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# Extending the multi-agent modelling platform MAELIA to support land conversion to agroforestry systems

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## Background and objectives

Assessment of environmental, economic and social impacts of agroforestry at local level requires development of adapted modelling tools.

The platform **MAELIA**<sup>[1]</sup> (<http://maelia-platform.inra.fr>) is a **multi-agent platform of socio-agro-ecological systems** simulating at fine spatio-temporal resolution dynamic agricultural activities (rotation and crop management within each production system) and their biophysical and socioeconomic effects over the landscape.

The objectives here are to extend the functionalities of MAELIA to simulate:

- management strategies in agroforestry systems;
- growth of trees and their biophysical interactions with underlying crops and grasses.

## Methods and modelling approaches

**MAELIA** allows simulating:

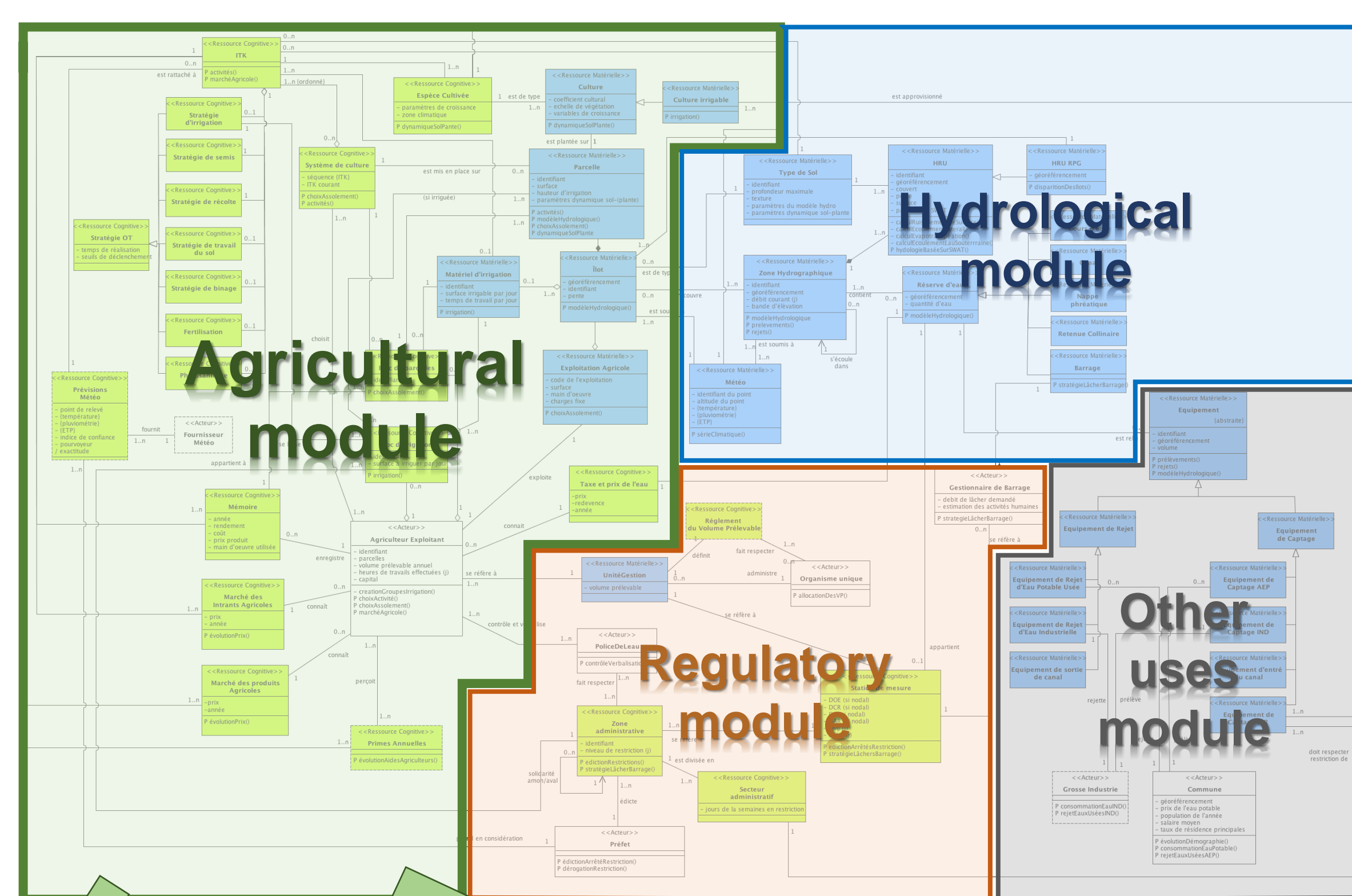
- technical operations
- development and yield
- workload
- gross margins

of arable crops and grasslands and their interactions with the dynamics of:

