

Backward and Forward Crop Diversity Monitoring in Africa

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Context

- Globalization and the cropping system dynamics
 - Species adoption/abandon, climate variability, ...
- Smallholder agricultural systems remain crucial
 - 80% of African farmers (Altieri 2009)
- *In-Situ* conservation of crop genetic diversity must be encouraged



General questions

- What is the spatio-temporal dynamics of both species and farmers' varieties diversity?
- How to develop a scientific basis of *in situ* conservation...
- While strengthening the inter-disciplinarity and the international cooperation, including training, with developing countries?



Scientific and social context

- The Genetic Resources (GRs) do not have any value *per se*
- The values hold in the network of ecological and social constraints that shaped them over time
- The GRs thus cannot not be considered only as material resources, ...
 - ...Need to consider the historical and socio-cultural dimensions, notably, the farmers' knowledge and practices, and farmers' social organization

Scientific and social context

- Crop genetic diversity result from
 - Many domestication events (not one)
 - Gene flow between wild and crop relative
 - Natural selection
- But also, from temporal and spatial process mainly oriented by human societies
 - Farmer selection
 - Seed dispersion
 - Past and current uses of crop GRs, including international and national rules, which influence the way of conservation, exchanges and uses

Need of interdisciplinarity

LANDRACES
ARE NOT ONLY
BIOLOGICAL
BUT ALSO
SOCIAL OBJECTS



Can social and biological sciences work together?



Complementarity

- Using similar method for studying cultural and biological domains
- Favoring quantitative and **individual based approach** in order to allow variability within the compared social communities, or compared environments
- Considering the historically close relations between farmers and their landraces

Outlines

- A. Skill diversity for studying hybrid objects
- B. Snapshot diversity monitoring
- C. Backward and forward diversity monitoring

Field work

Realistic
Workplan

Partnerships

Social
Organization

Seed
Exchange
Systems

Genetic
characterization

A. Skill Diversity

On-Farm
germplasm
sampling

Variety
Inventorization

Student
Training

Morphological
Charactrization

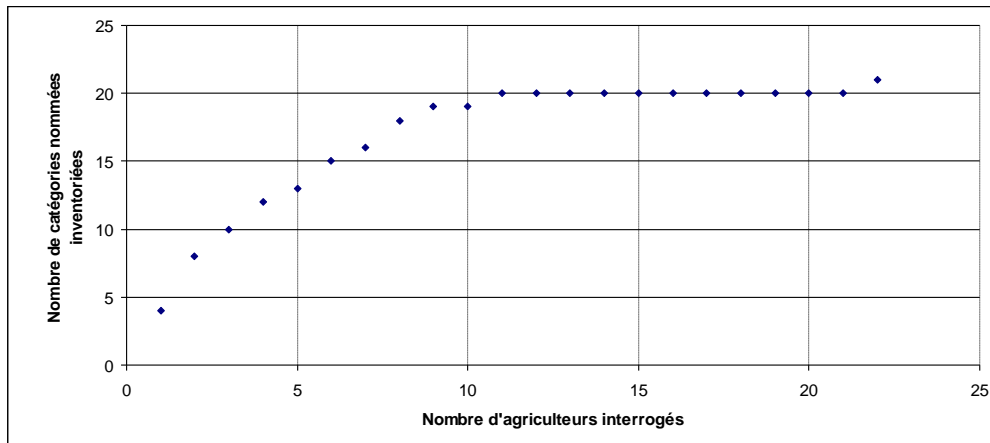
Agronomical
Tial setting

Our option: Individual based approach

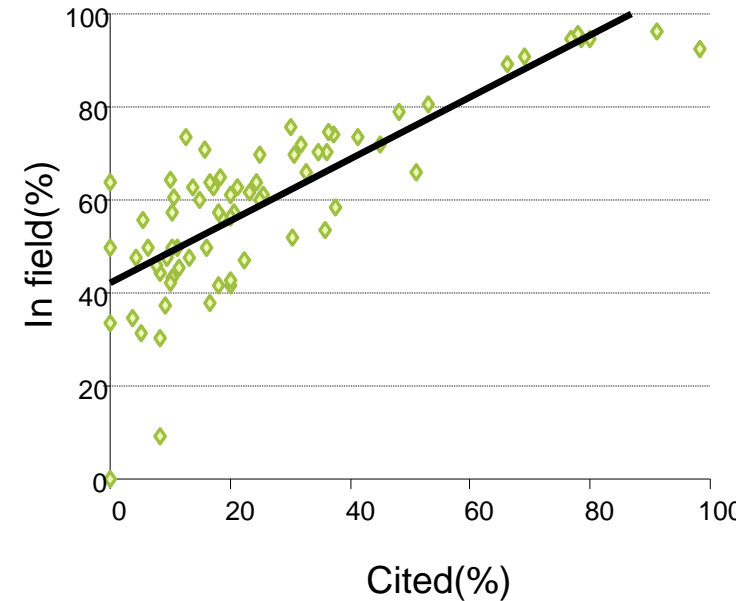
Surveying farmer individually and not in a group setting

