Participatory design of cropping systems territorial distributions to limit the risk of water crisis

Clément Murgue, Delphine D. Burger-Leenhardt, Olivier Therond

► To cite this version:

Clément Murgue, Delphine D. Burger-Leenhardt, Olivier Therond. Participatory design of cropping systems territorial distributions to limit the risk of water crisis. ESEE 2013 Conference :10. International Conference of the European Society for Ecological Economics, Jun 2013, Lille, France. , 686 p., 2013, Ecological Economics and Institutional Dynamics. hal-02745747

HAL Id: hal-02745747
https://hal.inrae.fr/hal-02745747

Submitted on 3 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Participatory design of cropping systems territorial distributions to limit the risk of water crisis

Murgue, Clément, and Delphine Leenhardt, Olivier Therond
INRA, UMR AGIR, Team MAGE (Modelling for water management)

Territorial quantitative water management

In many sub-basins of the Adour-Garonne watershed (South-West France) the river flows are regularly monitored below the regulatory low-water flow levels (LWFL). These recurring "**water crisis" highlight local structural water deficit situations.** They are often **linked to irrigated agriculture,** especially maize mono-cropping, as it is responsible in these basins for about 80% of water extraction during low flow period.

The French law on water and aquatic environments (LEMA 2006) seeks to ensure a local, sustainable water management (i.e. balance between water resources and demands). In some basins, this means for **agriculture to lower its withdrawal levels**. However irrigation is a key production factor for farming systems**.** Implementing the law therefore generated **conflicting situations** which froze the transition process.
The main issue that arises from this context is **how to conciliate water resources protection and economic viability of agriculture ?** Some scientists propose to develop integrated approaches to design **water management and agricultural strategies at watershed level where stakeholders participate strongly in the decision-making processes.** This study presents such an **integrated and participatory approach** that makes use of different modelling methods **to assist stakeholders** in designing alternative territorial organizations of cropping systems that could lower water demands and/or spread it over space and time, and improve the management of existing water storage. **Models are a mean to represent, apprehend and simulate** the spatial dynamics of the irrigated territory year after year. The **participatory design process is organized into 4 main steps**.

