



# **Agricultural Biodiversity**

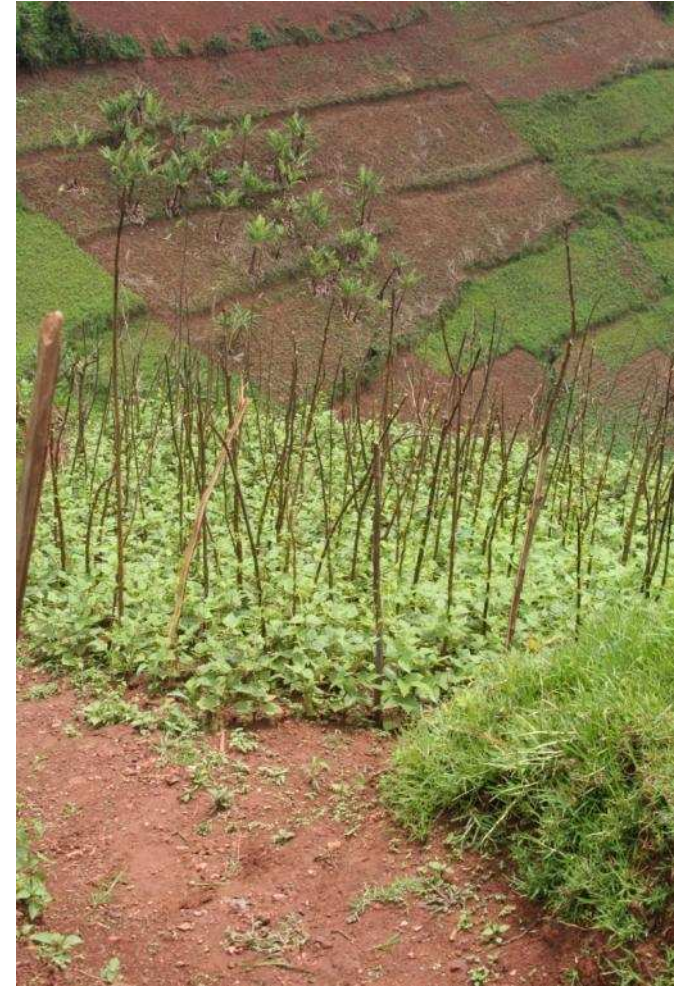
**promoting adaptive capacity within  
production systems**

**Paola De Santis, Devra Jarvis**



# How we work

- A Research Agency for development
- With partners (NGOs, IGOs, Universities, local communities and others)
- No laboratories or field sites
- Through networks





# Where we work

A staff of over 300 operating from 30 locations around the world



# What we do

- Bioversity seeks to provide evidence of the benefits of agricultural biodiversity for:
  - Improved productivity, resilience and resistance in farming systems
  - Better human health through improved nutrition & diversified diets
  - Enhanced options for income generation
- Benefits are secured through:
  - Informed policies, public awareness, increased capacities to manage biodiversity
- Upscale benefits through:
  - Widely applicable methods based on greater understanding of benefits

