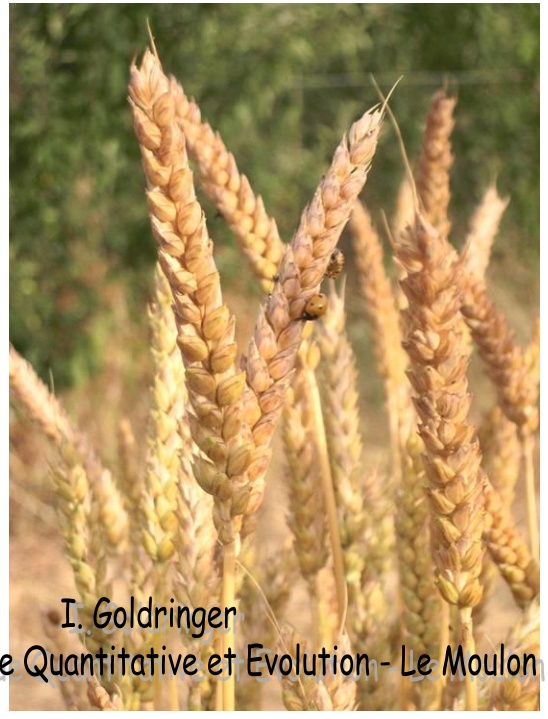
On farm crop diversity management as a lever for Climate Change mitigation and adaptation: lessons from 15 years of participatory research



I. Goldringer
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Outline

- Background of the research question
- The starting point of the participatory research
- Principles for participatory plant breeding
- Five types of outcomes
- Bottlenecks / challenges and good practices
- Summary

CC issues in crop breeding

• Substituting chemical inputs (including fossil E) by biological regulations induces:

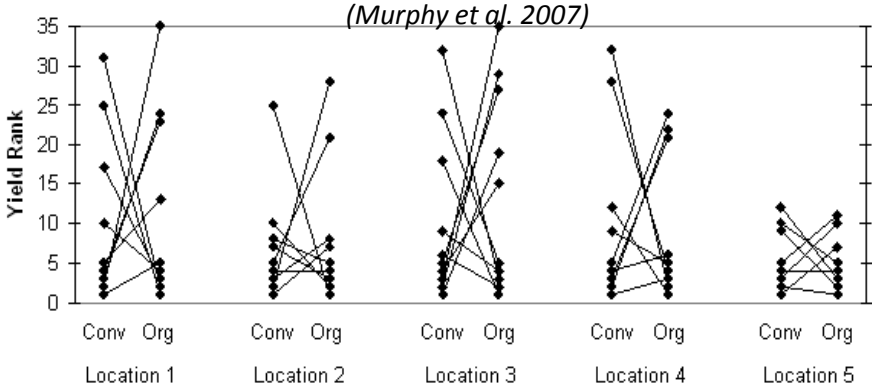
- more diverse farming practices
- more contrasting environmental conditions

= ↗ **Genotype x Management x Soil x Climate**

=> decentralized breeding

Genotype x farming system interaction

(Murphy et al. 2007)



CC issues in crop breeding

- Climate Change and less protective conditions lead to:
  - more variable and unpredictable climate and environments

= Need for **buffering capacity**

Within field crop genetic diversity **=** lever for productivity and resilience

=> breeding for populations or mixtures

CC issues in crop breeding

- Varieties must be adapted to:
  - farming practices, local conditions
  - the processes, produces, market chains

= Incorpore the **knowledge of the actors**,

= utilize a **contextualized, inclusive innovation process**

=> participatory approach

The starting point of the participatory research: 2003

1) Farmers and citizens NGO « Réseau Semences Paysannes » request:

- **Commercial varieties are not adapted to** farmers needs and expectations in organic farming and agroecology:
  - Breeding is done in experimental stations under conventional and optimal conditions (very different from on farm conditions)
  - Farmers' requests are too diverse to be addressed by a single centralized breeding program
  - Breeding objectives / criteria are not appropriate