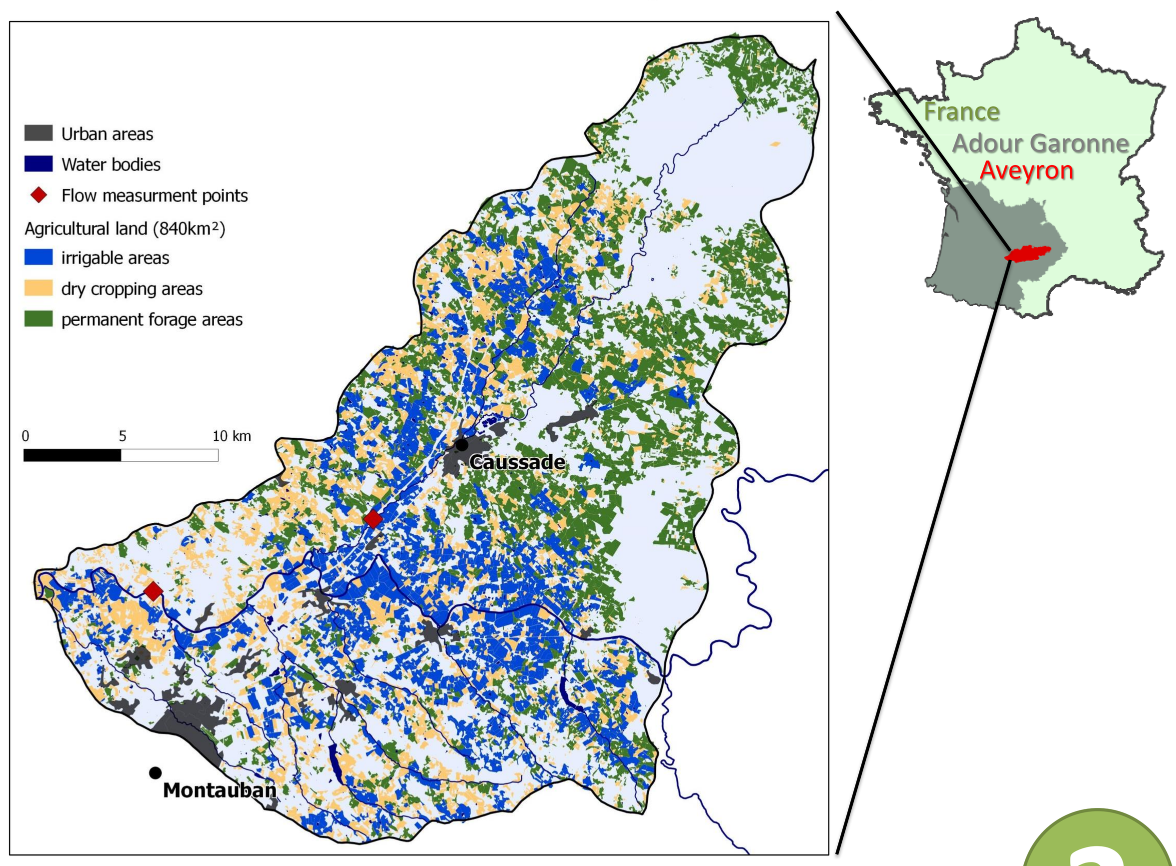


Fig.1: Location and presentation of the study site: the irrigated territory downstream of the Aveyron river basin in Adour Garonne

1 Building a shared representation of the system

We integrate available data and stakeholder knowledge to formalize a representation of the current bio-physical structure and dynamics of the territory (hydrological, hydraulic, agricultural and bio-physical). This information is gathered into a geographical database.