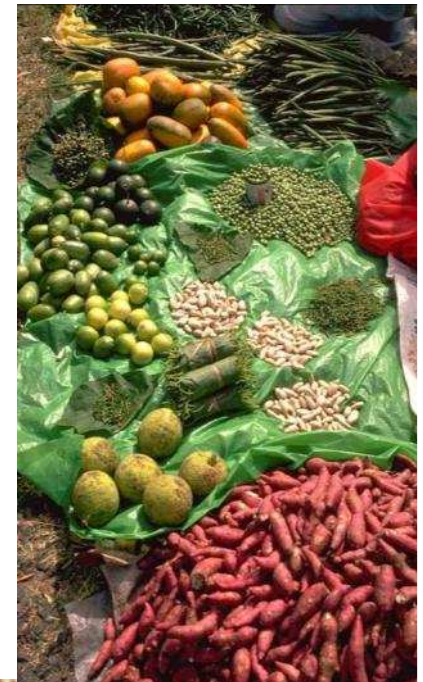






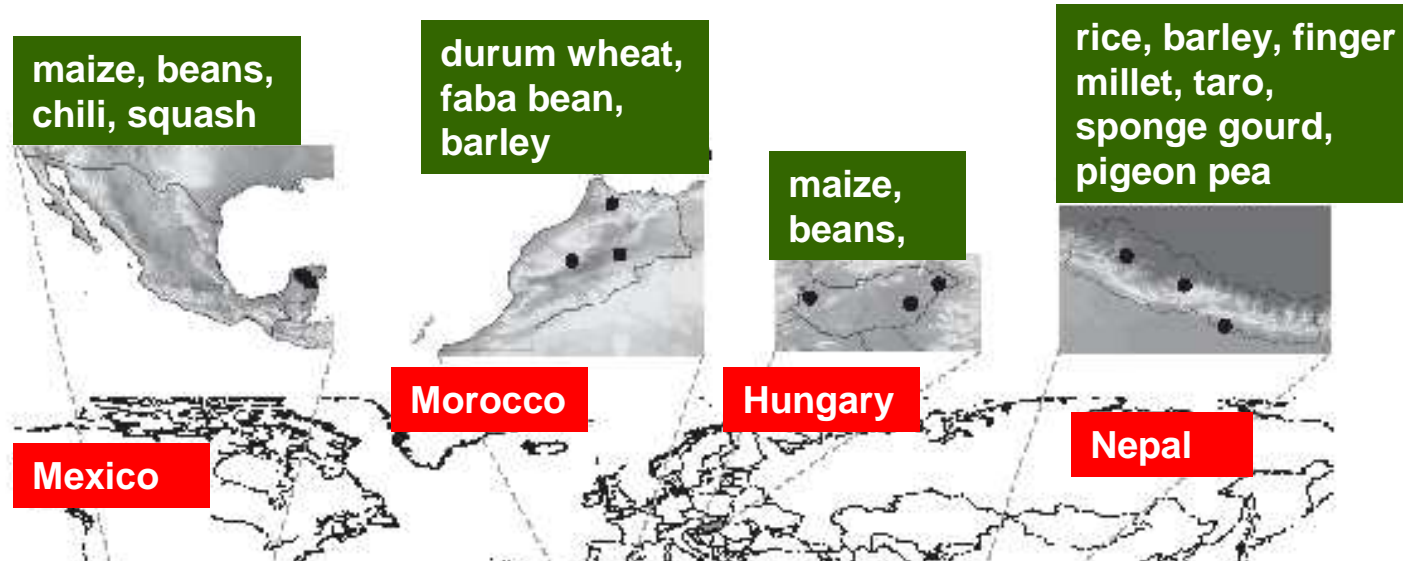
# Building Better Use of Agricultural Biodiversity

- Build strong scientific evidence base to convince the major development actors
- Adopt different development models
  - Combining multi-functional benefits of diversity
  - Based on better use of the adaptive capacity of local diversity
  - Taking into consideration cultural values
- Document and conserve traditional knowledge
- Ensure Awareness



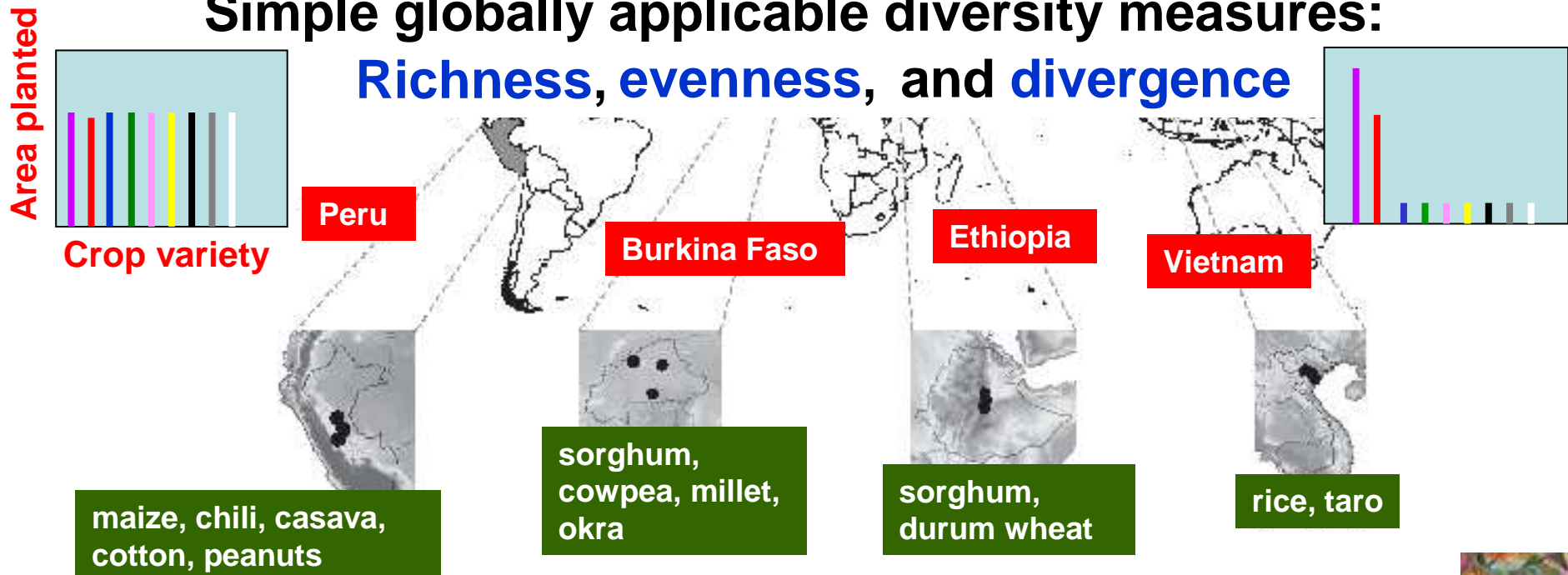


# The "on-farm project" (Jarvis et al., PNAS, 2008)



## Simple globally applicable diversity measures:

### Richness, evenness, and divergence



## Agricultural diversity is managed and maintained by small scale farmers in the developing world.

2-5 traditional apple varieties per farm,  
8-10 per community, + wild apple for  
rootstock, seedlings and fruits  
*Kyrgyzstan, Tajikistan, Uzbekistan*



Traditional varieties of  
*Phaseolus lunatus* in  
Cuban home gardens  
cover the diversity of the  
entire national *ex-situ*  
collection.