- Farmers are looking for **heterogenous varieties** in order to buffer unpredictable variations and adapt their varieties over time

- Farmers would like to become **self-sufficient** in the management of their seeds

The starting point of the participatory research: 2003

2) Interest of the research team in the development of on farm dynamic management of crop diversity

- To develop and propose **strategies for crop diversity dynamic management**
  - Growing and reproducing crop populations on farm to allow for adaptation
- To contribute to changing agricultural practices by **diversity based solutions**
- To allow farmers to better **drive / control their systems** => increase resilience

⇒ **Outcome: co-construction of a participatory research approach for wheat diversity dynamic management**

⇒ **People-based approach, initially: no institution involved, no funding**

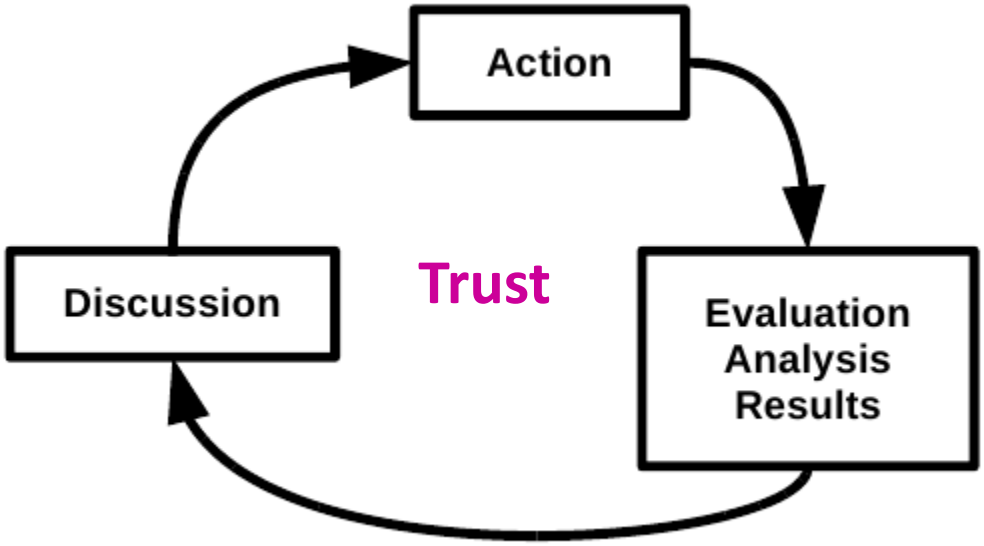
Objectives agreed:

- Action research to:
  - Create populations varieties adapted to low-input / agroecologic / organic farming systems, to local conditions and diverse produces
- Co-production of knowledge on:
  - The strategies to create and maintain crop diversity via on farm dynamic management and farmers breeding.
- Empowerment of actors:
  - For farmers and facilitators: reclaim concepts, methods and technics for the management of crop diversity on farm

The means (over time):

- **=> Participatory research** bringing together *farmers, citizens, processors* and *academic research teams* for a collective innovation
- *Fundings: Région IdF Projets PICRI, Région Centre SPEAL, Projets européens FP7 SOLIBAM, CORE Organic II COBRA, H2020 DIVERSIFOOD, Fondation de France EcoAgri, INRA AgriBio4*

