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# PARTICIPATORY APPROACH TO MODEL COMMUNITY SEED SYSTEMS

Sustainable farming in the context of global change should be based on diversified agro-ecosystems, including crop genetic diversity, as it generally offers better resilience to changing environmental conditions. Seed circulation between farmers is a major driver of the dynamics of genetic diversity over time. Although several studies have shown that seed flows between farmers have a strong influence on the evolution of crop genetic diversity, there is a lack of knowledge on how seed circulation, farmers' practices and local selective pressures interact to shape the structure of crop genetic diversity over time. Over the past twenty years, community initiatives involved in the management of crop diversity - called Community Seed Systems (CSS) - have emerged in Europe. Among those, farmers seed networks or community seed banks now include more diverse actors in addition to farmers, such as gardeners, small seed producers, etc. It is interesting to document to which extent these diverse CSSs shape the genetic diversity of crops.

**AT FIRST GLANCE**

A participatory approach has been developed to model the functioning of community seed systems:

- ✓ to foster their empowerment in the management of crop diversity through a reflexive approach
- ✓ to highlight the genetic, practices and organizational diversities

Embedding crop diversity and networking for local high quality food systems

## Objectives and approach

DIVERSIFOOD objectives are: a) to support a reflexive approach to CSS actors to help them in organizational decision-making; b) to develop scientific expertise on on-farm diversity management strategies based on collaborative work between researchers and actors of the seed networks. For that, simulation-based approaches are good alternatives to surveys and experimental studies that are very cumbersome and costly to conduct, and analytical approaches that are difficult to implement in such complex systems.

Tools and methods developed in Diversifood:

- A simulation software (CropMetaPop) to model the evolution of the genetic diversity of cultivated populations by taking into account growers' practices and their social organization;
- A demo-genetic analysis pipeline to analyze the model outputs and represent them graphically.

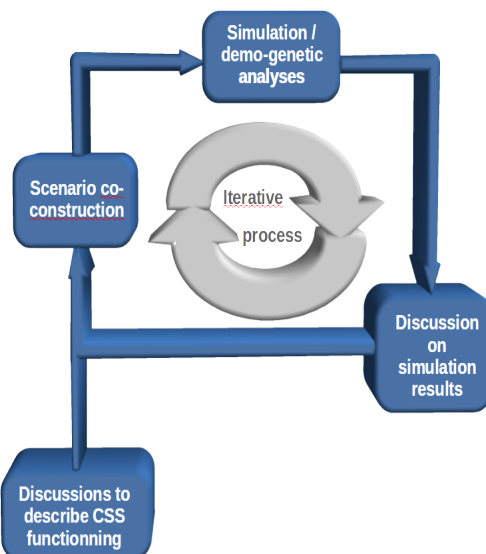


Figure 1: Illustration of the iterative process

**Approach:** Meetings were organized with the facilitators of the CSSs in France (RSP), Italy (RSR) and Spain (RAS) to document their species and varieties, growing practices, seed circulation rules and organizational characteristics. This information allowed to co-construct scenarios for community-based management of crop diversity. Initial scenarios were simulated and the results discussed with the facilitators. New scenarios can be proposed from these discussions in an iterative process (cf fig. 1).

### *Focus on two case studies*

Among four case studies investigated within DIVERSIFOOD (bread wheat in Italy and France, Tomatoes in Spain and France) two are illustrated below.

#### **Example 1: Tomatoes in Spain**

*Initial condition:* The Red Andaluza de Semillas (RAS) manages a Community Seed Bank (CSB) in Sevilla mainly focused on vegetables, in particular on tomatoes. The CSB is composed of facilitators and members: farmers, market gardeners or amateur gardeners. The tomato seed circulation has been registered since 2010.

*Changes:* New local CSBs have recently emerged. Now, the CSS is composed of different CSBs leading to: a) an increase in the number of actors involved in the CSS; and b) new pathways for seed flows within and between CSBs.

*Specific question addressed:* To what extent does this change in the CSS social organization have an impact on the crop genetic diversity maintained in the system?

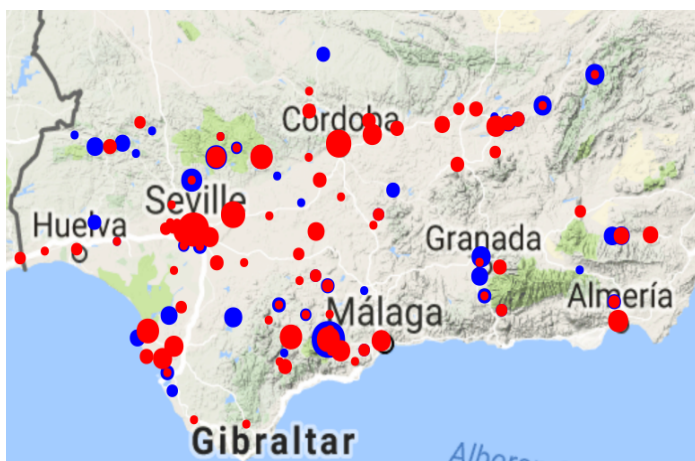


Figure 2 Localization of the seed providers (blue) and seed receivers (red) involved in tomatoes seeds circulation in RAS (2010-2017)

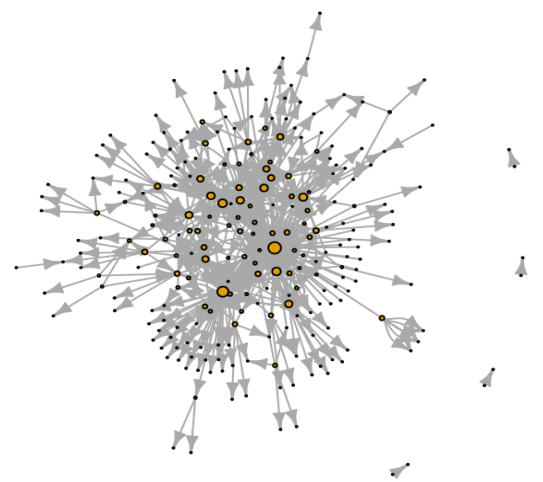


Figure 3 Tomatoes seed networks of RAS (2010-2017)

#### **Example 2: Bread wheat in Italy**

*Initial condition:* Since 2011, the Rete Semi Rurali (RSR) is supporting the experimentation, selection and distribution of a bread wheat evolutionary population with a broad genetic basis. Starting from two farmers in Sicily and Tuscany, the population spread to more than 50 farmers in different regions of Italy.