30 home gardens per  
agroecosystem - a  
sampling strategy. *Cuba*  
*and Guatemala*

2-3 traditional rice varieties per  
farm (**0.2 ha**), 34 per community,  
with any two plants drawn at  
random within a farm differed in  
**25%** (within a community **77%**)  
*Nepal and Vietnam*



4-5 traditional sorghum varieties  
per farm (**1.2 ha**) and 23 per  
community with any two plants  
drawn at random within a farm  
differed in **69%** (within a community  
**91%**) *Burkina faso*

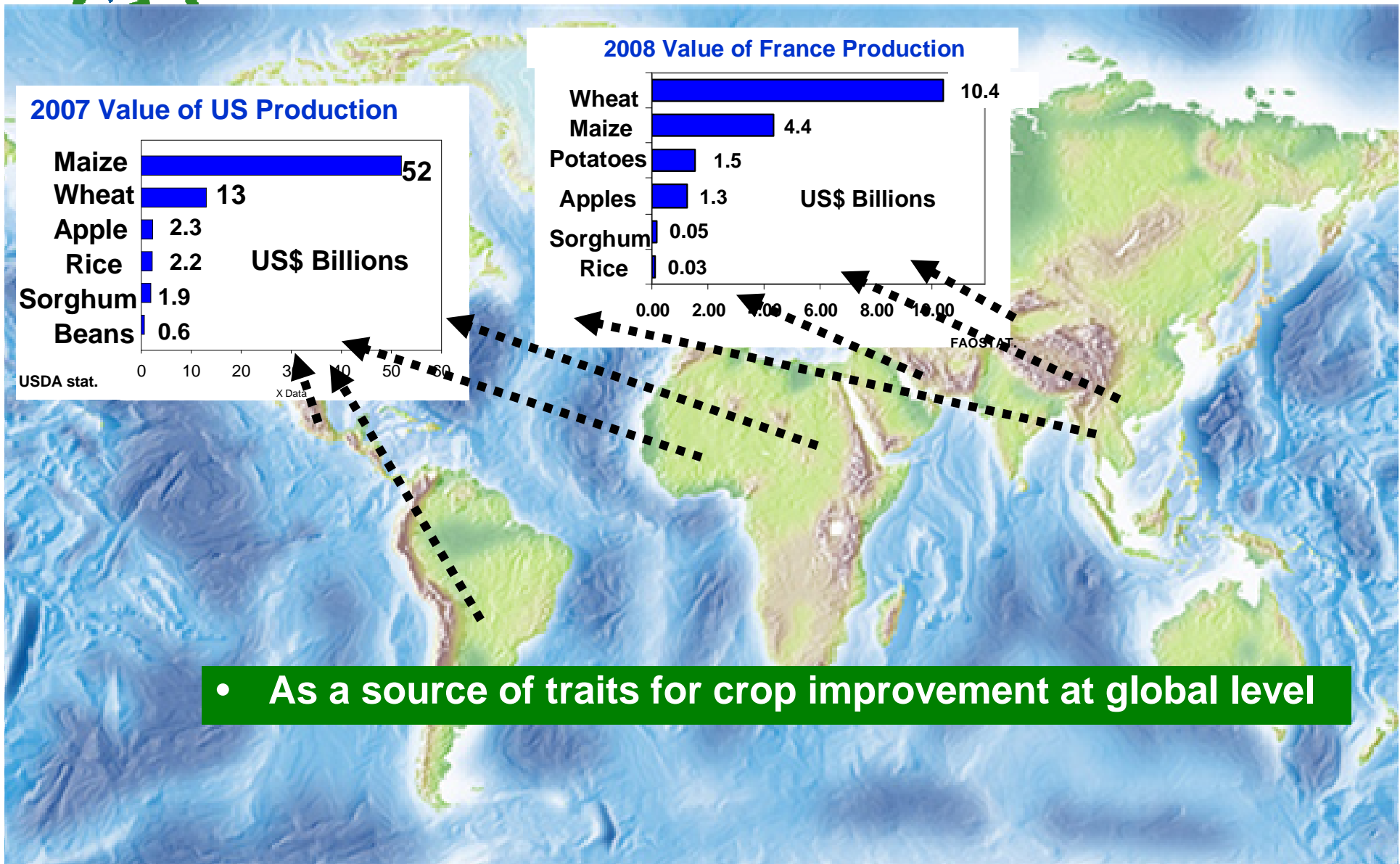


# The Importance of Agrobiodiversity

- Conventional view
  - **As a source of traits for crop improvement at global level**