Free listing methods – list of variety names

Limited number of farmers surveyed



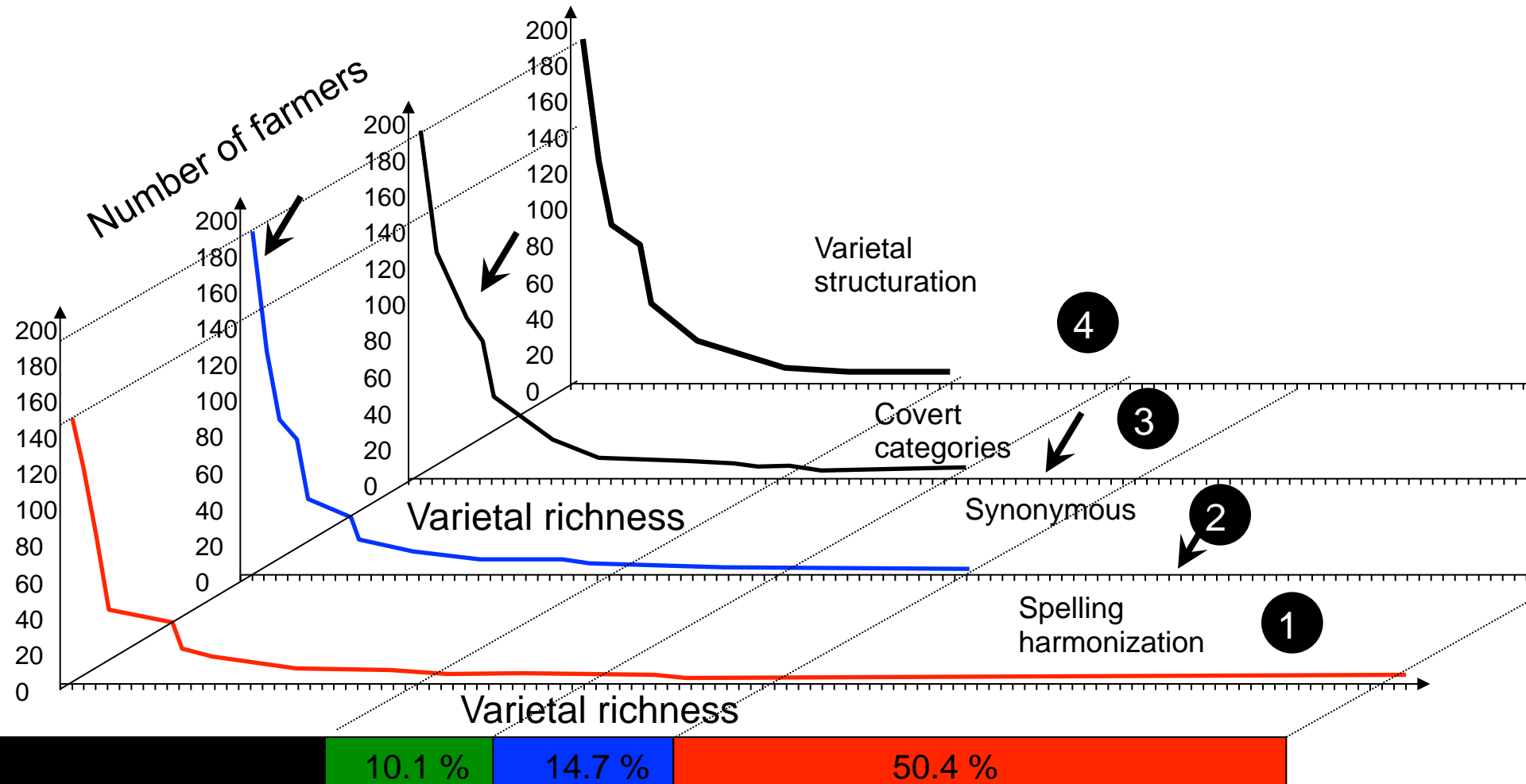
Indirect Estimation of Cultivated Areas



(S Caillon, 2008)

Allow considering inter individual variability

Steps of varietal inventory



Morphology under a name : Phenotyping



Which traits ?
How many ?
Quantitative traits ?
Qualitative traits ?
According to farmers ?

Trials implemented with the Primary School



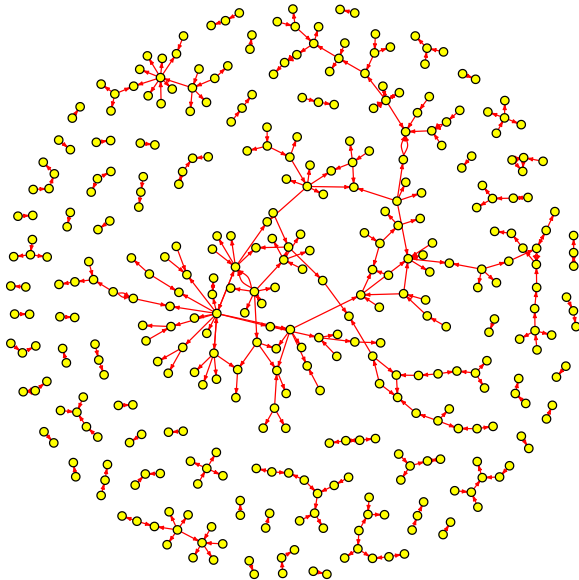
Participatory?