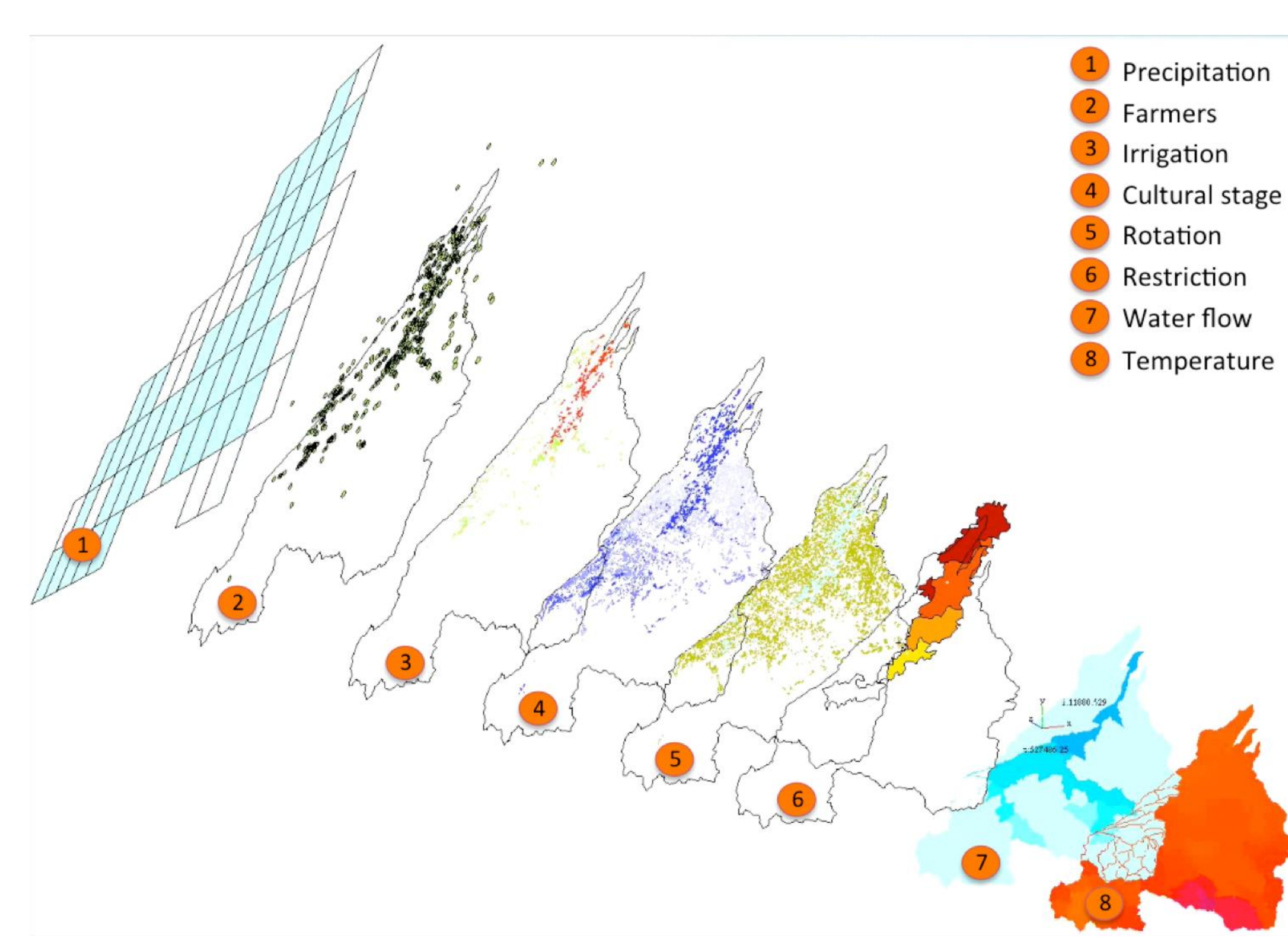
- water
- carbon
- nitrogen

in each field of the landscape, considering farm and resource management constraints.