# Country inter-dependence, simplification and vulnerability



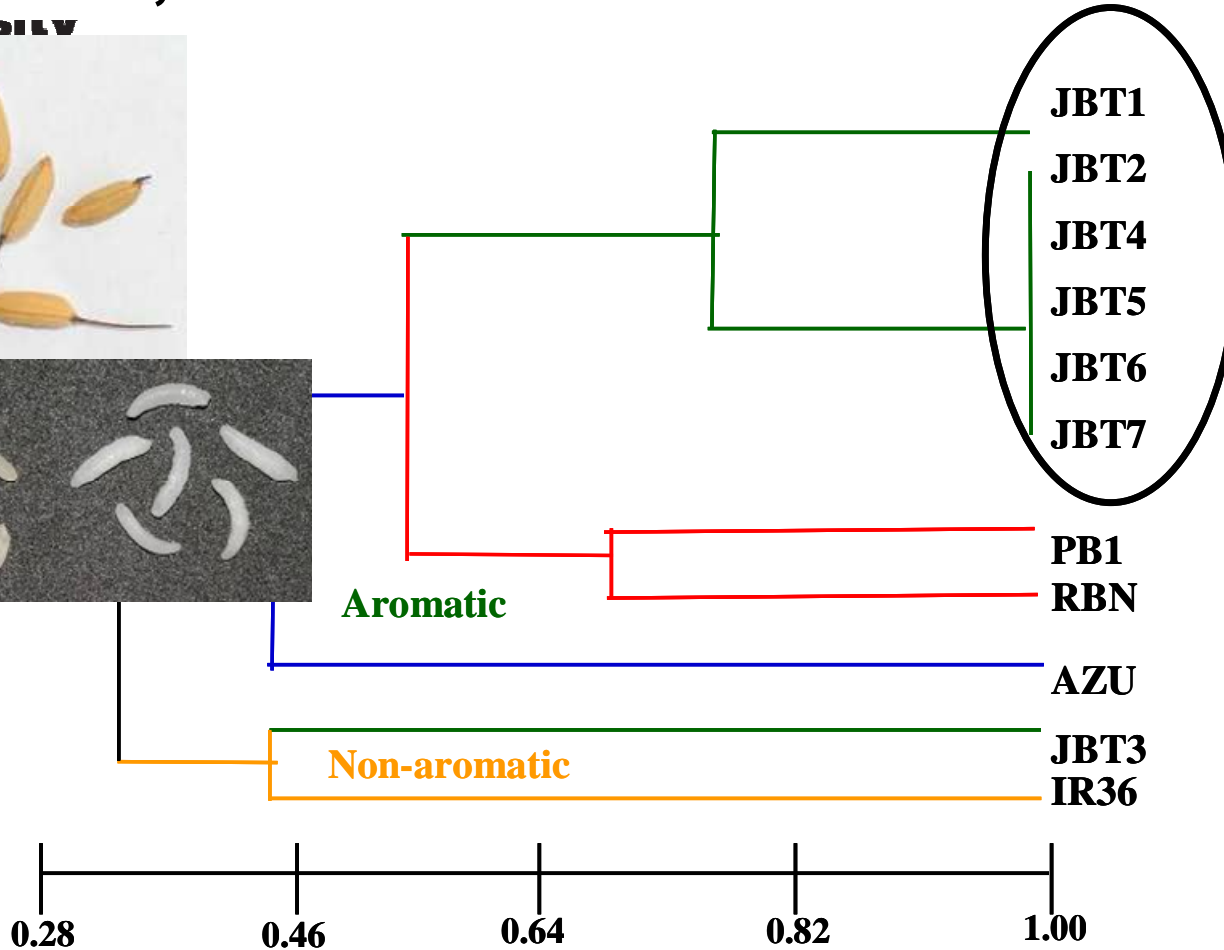


# The Importance of Agrobiodiversity

- Conventional view
  - As a source of traits for crop improvement at global level
  
- Unconventional: more sustainable agriculture
  - **As a source of traits for participatory crop improvement through PPB/PVS**

# Community institutions with the capacity to access, conserve and benefit from diversity

Biodiversity  
In



In 2006, *Jethobudho* rice is formally released through the Nepalese Seed system as Nepal's first farmer bred registered variety



# The Importance of Agrobiodiversity

- Conventional view
  - As a source of traits for crop improvement at global level
  
- Unconventional: more sustainable agriculture
  - As a source of traits for crop improvement through PPB
  - **As a source of increased income and improved livelihoods, especially in marginal areas**



## Options for income generation

**Better marketing of local crops (case of leafy vegetables in Kenya with >1,100 % rise of sales over 2 years)**



**Major constraints to consumption of indigenous leafy vegetables were the cost, lack of time and knowledge in food preparation**



## Local food sources: shorter, more equitable, more transparent market chains



**300 farming families monitored increased their production from 31 to 400 tons a month**





# The Importance of Agrobiodiversity

- Conventional view
  - As a source of traits for crop improvement at global level
  
- Unconventional: more sustainable agriculture
  - As a source of traits for crop improvement through PPB
  - As a source of increased income and improved livelihoods, especially in marginal areas
  - **As a source of better nutrition**



# Indigenous fruit and leaf vegetables –

suppliers of ascorbic acid, micronutrients (minerals & vitamins), anti-oxidants

- Traditional leafy vegetables for nutrition
  - More than 200 species in Kenya
  - Much more nutritious
- Source of improved family nutrition