Anthropological Issues

Naming System Consistency

(D'Andrade 1981, Boster 1985)

Seed exchange System

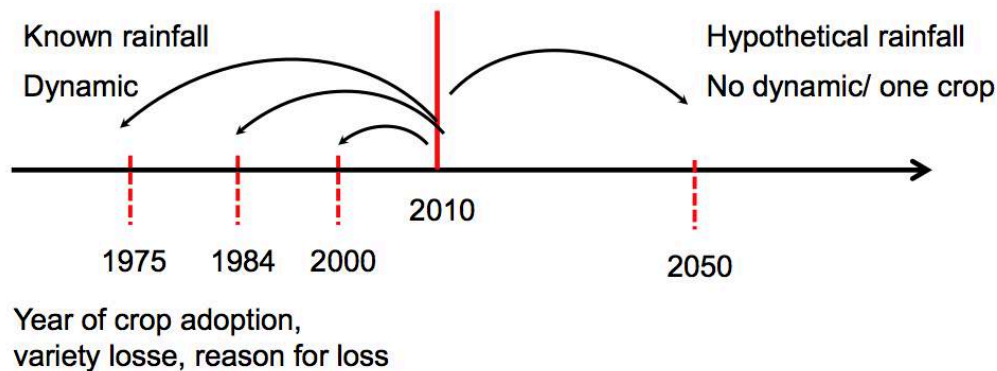
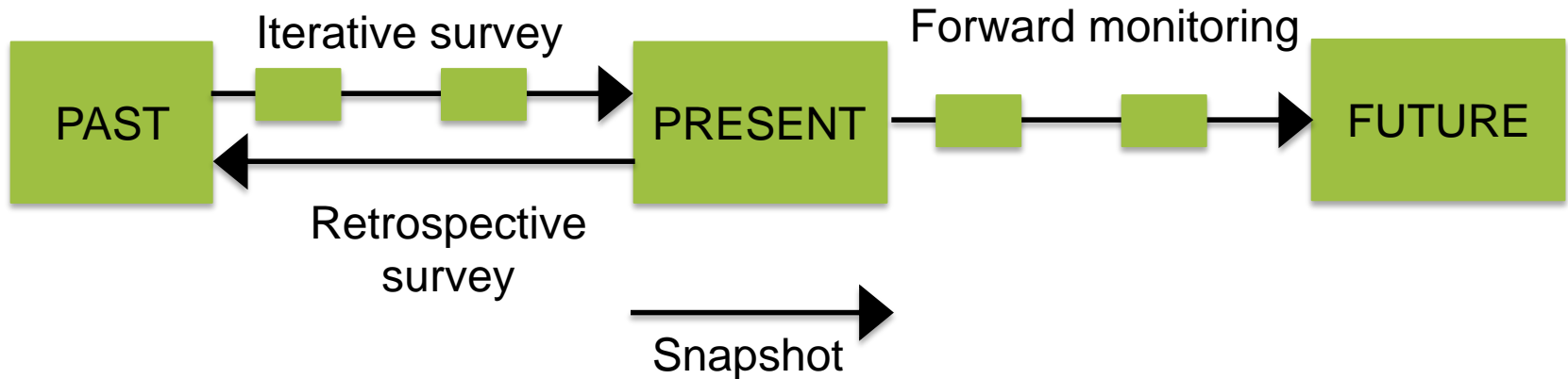


Cultural Consensus Survey
(V. Labeyrie)

Feedback to communities



Backward and forward diversity monitoring





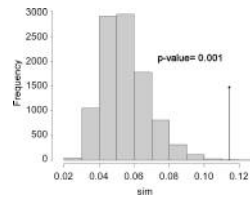
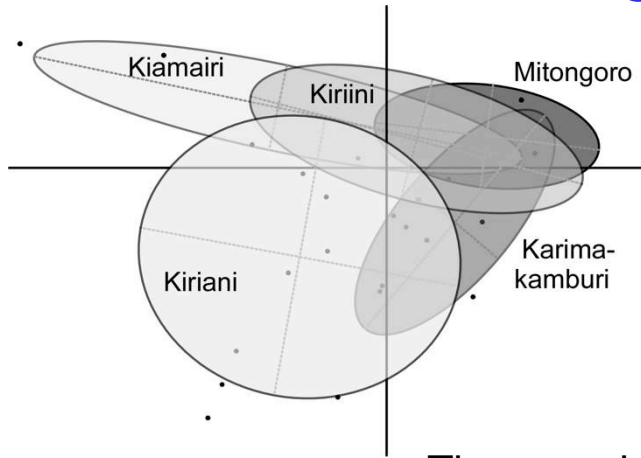
A. Snapshot diversity monitoring

Local scale Snapshot

Vanesse LABEYRIE

Ecole Doctorale SIBAGHE- SupAgro

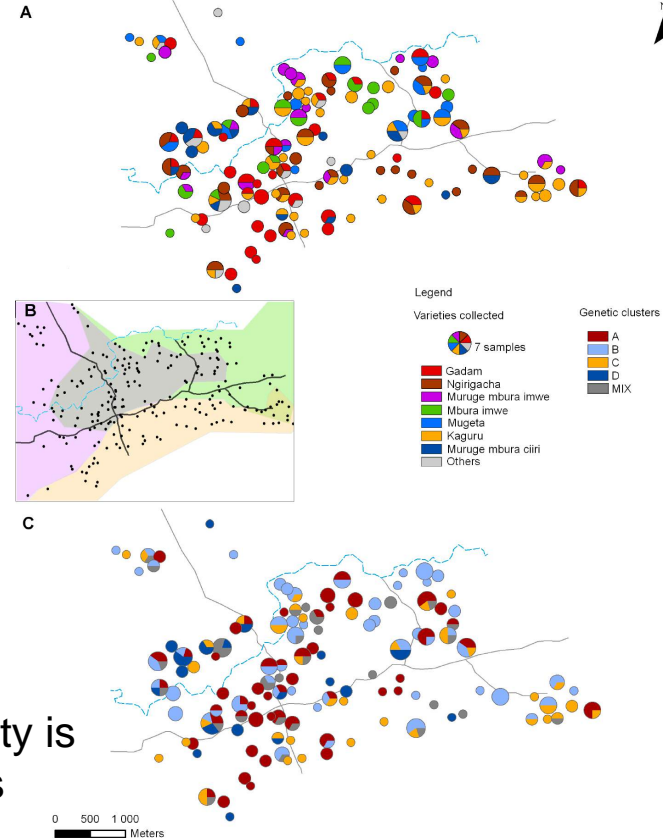
The social organization of crops. Impact of exchanges, representations and practices on sorghum diversity (Mont Kenya)