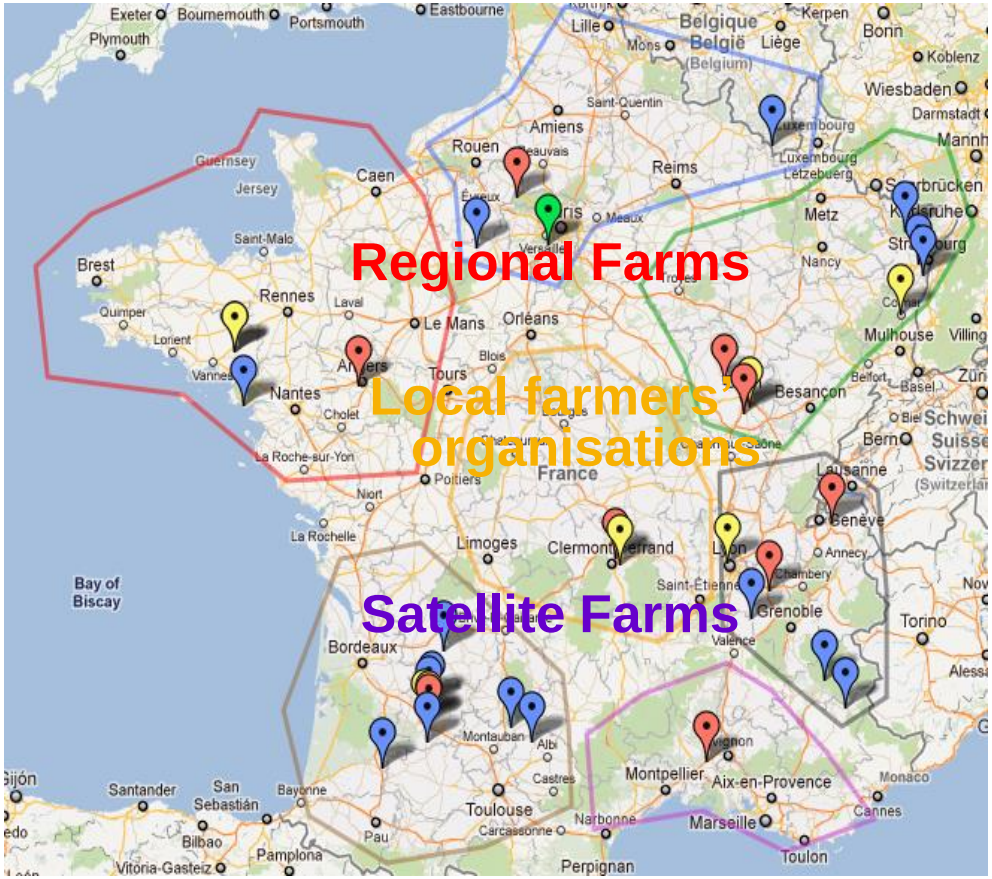
The PPB programme is co-designed by farmers, farmers organisations facilitators and researchers



This project is action research : while conducting research to respond to the initial questions, the selection, methodology and organisation can be modified at each step based on collective decisions.

Principles

- **Decentralized selection**



- **On farm evaluation under the usual agronomical practices of each farmer**

JF Berthellot (Port Ste Marie)

Use of increased genetic diversity: new crosses or mixtures or Composite Cross Populations (CCPs) among landraces, old varieties, organically bred varieties…

Five types of outcomes (1)

