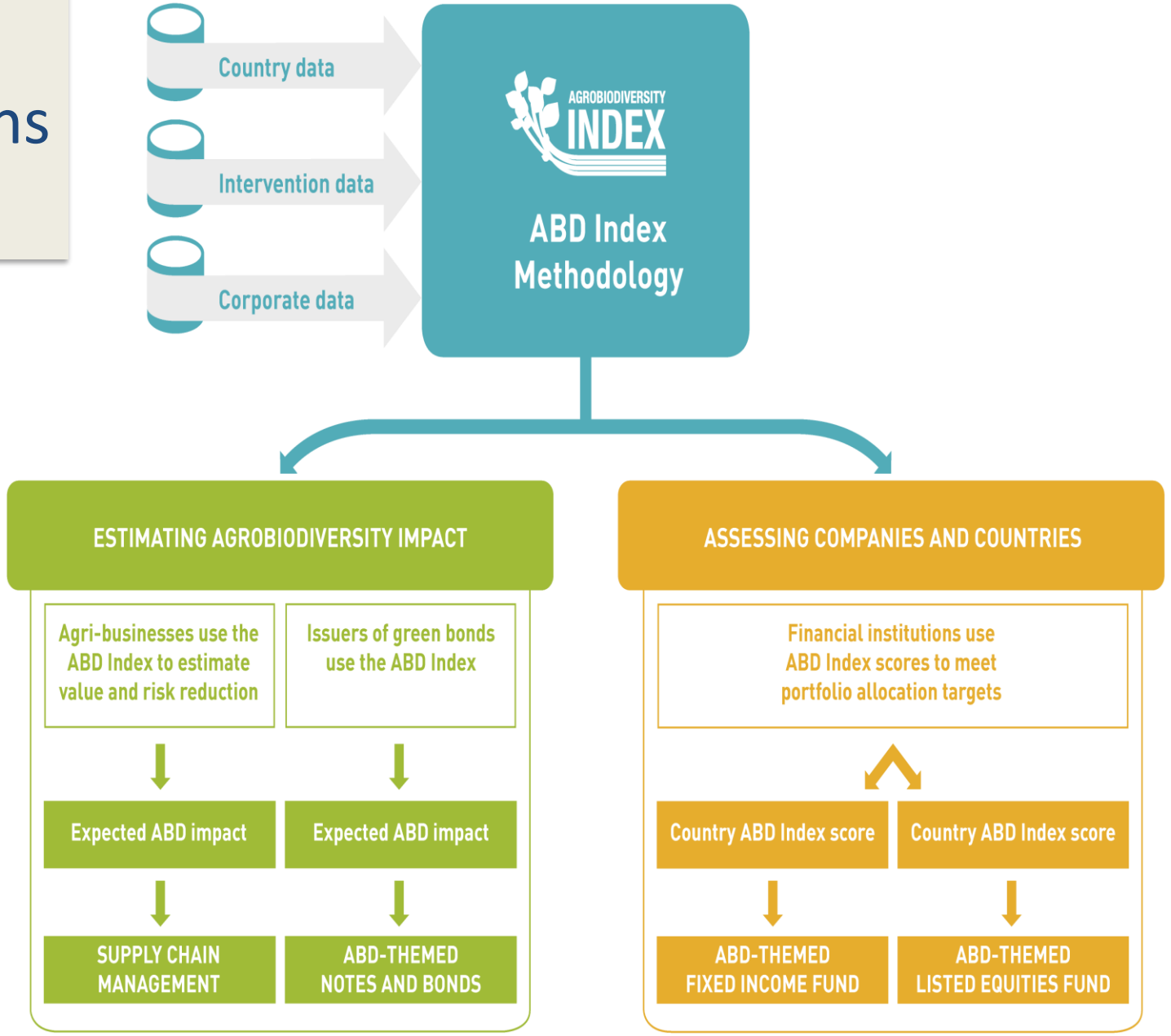
Supplementary slides

Applications



Interactive portal