The cropping systems differ among residence groups (Labeyrie et al. 2013)



The crop genetic diversity is shaped by social factors (Labeyrie et al. 2014)



Linguistic contact zone

Is there a relation between Farmer social organisation and the Crop Genetic diversity?

Stratégie “G x E” → “G x E x S” → G x S

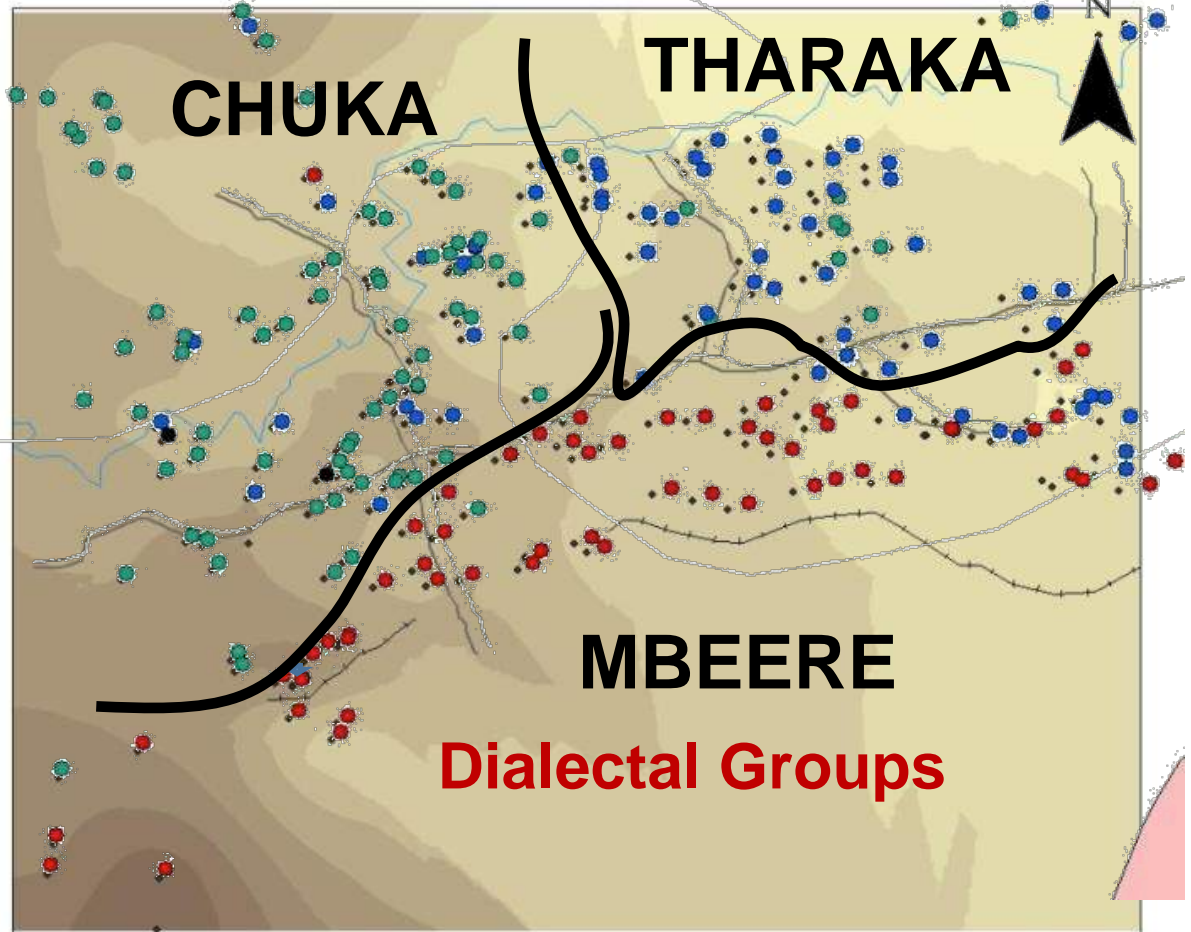
130 households
297 individual plants
16 variety names
18 SSR molecular markers
15 morphological descriptors.