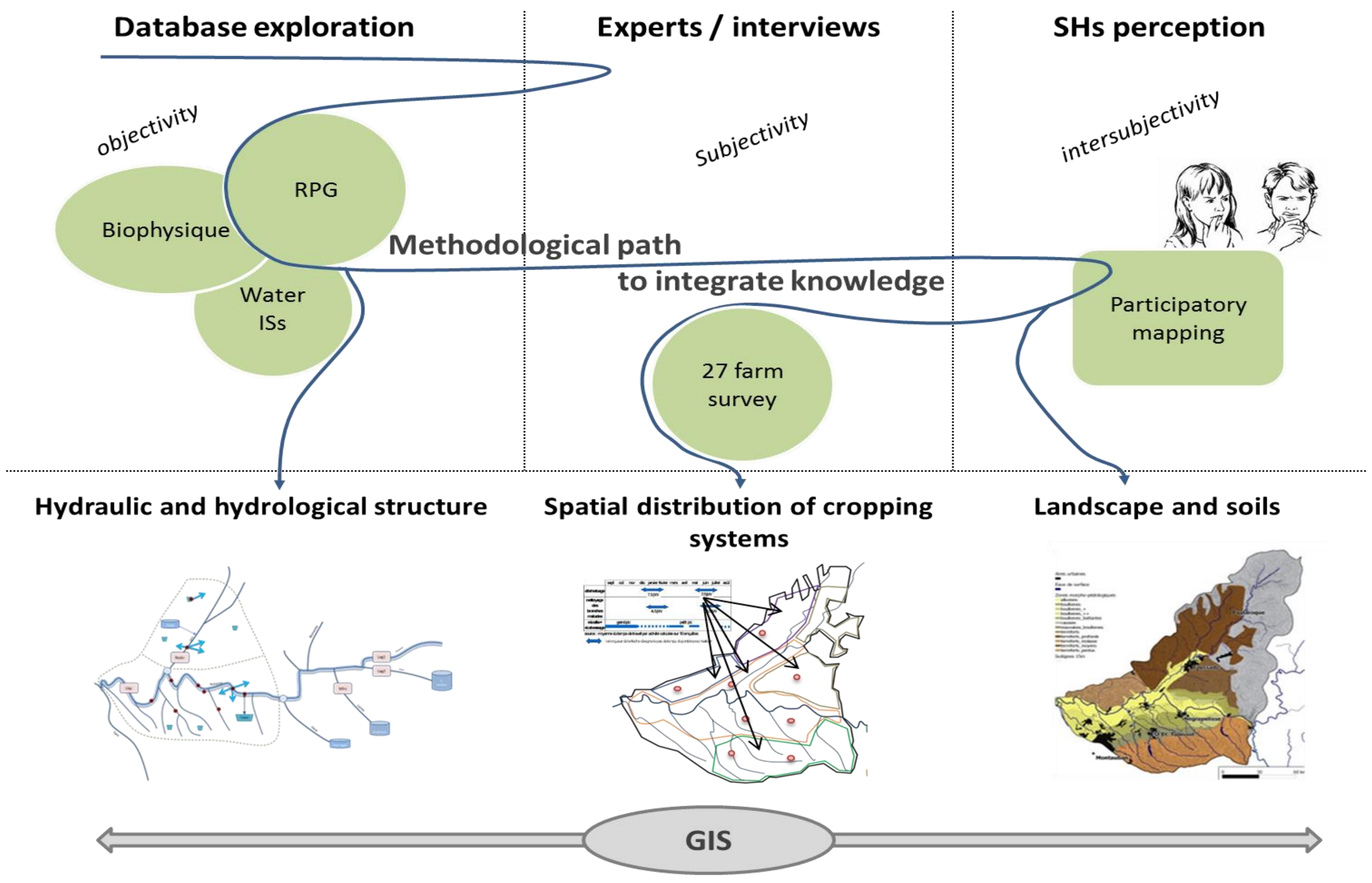


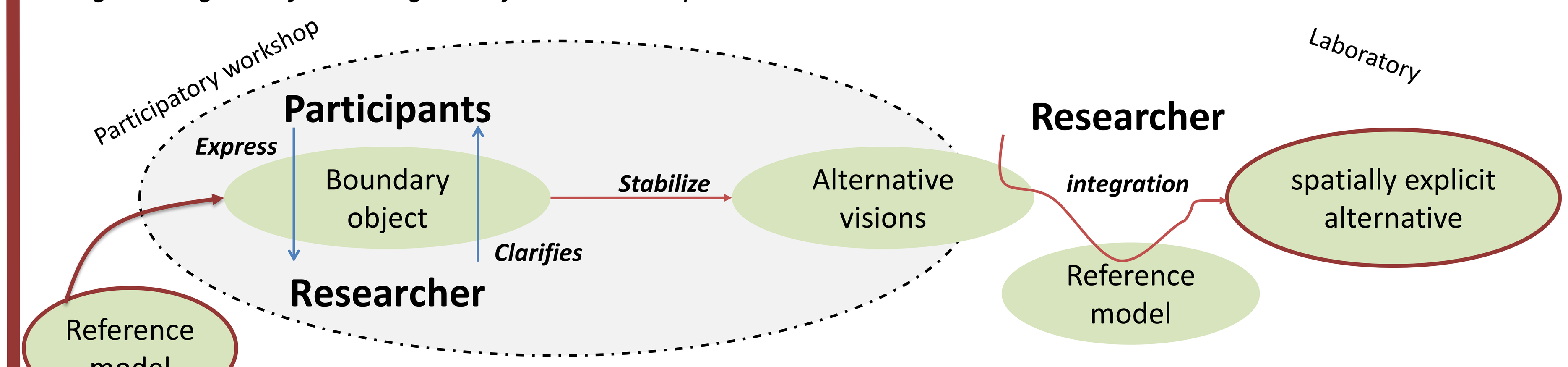
Fig.2: Diagram of the methodological procedure used to build a shared representation of the irrigated territory

By surveying 27 farming systems of the territory and operational water managers, **we formalized decision rules associated to cropping and irrigation practices as well as water management practices** (dam releases and usage restrictions). The GIS and set of rules are considered as a shared model of the irrigated territory system as they are built in interaction with participants of next steps of the design process.

2 Co-designing alternative distributions of cropping systems

We ask stakeholders of agriculture and then of environment and local state services to express their view on possible or expected changes in current spatial distribution of cropping systems and operational water management practices, that could reduce the probability of severe low flow while ensuring viability of farming systems.