# The Importance of Agrobiodiversity

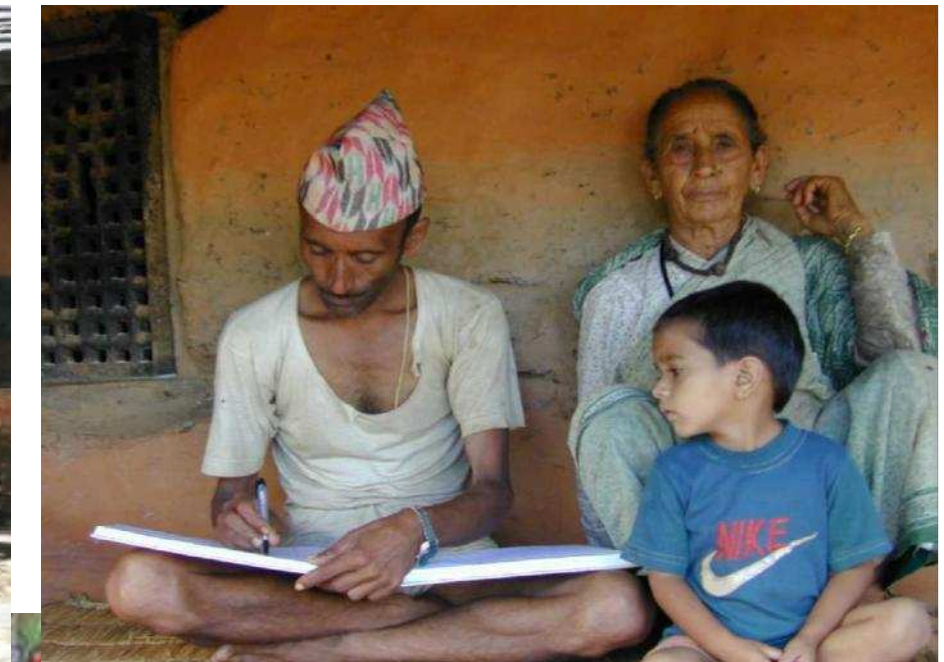
- Conventional view
  - As a source of traits for crop improvement at global level
  
- Unconventional: more sustainable agriculture
  - As a source of traits for crop improvement through PPB
  - As a source of increased income and improved livelihoods, especially in marginal areas
  - As a source of better nutrition
  - **As a valuable contribution to sustaining cultural, ethnic traditions and identity**



## Sustaining cultural, ethnic traditions and identity

- Diversity field fora and seed fairs to promote traditional know-how

“Such is the Happenings of a Village”





# Diversity Field Fora



- Empower small farmers to develop more effective livelihoods strategies
- Enhance identification and promotion of local genetic resources
- Enhance exchange of knowledge and local genetic resources
- Technical knowledge of farmers strengthened through specific training and field visits and observations

# Diversity Field Fora

- Promote multi partnership (farmers, extension services, researchers, local decision makers, private sector)
- Best traditional seed conservation practices documented, and disseminated to other villages







# Seed fairs

- Value farmers' contribution to conservation and development of crop genetic diversity
- Exchange of information at different levels (Villagers, local Decision makers, Researchers etc.)
- Favour exchange of practices (management and conservation) among farmers from different villages.
- Favour exchange of varieties among farmers, and between farmers and researchers





# Agricultural Biodiversity and Protected Areas

- (i) linking agricultural and natural landscapes
- (ii) linking protected area conservation to development
- (iii) linking quality production and cultural diversity to healthy ecosystems





# The Importance of Agrobiodiversity

- Conventional view
  - As a source of traits for crop improvement at global level
- Unconventional: more sustainable agriculture
  - As a source of traits for crop improvement through PPB
  - As a source of increased income and improved livelihoods, especially in marginal areas
  - As a source of better nutrition
  - As a valuable contribution to sustaining cultural, ethnic traditions and identity
  - **As a source of resilience and stability against abiotic and biotic threats**

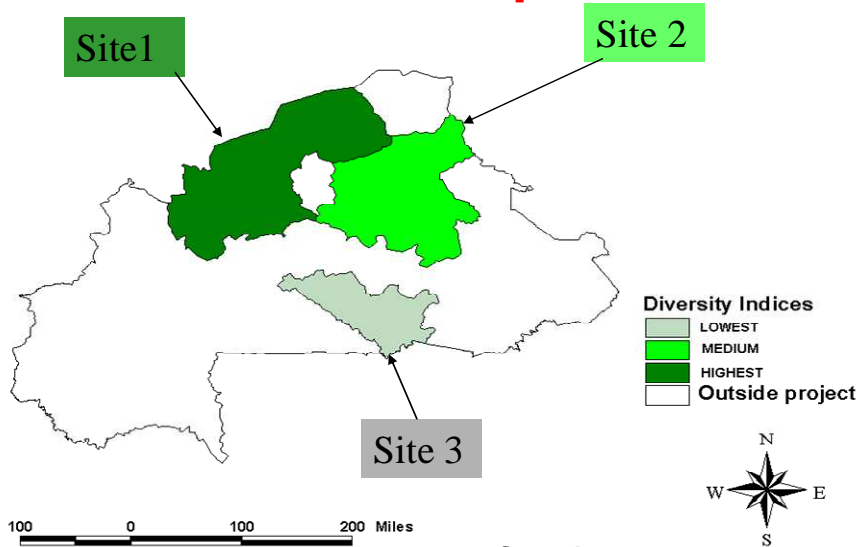


# Abiotic: Diverse sets of varieties for unpredictable environmental conditions



Farmers' management of genetic diversity prevents dilution of the stress resistance characteristics of local varieties

↑ Unpredictable rainfall = ↑ Variety diversity



Sawadogo et. , 2006



## Biotic: Diverse sets of varieties for managing pests and diseases



- One third of global harvest lost to pests and diseases
- Hypothesis of project: intra-specific diversity in farmers' fields reduces vulnerability and damage to crop
  - Diversity to improve resistance and resilience
  - Morocco, Ecuador, China, Uganda