*Changes:* The experiment of marketing heterogeneous material led to a larger scale distribution of the population.

*Specific question addressed:* How should the seed distribution to new farmers be organized to optimize the adaptation and adaptability of the populations maintained in the CSS?

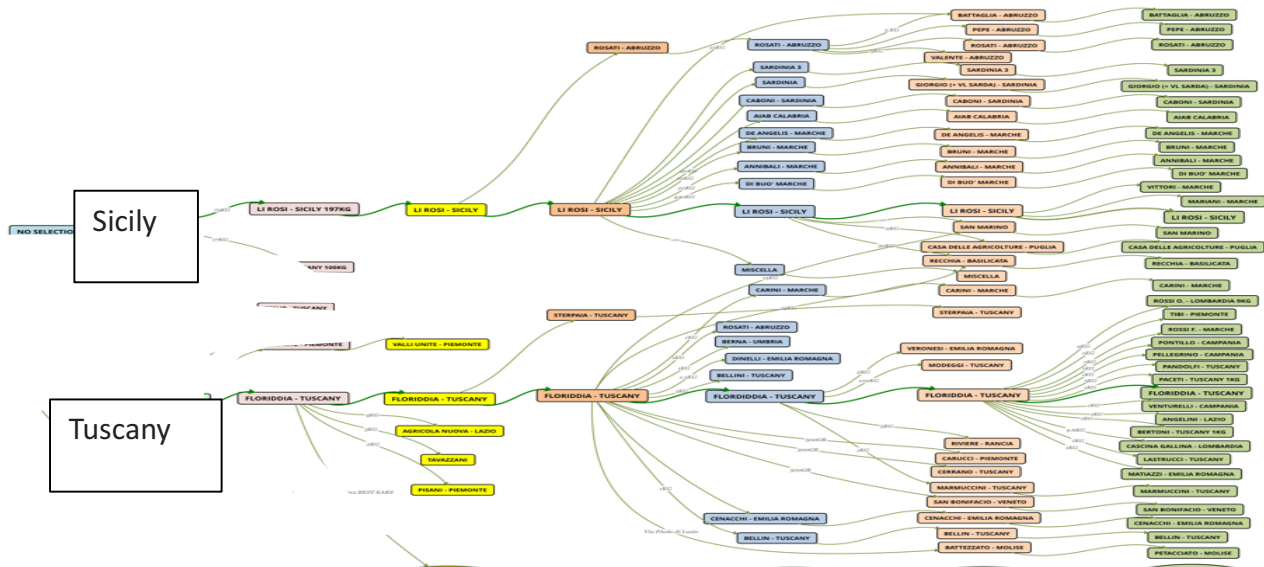


Figure 4 History of seed circulation of the bread wheat population within the Italian CSS

### The way forward

The values of the parameters used in CropMetaPop need to be refined to better represent the initial situations (e.g. in the RSR CSS, introduction of populations extinction) and assess more realistic scenarios with each CSS. Representing in a realistic way the different selective pressures (farmers agronomic and selection practices, environments) is critical but remains touchy and needs time and a strong involvement from the CSS facilitators. Finally, it might be needed to include other actors of CSSs such as genebanks, and to model the reintroduction of ex situ genetic resources into agricultural landscapes.

The widespread use of participatory modelling in many CSSs will increase:

- a) the empowerment of the communities
- b) the visibility of on-farm management of crop diversity.

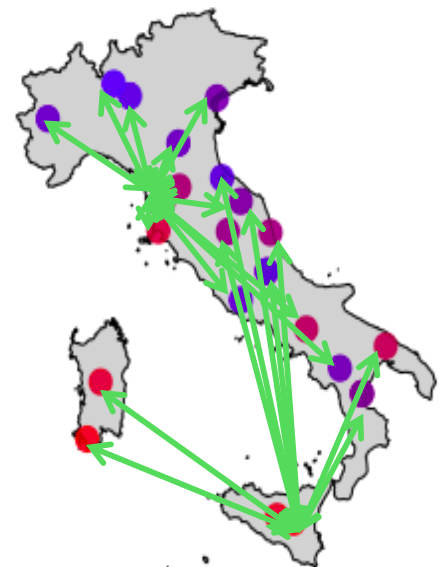


Figure 5 Representation of the seed network and the diversity of environments take into account in the simulation

### Suggested readings

Barbillon, Pierre, Mathieu Thomas, Isabelle Goldringer, Frédéric Hospital, et Stéphane Robin. 2015. « Network impact on persistence in a finite population dynamic diffusion model: Application to an emergent seed exchange network ». *Journal of Theoretical Biology* 365:365-76.

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***This Innovation Factsheet is the result of the collective work of DIVERSIFOOD partners, coordinated by Isabelle Goldringer (INRA) and Mathieu Thomas (Cirab), with the support of Abdel Kader Naino Kika (INRA), Bettina Bussi, Matteo Petitti (RSR) and Maria Carrascosa (RAS)***