- New populations varieties grown by the farmers


At Berthellot's family farm, 1 commercial variety surounded by PPB varities


The PPB variety **Japhabelle - JF & C Berthellot (47)**

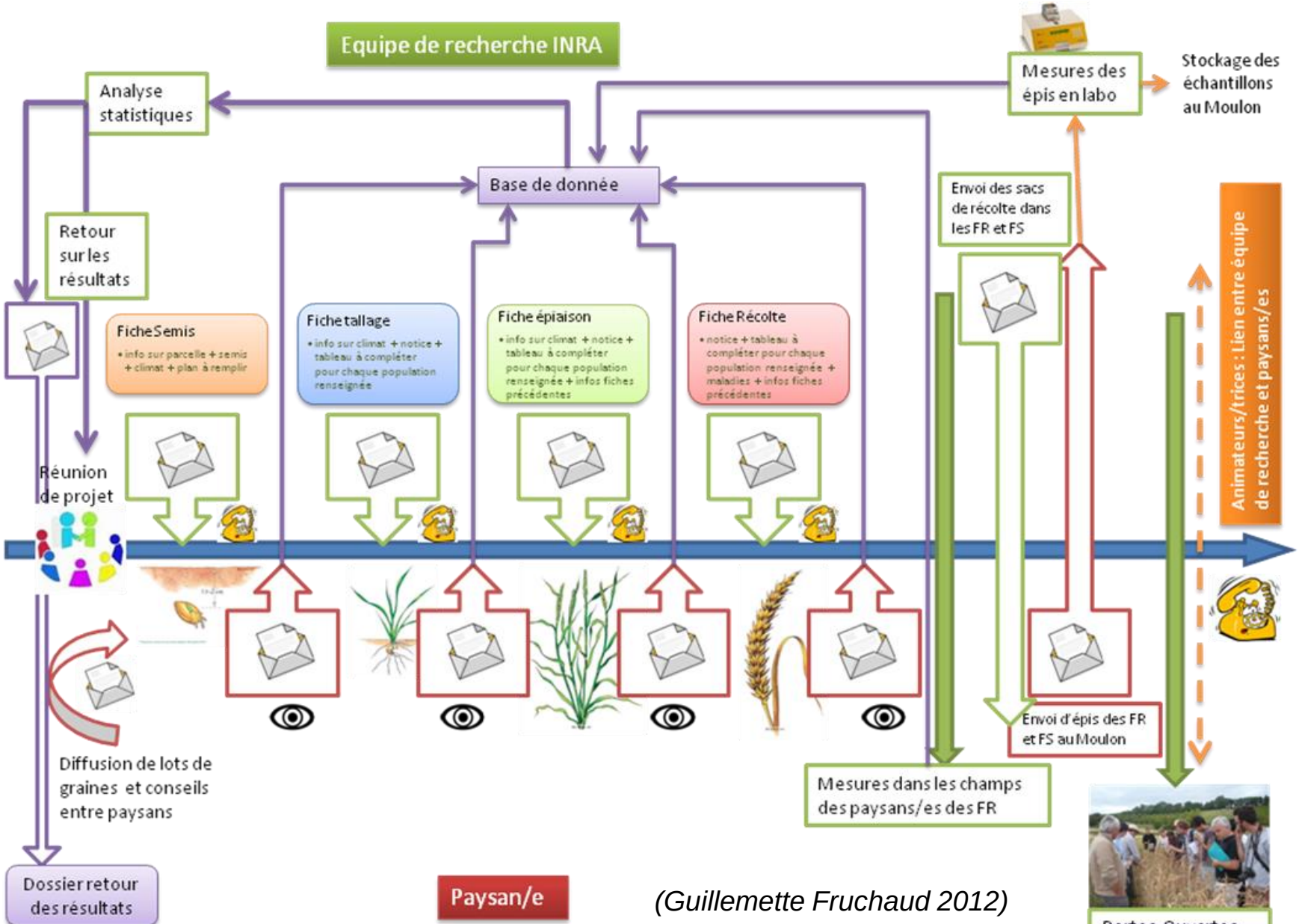
The 10 first PPB varieties

Nom	Origine	Type
Saint-Priest	F Mercier, Maine-et-Loire	Issue d'une variété Suédoise (Progress)
Rouge du Roc	JF Berthellot, Lot-et-Garonne	Sélection massale dans Rouge de Bordeaux
Pop dynamique 2	F Mercier, Maine-et-Loire	Mélange de 3 variétés de pays et 2 variétés + récentes
Mélange-5 Bourguignon	B Ronot, Côte d'Or	Mélange de 11 variétés de pays locales
Mélange du Sud-Ouest	JF Berthellot, Lot-et-Garonne	Mélange de ~ 20 variétés de pays locales
Savoysone	R Balthassat, Haute-Savoie	Issue d'un croisement entre 2 variétés de pays
Rocaloex	R Balthassat, Haute-Savoie	Mélange de 11 populations issues de croisements
Mélange-1 13 pops	B Ronot, Côte d'Or	Mélange de 13 populations issues de croisement
Dauphibois	C Dalmasso, Isère	Mélange de ~25 variétés de pays, populations issues de croisements et variétés récentes
Japhabelle	JF Berthellot, Lot-et-Garonne	Mélange de ~25 populations issues de croisements et sélectionnées