Fig.3 : Diagram of the design and formalisation process:



Changes expressed by stakeholders are integrated into a spatial and quantitative representation, through the use of the GIS built in step1. The formalized "alternatives" can then be submitted to the collective in order for it to refine them, making use of use information available in GIS. (e.g. Prioritize location of change using farm type)

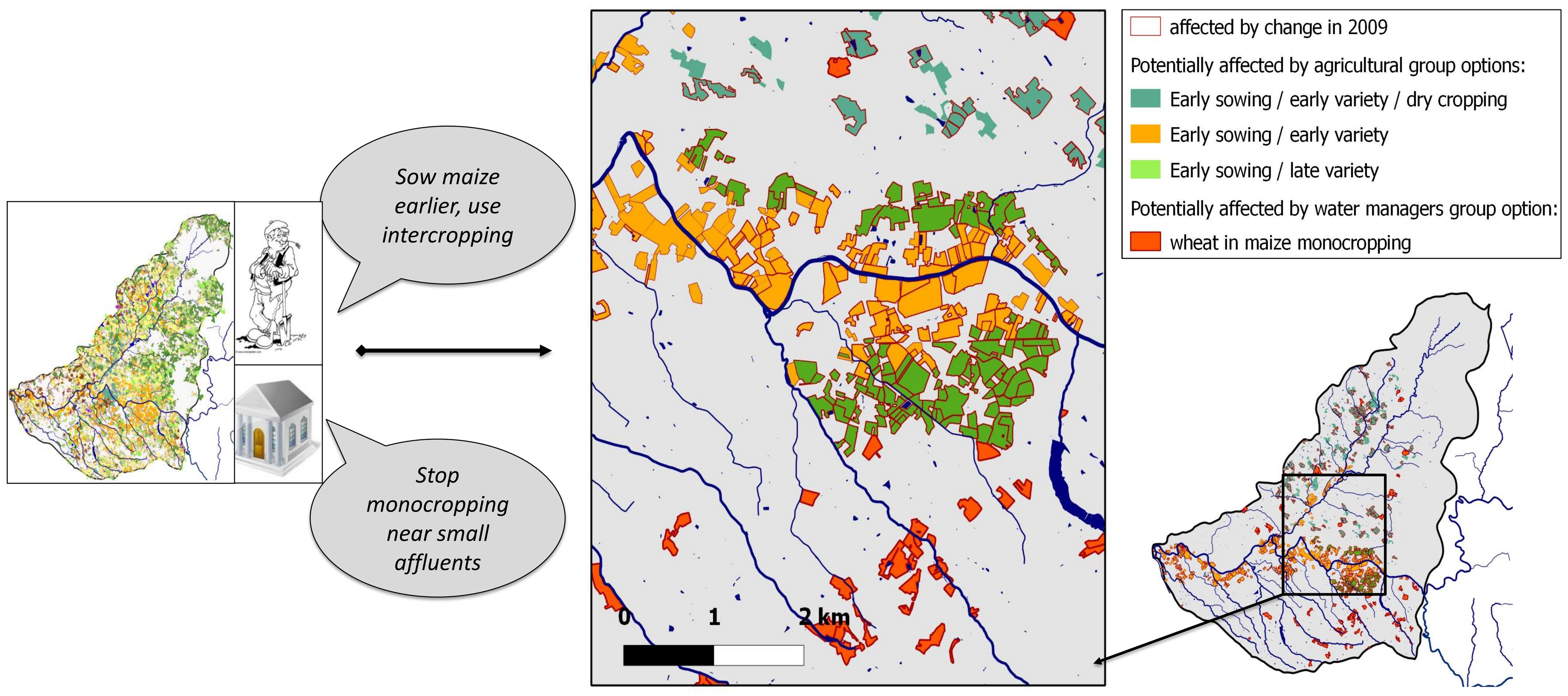


Fig. 4: Example of results: a formal representation of plots affected by change in an alternative that integrates compatible options from environment and state services group and agricultural group.

3 Simulation of the territorial behavior

Alternatives of cropping system distribution and water management are implemented into **a multi-agent simulation platform, to assess their impacts** on :