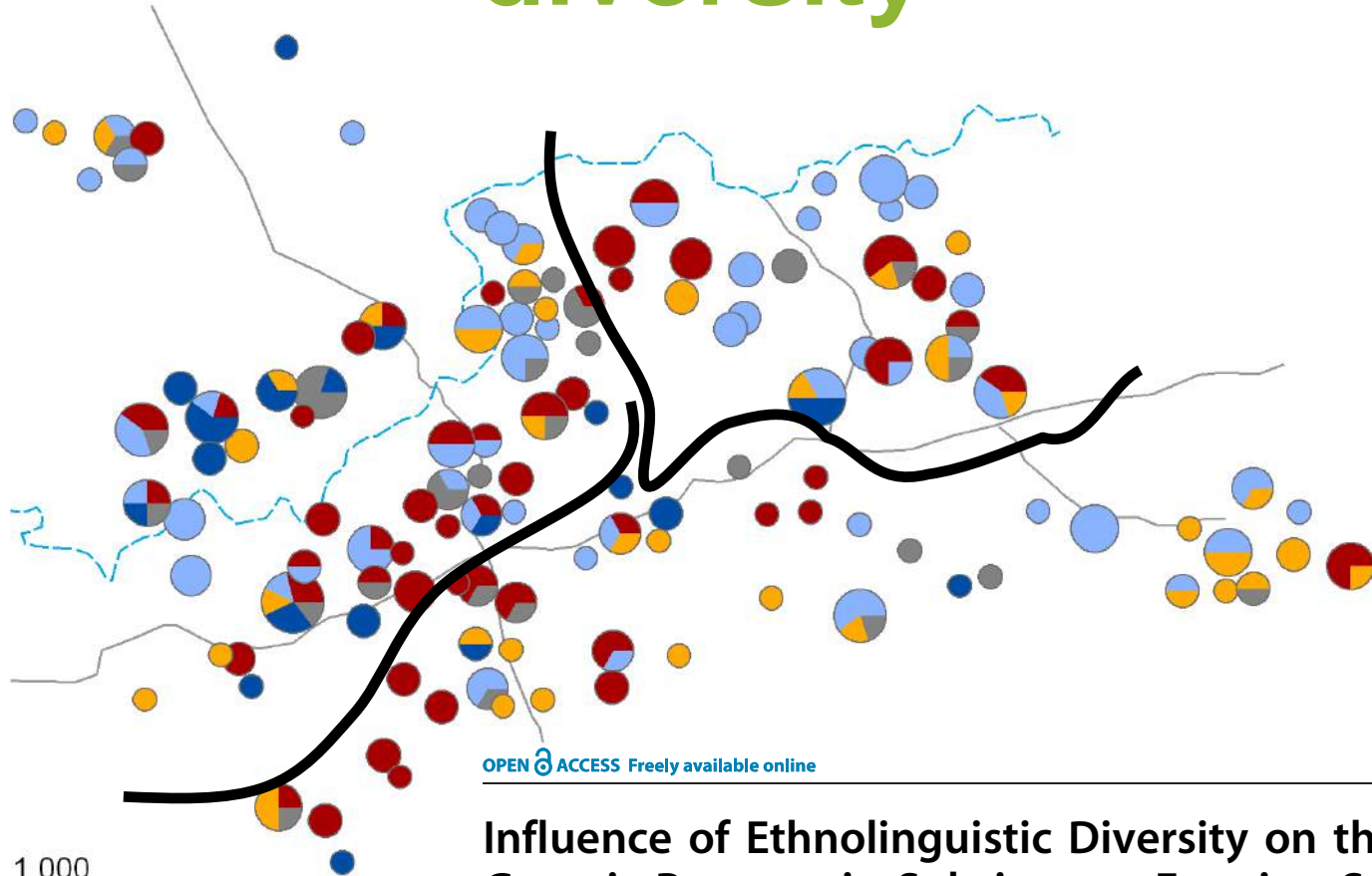
1 Km

Legend

- farms
- Ruguti river
- dyke
- Main tracks
- 783 - 810
- 810 - 837
- 837 - 864
- 864 - 891
- 891 - 918
- 918 - 945
- 945 - 971
- 971 - 998
- 998 - 1 025



Spatial/social distribution of diversity



Influence of Ethnolinguistic Diversity on the Sorghum Genetic Patterns in Subsistence Farming Systems in Eastern Kenya

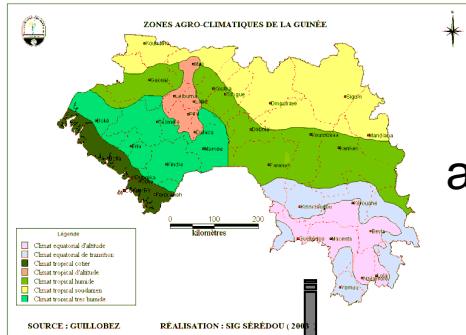
Vanesse Labeyrie^{1*}, Monique Deu¹, Adeline Barnaud³, Caroline Calatayud¹, Marylène Buiron¹, Peterson Wambugu², Stéphanie Manel^{4,5}, Jean-Christophe Glaszmann¹, Christian Leclerc¹

¹ UMR AGAP, CIRAD, Montpellier, France, ² National Genebank of Kenya, KARI, Nairobi, Kenya, ³ UMR DIADE, IRD, Montpellier, France, ⁴ UMR LPED, Université Aix-Marseille/IRD, Marseille, France, ⁵ UMR AMAP, CIRAD, Montpellier, France