Five types of outcomes (2)

- New populations varieties grown by the farmers
- A collective organisation among the research team, farmers and facilitators relying on a lot of organization
  - Sharing data, discussing the results, experience feedback, seed exchange

Organization over the wheat cycle



(Guillemette Fruchaud 2012)

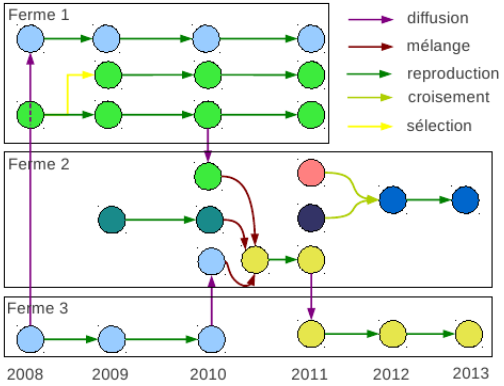
Five types of outcomes (3)

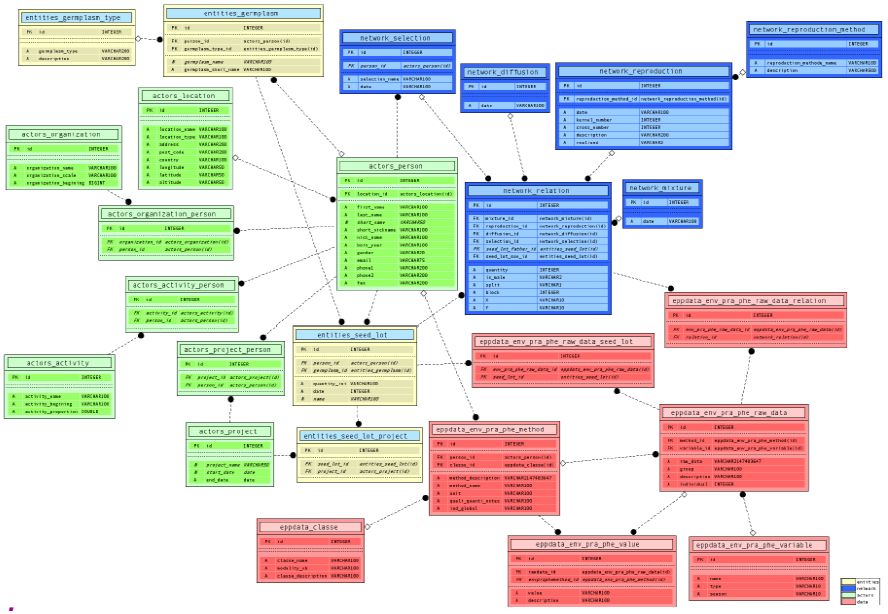
- New populations varieties grown by the farmers
- A collective organisation among the research team, farmers and facilitators relying on a lot of organization
  - Sharing data, discussing the results, experience feedback, seed exchange
- Generic tools and methods for supporting a collective selection / management of diversity
  - Protocols for observation, unbalanced experimental designs, Bayesian statistics, synthesis report to farmers, booklet on PPB, an adapted database - *SHiNeMaS & PPBStats (https://github.com/priviere/PPBstats)*

An adapted database

- Two types of data:
  - Seed lots history
  - Data from experiments
- Multi-site and multi-year data
  - On farm experimental design:
    ~ 25 farmers involved / yr,
    > 60000 data / yr, 2009 - 2018

⇒ **Database** = a key element for the management of the system





Pierre Rivière & Yannick de Oliveira

Five types of outcomes (4)

- New populations varieties grown by the farmers
- A collective organisation among the research team, farmers and facilitators relying on a lot of organization
  - Sharing data, discussing the results, experience feedback, seed exchange
- Generic tools and methods for supporting a collective selection / management of diversity
  - Protocols for observation, unbalanced experimental designs, Bayesian statistics, synthesis report to farmers, booklet on PPB, an adapted database - *SHiNeMaS & PPBStats (https://github.com/priviere/PPBstats)*
- Increased learning and autonomy for crop diversity management
  - Within population mass selection, among populations selection, design of new crosses

