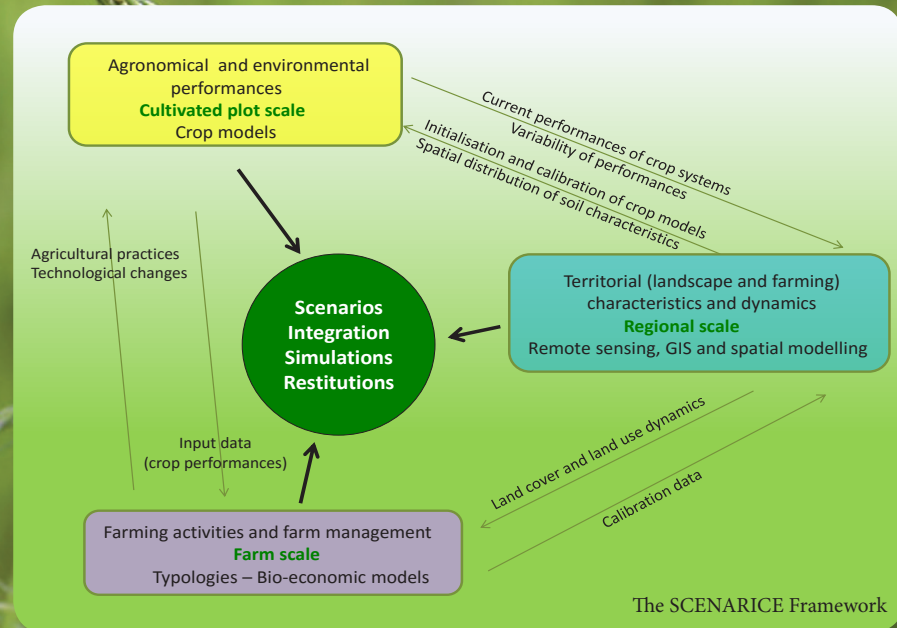
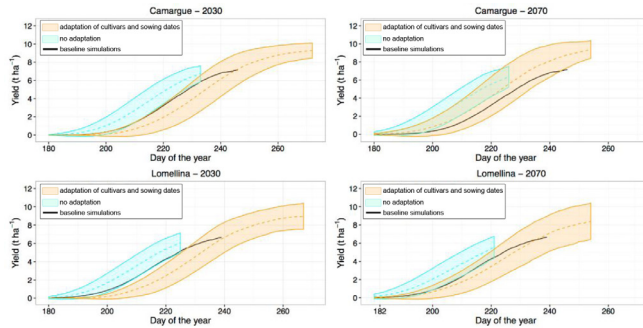


Scenario integrated assessment for sustainable rice production systems

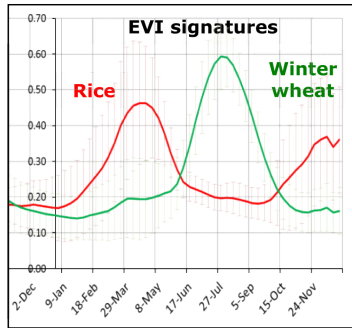
The SCENARICE project (2013 - 2016) had two main objectives: **(1) organize and coordinate**, in a flexible and consistent way, **methods and tools** from different scientific disciplines and research teams from France and Italy, in order to **(2) evaluate scenarios** of possible evolutions for rice-based cropping systems in terms of **sustainability performances**, i.e., socio-economical and environmental.

The SCENARICE framework was developed and tested on **European** (French Camargue and Italian Lomellina) and **southern** (Madagascar, Sierra Leone) **case studies**.