## Determining when and where intra-specific diversity is the answer (and when it is not)

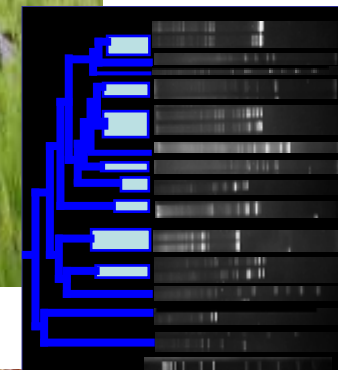
- **Participatory Diagnostics:**
  - **Focus Group Discussion; Household Survey;**
  - **Technical Evaluation (laboratory and field analysis)**
- **Field assessment; On farm trials; Collection of pathogen variation; On station trials; Glass house experiments.**





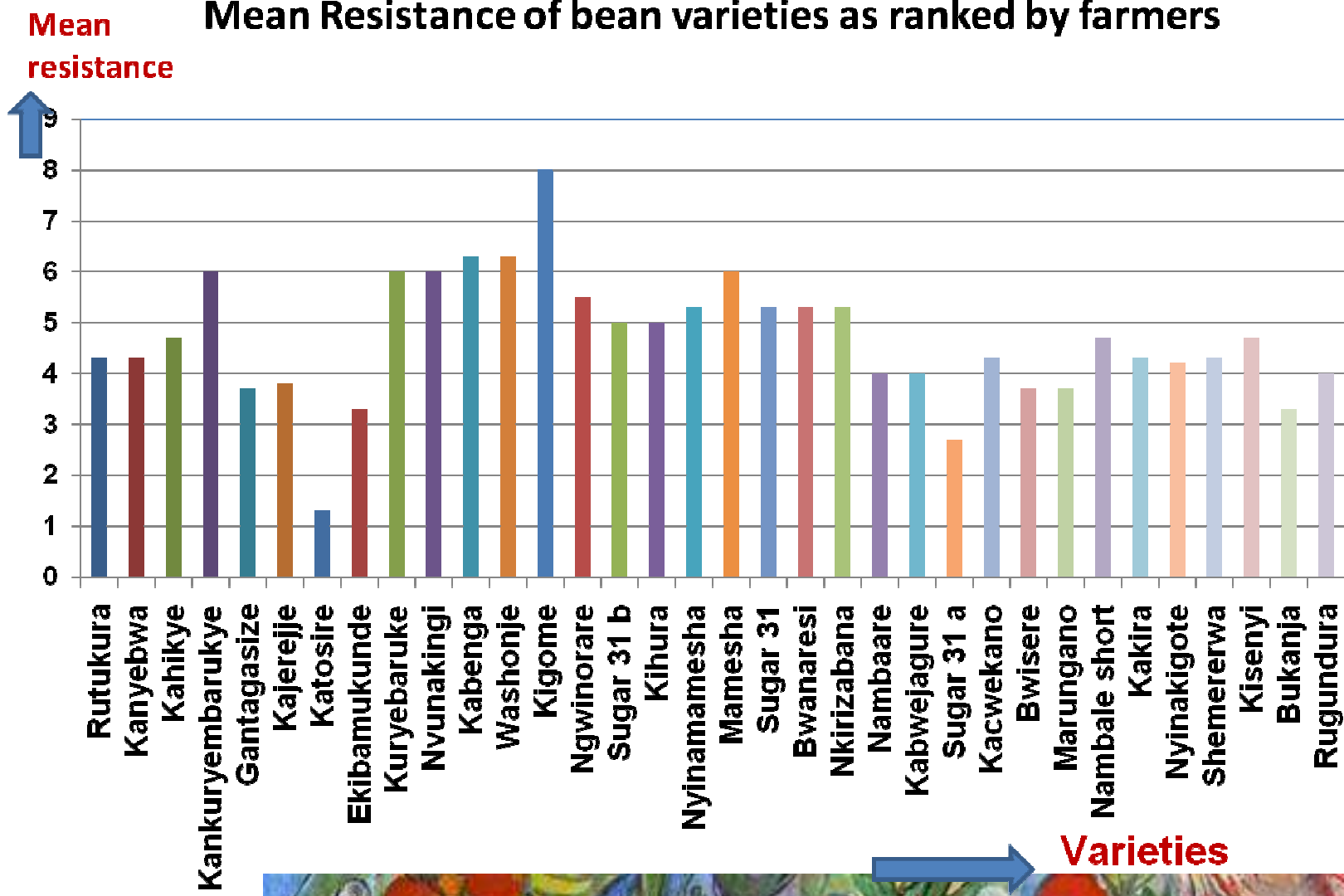
*Intra-specific diversity in farmers' fields reduces vulnerability and damage to the crop (reducing the probability of crop loss in the future)*

- **Diverse sets of varieties within a crop with:**
  - **Non-uniform resistance**
  - **Less probability that migrations of new pathogens or mutations of existing pathogens will damage the crop**