MAELIA Actor-Resource Diagram



3D visualization of some MAELIA's entities



### Comparing 2 modelling approaches

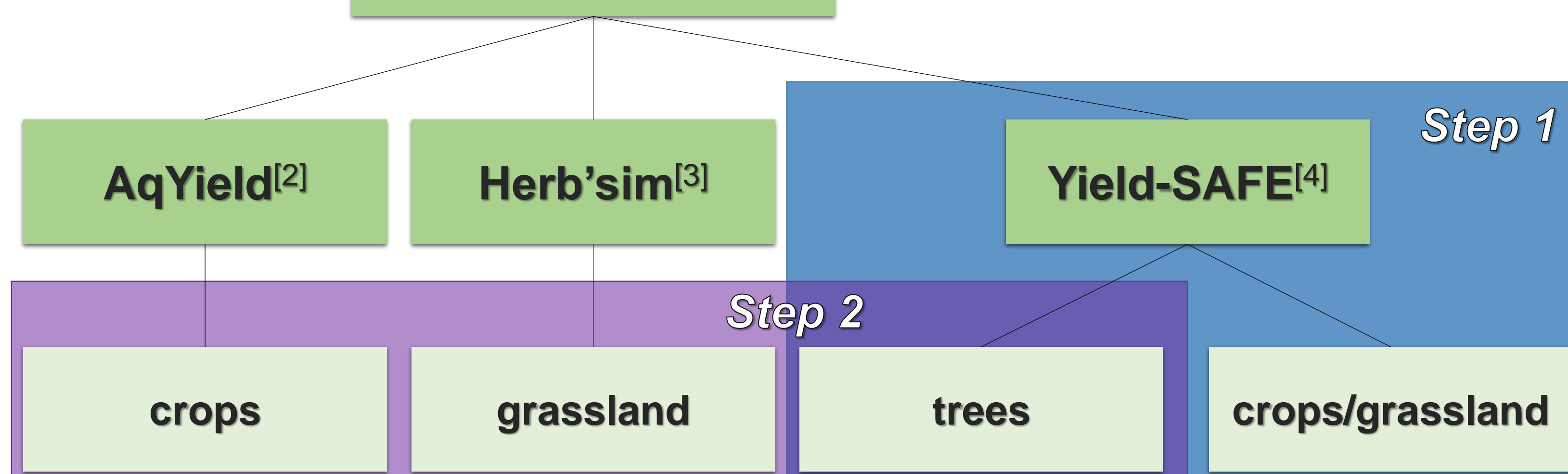
### Collecting data on management strategies

Parameterization

Decision rules for technical operations

Economic module

### Soil-crop model



### Platform calibration and validation

Using:

- Data on biophysical processes from an instrumented experimental site
- Data on a subset of processes from 6 field sites

See poster L20.P.06 by Marron *et al.*

« Evaluation of alley cropping agroforestry potential in northeastern France »



## Expected results and perspectives

- Robust representation and simulation of plant growth and water fluxes in temperate agroforestry systems.
- Assessment of environmental and socio-economic impacts of scenarios introducing alley cropping in a French temperate region.
- Ongoing developments in MAELIA will allow to address agri-environmental issues related to carbon and nutrient cycling in agroforestry systems.

### References:

- [1] Gaudou *et al.* (2013) The MAELIA multi-agent platform for integrated analysis of interactions between agricultural land-use and low-water management strategies. In: *International workshop on multi-agent systems and agent-based simulation*. Springer, Berlin, pp 85-100.
- [2] Constantin *et al.* (2015) The soil-crop models STICS and AqYield predict yield and soil water content for irrigated crops equally well with limited data. *Agricultural and Forest Meteorology*, 206: 55-68.
- [3] Duru *et al.* (2010) Herb'sim: a model for a rational management of grass production and grass utilization. *Fourrages*, 201: 37-46.
- [4] van der Werf *et al.* (2007) Yield-SAFE: A parameter-sparse, process-based dynamic model for predicting resource capture, growth, and production in agroforestry systems. *Ecological Engineering*, 29: 419-433.