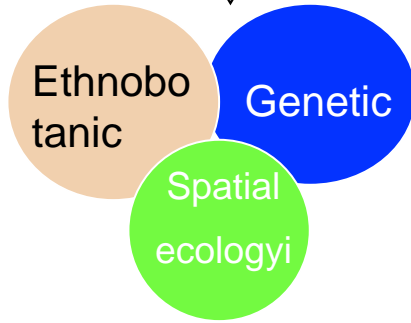
Regional scale Snapshot



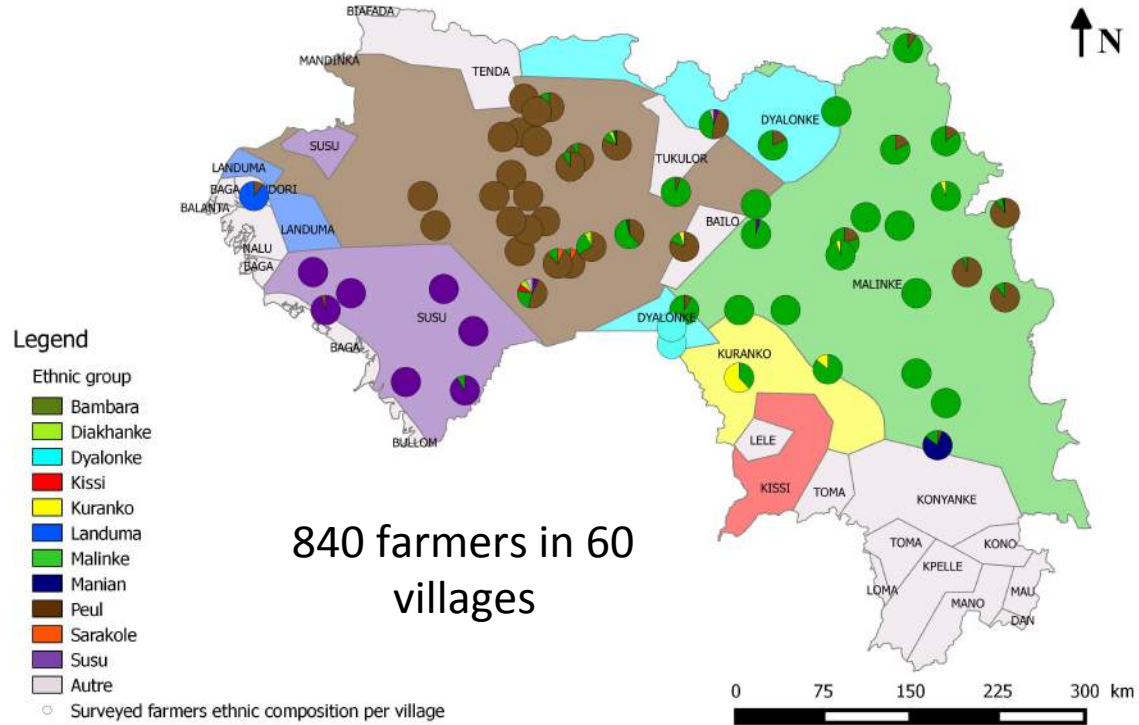
Documenting crop genetic diversity in Guinea



Climatic and social gradient



Combined data analysis



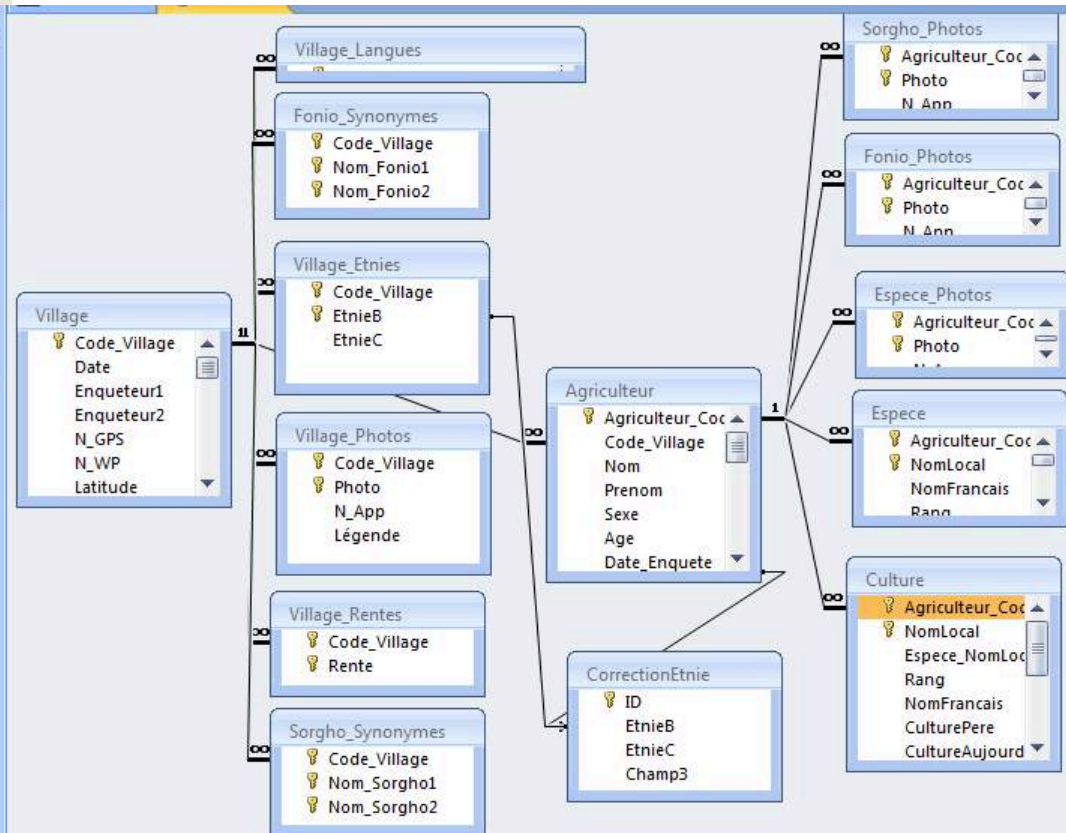
J. Piquet IRD-QGIS



Data base management : a first step toward long term monitoring

Village

Code_Village	Date	Enqueteur 1	
N_GPS	N_WP	Enqueteur 2	
Nom_Village	Nom_Chef_Village	Anciennete_Village	Origine_Fondateurs
N_Habitants	N_Exploitations	Composition Ethnique	Religions
		Ethnie	Religion
Rentes	Mecanisation	Présence d'ONG	Présence des Services Agricoles
Rente			
3 espèces les + cultivées	Vente de bétail au village	Distance du marché (km)	Habitat:
1:			
2:			
3:			
Numero des photos	Remarques sur l' acces au village:		
Photo	Légende		