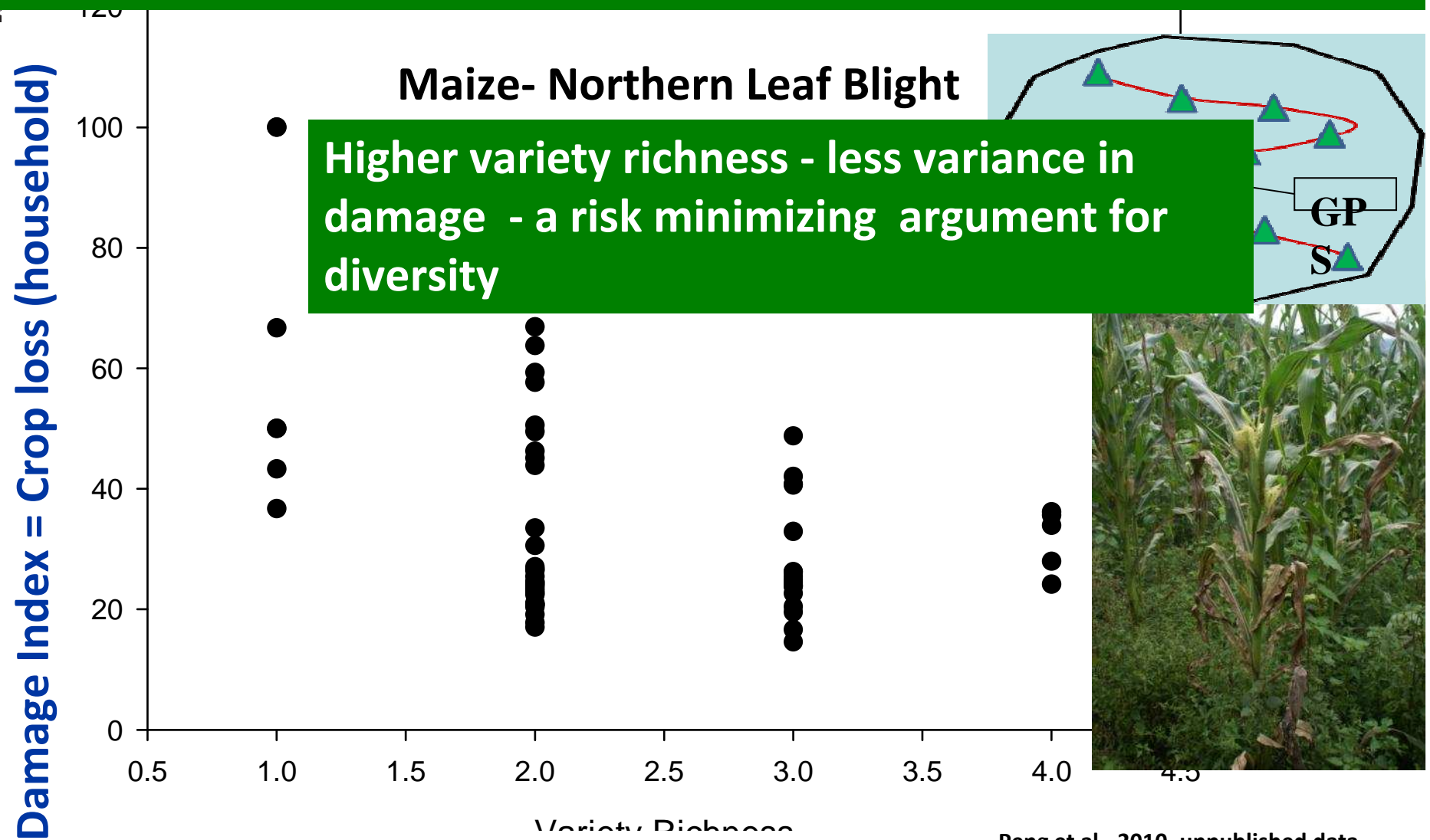


## Results (Cont.)

**Mean Resistance of bean varieties as ranked by farmers**



# Indicators to compared to diversity to damage at household level – monitoring system resilience



Crop variety richness at household level





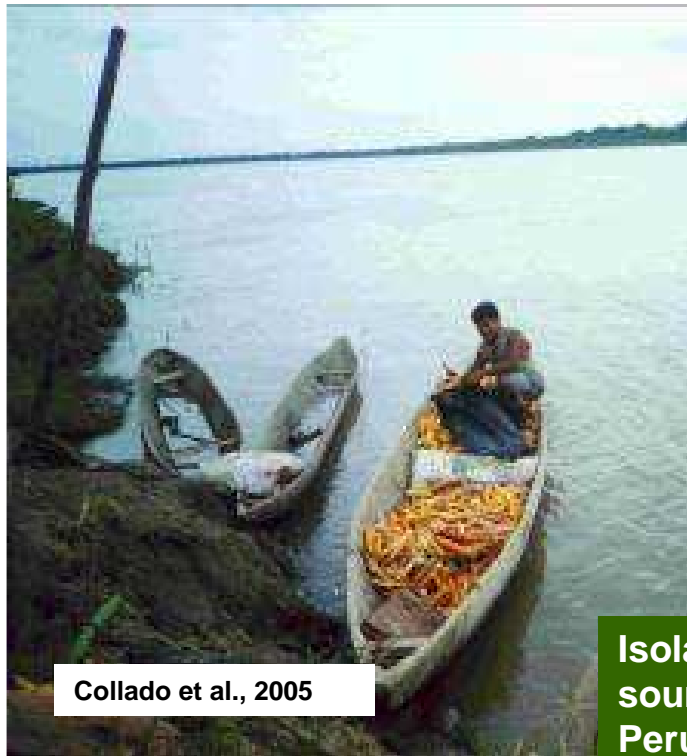
# How to support and promote agrobiodiversity