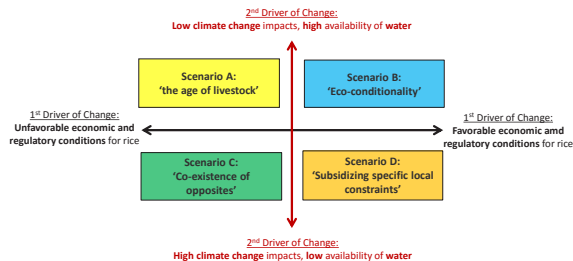
Two **crop models** - STICS and WARM - were applied to characterize the performances of rice, wheat, alfalfa and maize cropping systems at **cultivated plot scale** in Camargue and Lomellina. Remote sensing techniques and the farm typologies provided inputs for the crop models' application in the case study areas. **Climate change and agromanagement** scenarios were simulated to assess future **yield trends and variability**. These data were used as input for bioeconomic modelling.



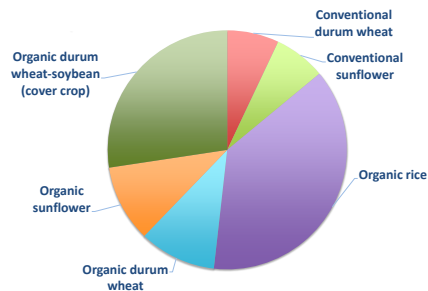
Earth observation data were used to retrieve information about the **diversity and dynamics of change** of rice-based systems. Using 10-years MODIS data, algorithms were developed based on typical crop optical signatures to determine at the **regional scale**: (1) the inter-and intra-annual variability of the **sowing dates** of winter wheat (used for simulation in crop models); and (2) medium-term individual **farm trajectories** regarding land uses (winter/summer crops allocation, to be used for farm typologies).



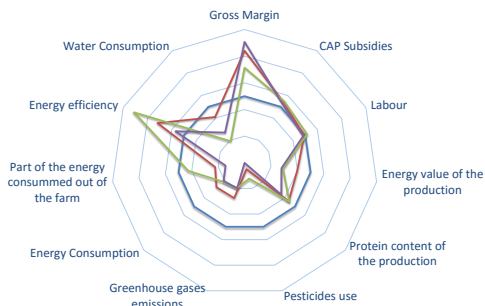
Participatory methods were used to develop **narrative scenarios** related to the future of local agricultures. In each case study, workshops with **local stakeholders** aimed at: (1) identifying and ranking the drivers of change for **future agricultural systems** (at the local and global scales); (2) consistently combining the main drivers into four consistent and creative scenarios; (3) designing the possible **adaptation strategies** of local farmers to these possible changes of context (taking into account farm diversity).



In a parallel and independent way, the stakeholders' consultations let to highlight **similar main drivers of change**, affecting the rice systems in the future. The two main drivers are **climate change** and the **socio-economic conditions** (i.e., the evolution of the CAP and of the national/European regulations). All these information were used for the **parameterization and simulations** with the bio-economic model.



Based on the analysis of the current cropping systems management, future crop performances and scenarios' narrative, we performed an **integrated assessment of future cropping systems with a bio-economic model integrating plot, farm and regional scales**. The possible **land uses** are described in terms of **inputs** (e.g., fertilizer, pesticide, energy and water use, costs of production, labor) and **outputs** (e.g., yield of the crops, greenhouse gas and particulate emissions, energy and protein contents).



In **Camargue, Lomellina and Madagascar** the four scenarios of land use were associated to **different values of indicators** related to the **economic welfare** of agriculture, to **food production** and to the **environmental impacts** of agricultural activities. This highlights **the need of unavoidable trade-offs**, as **no scenario improved all indicators** in these case studies. These results were finally discussed collectively with **local stakeholders**, who envisage their use to **"anticipate future changes of context in order to better adapt"**.

ScENaRice

The **integration** of crop modelling, remote sensing, bio-economic modelling and participatory scenarios is an originality of the SCENARICE approach. Its implementation in multiple case studies facing different contexts (including developing countries e.g., Madagascar), confirms its **flexibility**, while keeping standards as **multi-scale, multi-criteria, participatory and prospective approach of local agriculture**. The **robustness** of this approach proved its usefulness regarding multi-criteria assessment of future agricultural systems. It thus can be considered as an **effective perspective to strengthen the capacity of local stakeholders in anticipating future changes in social, economic, legislative and climatic contexts**.


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