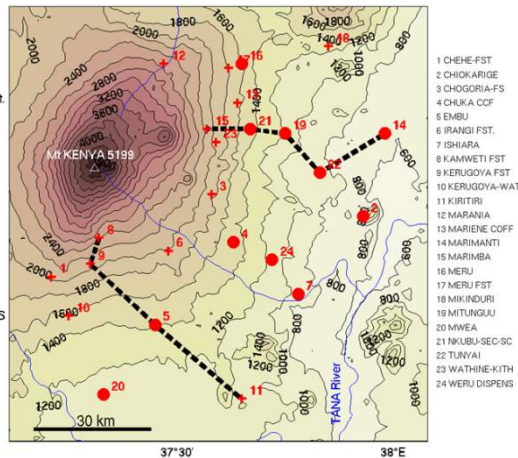
C. Backward and forward diversity monitoring

Backward Monitoring

Caroline MWONGERA

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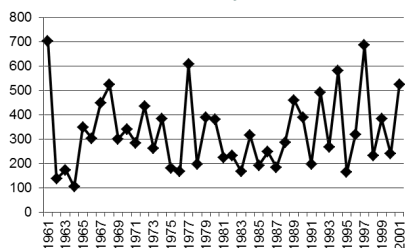
Hom smallholder farmers cope with climate variability. Case study of the Eastern slope of Mont Kenya



Camberlin al. 2012

Camberlin et Al., (en prep.)

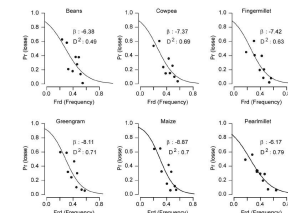
Rainfall October (1961-2001)



Correlate climatic changes, notably rainfall variability, with seed loss and crop adaptability

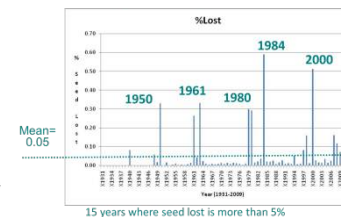


All crops are affected by seed loss

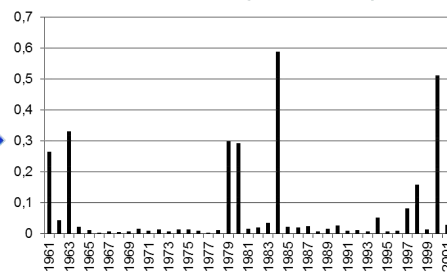


Leclerc et al. 2014

Percentage of seed loss (1931-2009)



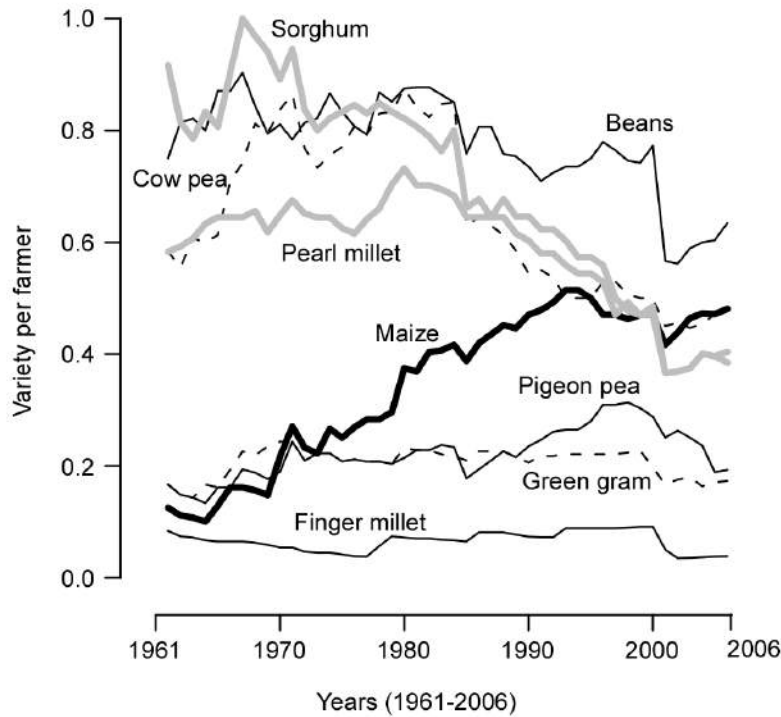
% Seed loss (1961-2001)