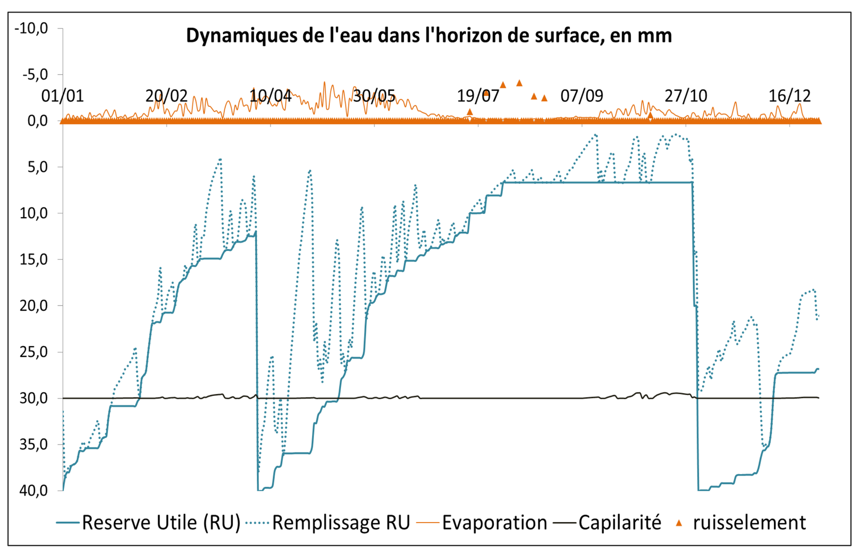


Fig. 5: exemple of outputs from the plant growth and soil water dynamics simulation model (JeudO)

- daily crop growth and soil water dynamics in interaction with **cropping and irrigation practices,**
- **water flows** in rivers, dam storage and groundwater levels,
- **crop yields, farm gross margins and water crisis frequency and intensity** year after year.

The simulation platform simulates decisions of dam releases and regulatory usage restrictions, their consequences on irrigation practices and hydrology and reverse.
To evaluate robustness of alternatives in the face of intra and inter-year climate variability we use observed climatic data over the recent ten years (2002-2012).

4 Collective evaluation of alternatives

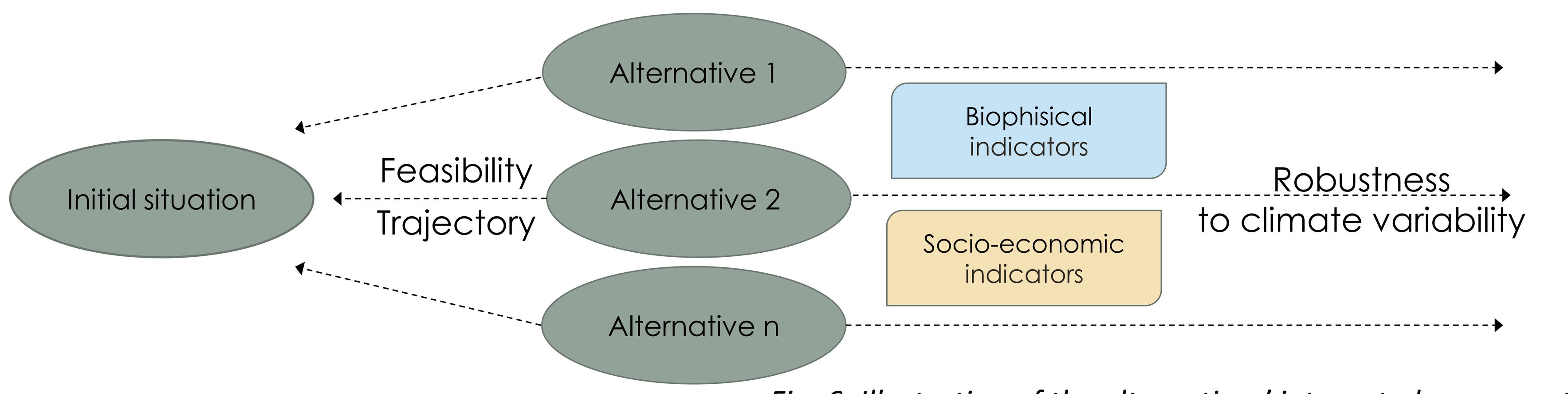


Fig. 6: Illustration of the alternatives' integrated assesment

We present an assessment based on a set of indicators, chosen and developed with stakeholders, and covering different sustainability domains and key organization levels (farm, farmer collective, sub-watershed…). We also ask stakeholders to qualitatively assess the technical feasibility of alternatives. The challenge is then to compare assessed alternatives to move towards decision making.

Centre Toulouse Midi Pyrénées
Chemin de Borde Rouge
CS 52627 • 31326 Castanet-Tolosan cedex
Tél : +33(0) 05 62 28 50 20

*corresponding author: clement.murgue@toulouse.inra.fr

Alimentation Agriculture Environnement