# Seed flows, seed access and seed production: A key element for communities to buffer and adapt to change

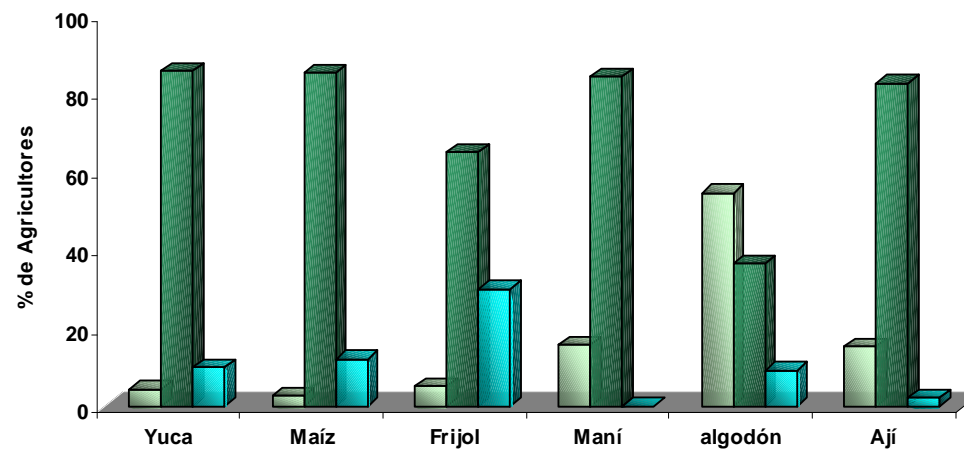
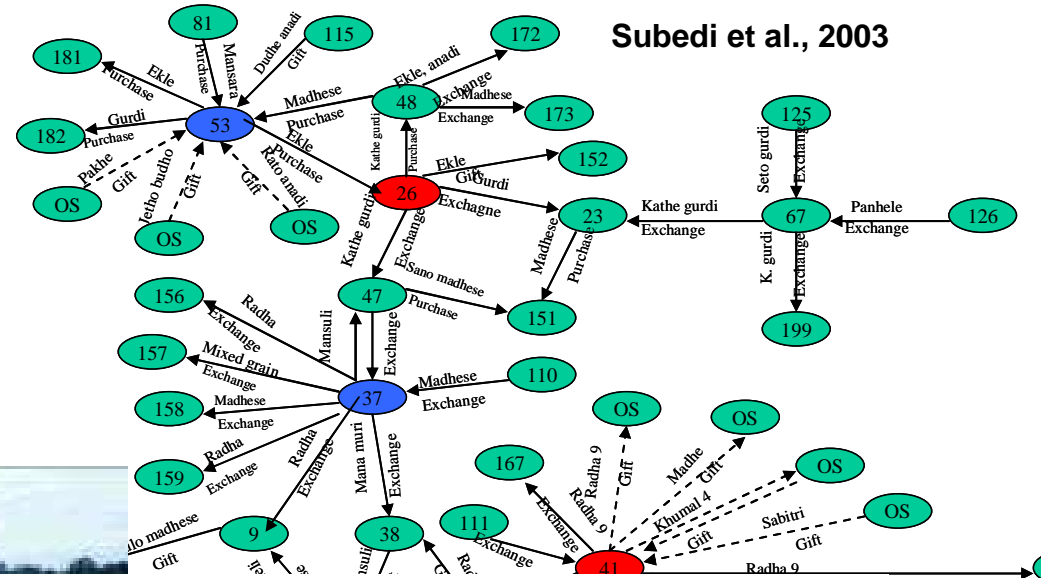
**Bioversity**  
International

- Custodians of diversity
- Population size, geneflow, migration, selection



Collado et al., 2005

Isolation and seed source – Amazonian Peru



No intercambia  
 Intercambio con la comunidad  
 Intercambio entre y con la comunidad







**Bioversity**  
International

# Community institutions with the capacity to access, conserve and benefit from diversity

## Diversity Field Fora

- Supporting seed systems in low heritability environments
- Participatory varietal evaluation
- Fora for learning and exchange
- Building trust in seed systems



## Community Biodiversity Registry

- Documentation
- Monitoring
- Marketing
- Exchange
- Biopiracy
- Ownership





## Access to landraces from Community Seed Bank increases particularly for the very poor

International

Year	Number of farmers of different socio-economic				No. of landraces	Seed (Kg)
	Rich	Medium	Poor	Total		
2007	23 (23)	34 (33)	45 (44)	102	28	103
2006	7 (11)	25 (39)	32 (50)	64	21	80
2005	17 (20)	37 (42)	33 (38)	87	23	197
2004	6 (17)	14 (40)	15 (43)	35	13	69



## The Future



### *Acknowledgements and thanks:*

Participating farmers, local, national and international institutes organisations and partners, SDC, DGIS, FAO, UNEP/GEF, WSU, Ford Foundation, IFAD, IDRC, GTZ/BMZ, JICAS, National Government Funding