Practical training on breeding, technical booklet,…

LE MOULON Génétique végétale UMR

Réseau Semences Paysannes

Des blés en (R)Evolution :

SOLIBAM, Projet de sélection participative entre le Réseau Semences Paysannes et l'INRA du Moulon : création de variétés de blé tendre de qualité adaptées à l'Agriculture Biologique et conservation de la biodiversité cultivée

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Site internet : http://moulon.inra.fr/index.php/fr/equipes/deap
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Août 2012

Five types of outcomes (5)

- New populations varieties grown by the farmers
- A collective organisation among the research team, farmers and facilitators relying on a lot of organization
  - Sharing data, discussing the results, experience feedback, seed exchange
- Generic tools and methods for supporting a collective selection / management of diversity
  - Protocols for observation, unbalanced experimental designs, Bayesian statistics, synthesis report to farmers, booklet on PPB, an adapted database - *SHiNeMaS & PPBStats (https://github.com/priviere/PPBstats)*
- Increased learning and autonomy for crop diversity management
  - Within population mass selection, among populations selection, design of new crosses
- A political recognition of the farmers organizations role as actors of the crop diversity management

Conclusions

- Increasing climatic stochasticity requires more diversity in the fields
- Involving multiple stakeholders in plant breeding can increase **system resilience** : seed control and decision making are less concentrated and genetic variability is distributed
- Collaboration between research and citizens allows for:
  - Elaborating **original and complex research question**s where basic and applied research are interlocked
  - Giving **more sense to researc**h
  - Stimulating **citizens' interest and involvement into research** and identification of research needs

Choux, V Chable, INRA Rennes

Bottelnecks / challenges and good practices

- This is a long term process !

  => Need to take the **time** to co-design = get to know / understand each other, build the **trust** to build the project

  $\Rightarrow$ Need for researchers to be **trained** in participatory research

- Difficult to find funding bodies that:
  - Acknowledge NGOs as research partners
  - Evaluate the whole of the outcomes of the project not only scientific publications
  - Appreciate transdisciplinary approaches

Bottelnecks / challenges and good practices

- To make the organization durable in a context of project-based research
  - Fast turn over of people involved on both sides (NGOs and research)
  - Loss of skills and knowledge
  - Loss of trust

  ⇒ Take the **time**

  ⇒ Develop **copyleft** design, tools, methods and training supports that allow for **traceability** of information, for sharing information and an **easy learning** / transfer to the new actors

  ⇒ Develop multi-stakeholders participatory research platform to allow for recurrent funding

- To produce and value diverse non standard outputs

  ⇒ Find the journals to publish transdisciplinary research

  ⇒ Find the time and/or other sources of funding to develop the non scientific dissemination (technical, broad audience, …)

Bottelnecks / challenges and good practices

- Lack of recognition of participatory research
  - A tendancy to oppose participatory research and scientific « excellence »
  - New jobs (facilitation, support, logistic organization,…) are not (little) recognize in research and education and there is a lack of training

  ⇒Develop the participatory research community, new journals, training sessions for higher education…

Summary

- A participatory research approach has been developed over 15 years for on farm bread wheat diversity management
- The starting point was the request of farmers organizations for adapted and adaptable populations varieties
- Researchers and farmers organizations identified the objectives: action research for varieties development, co-production of knowledge on on farm dynamic management of crop diversity, empowerment of farmers organizations
- Five types of outcomes have been achieved from the development of new scientific methods to political recognition of actors
- Participatory research (PR) in this field remains challenging mainly due (i) to the gap between research functionning (short term) and the need for a long term involvement of actors and (ii) to the lack of recognition of participatory research
- However the development of more PR projects and of a PR community should consolidate existing and new PR projects.

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Pierre Rivière,Jean-François Berthellot et les paysans et animateurs du groupe Blé *RSP*

Thanks for your attention !