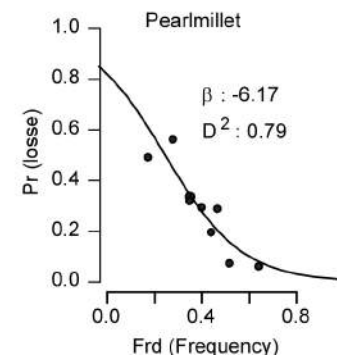
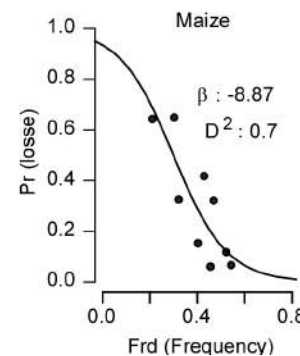
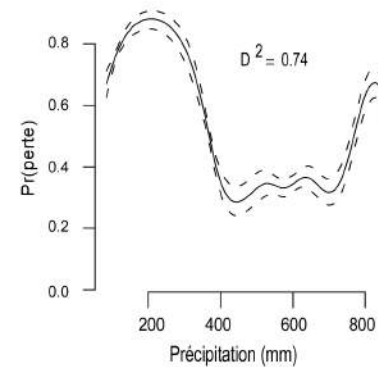
- ❑ Exploring better use of plant agro biodiversity by rural communities in adaptation to climate variability.
- ❑ Developing methodology of community-based biodiversity management.
- ❑ Establishing in situ/on-farm conservation through strengthening of farmer seed systems.

Crop adaptability in retrospect

Cropping system dynamics over time



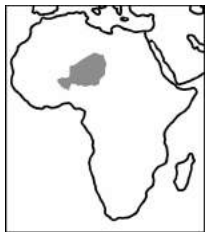
Modeling the dynamics with climate data



The evenness of drought sensitive crop increased while it decreased for drought resistant crops

Forward Monitoring

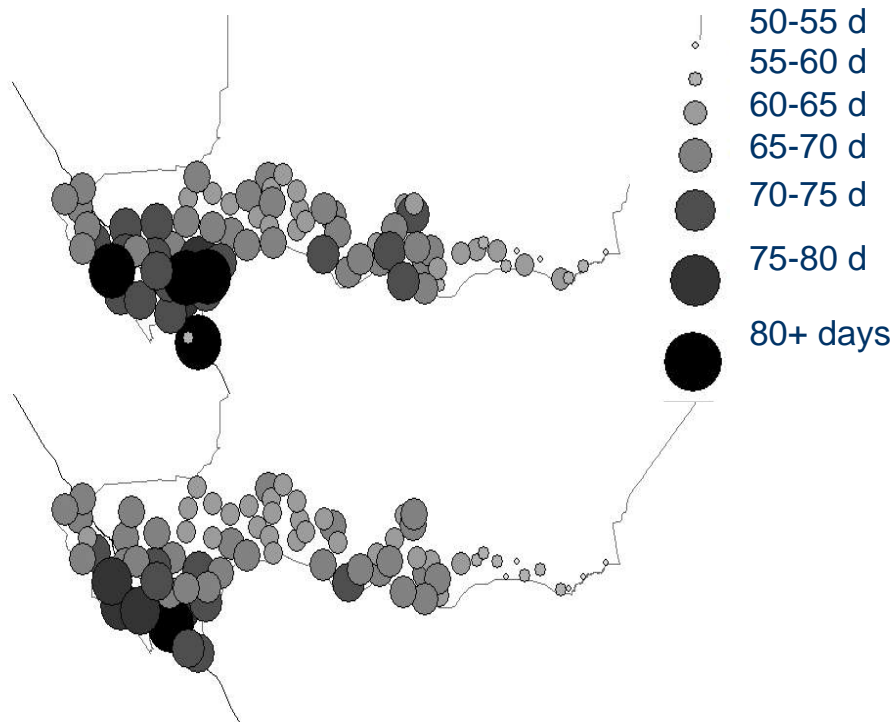
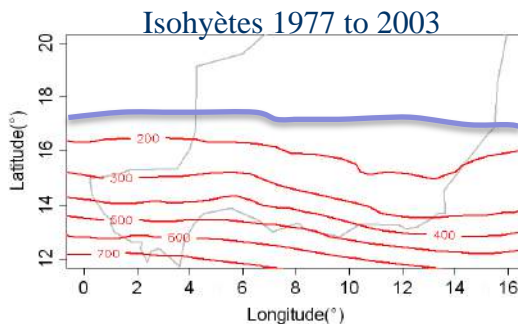
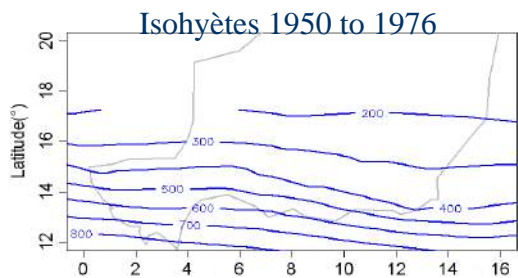
Spatio-temporal dynamics of millet diversity in Niger



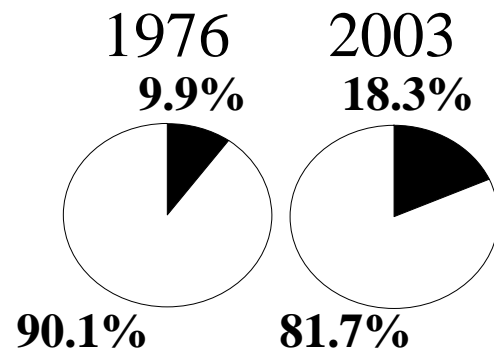
1976



2003



Selection for earlier flowering crop associated with climatic variations in the Sahel.



Discussion points

- Individual or groups based approach?
- Morphological characterization ?
- Genetic characterization ?

- Naming system consistency ?
- Both backward and forward monitoring ?

Thanks for you attention

IRD

Jean-Louis Pham
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