# A method to consider **pests and diseases impacts** on long term diversified cropping systems with STICS model

Arnaud Delbaere, Matthieu Carof, Olivier Godinot, Edith Le Cadre

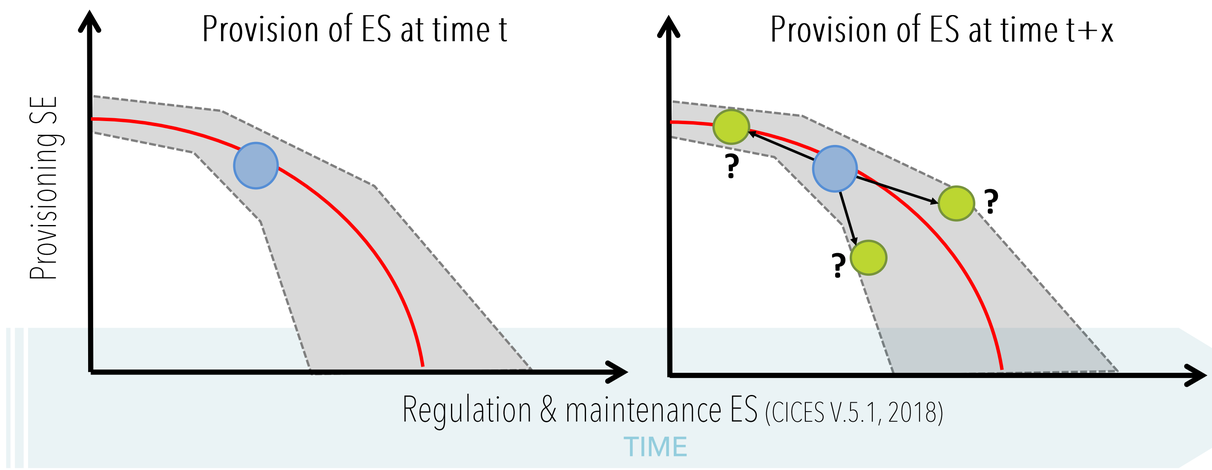
## CONTEXT

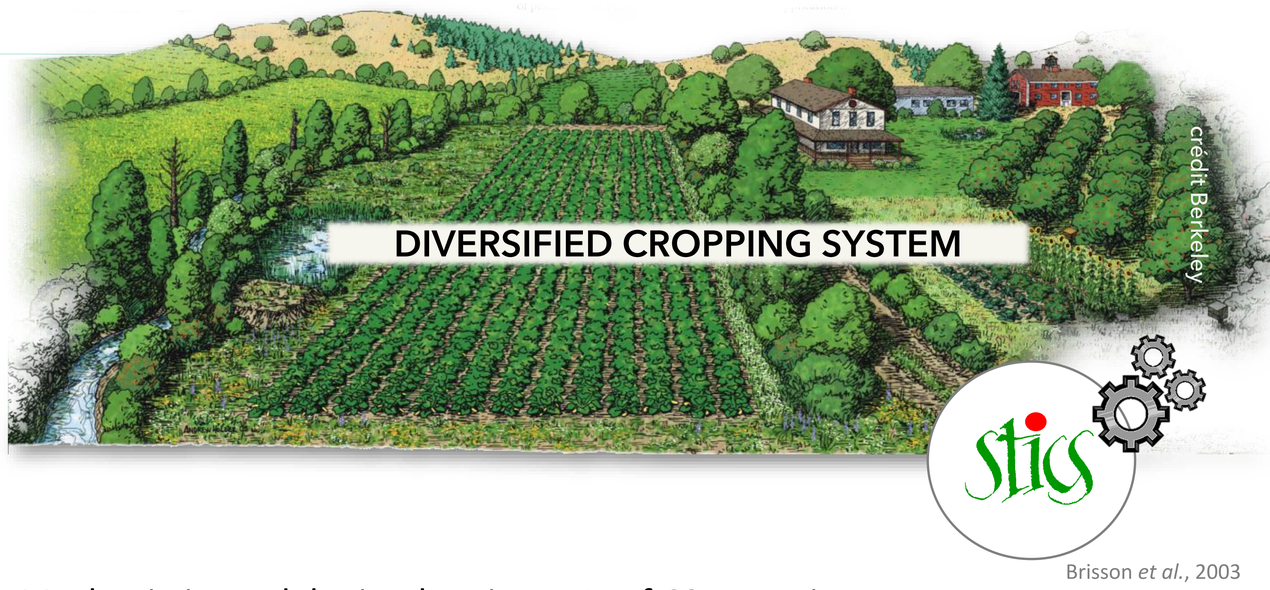
Crop diversification as an increase of crop number in rotation:

- ✓ Has a positive effect on the provision of ecosystem services (ES) (Beillouin *et al.*, 2021; Carof *et al.*, 2022)
- ✓ Increases the resilience of cropping system (CS) in the face of climate change (Duru *et al.*, 2015; Peterson *et al.*, 2018).

**BUT:**

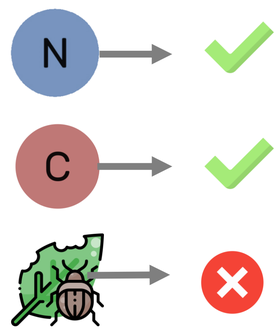
**→ Which evolution of ES provision in time ?**




Brisson *et al.*, 2003

Mechanistic models simulate impacts of CS on various variables over the **long term** (Cadero *et al.*, 2020, Yin *et al.*, 2020)




**BUT:**

**→ Pests and diseases are not always covered by a single mechanistic model like STICS, and remain complex to consider in long term simulation.**

Using STICS, how to consider **pests and diseases impacts** on ecosystem services provided by diversified cropping systems over the long term **?**

## METHOD

### Pests and diseases impacts on cropping systems by changing plant characteristics in STICS model

**PARTICIPATORY APPROACH**

**CO-DESIGNED DIVERSIFIED CS**

**EXPERTS ELICITATION**

- Which pests/diseases for which crops? (damage, frequency…)
- Which plant parameter affected by pests/diseases? How?
- What are the conditions (climatic thresholds) for the presence of the pests/diseases causing damage?

**SIMULATION APPROACH WITH STICS**

**CLIMATIC INPUTS - X YEAR**
DAILY STEP

Test: 1970-2020)
Long Term: 2020-2050

Extreme weather event generator

**SOIL DATA**

Climate file

Soil param file

Initialization file

Technical crop management data

Plant file

Climatic thresholds of favorable conditions for the pests/disease

Climate conditions **>** Threshold *1

Climate conditions >>> Threshold *2

Climate conditions **<** Threshold *3

Adjusting parameters of plant characteristics

Plant file

"New "plant file modulated by pest/disease

**Pool of individual crop simulations under possible pest/disease stress**

*Chaining crops for the Xth Year of rotation*

Simulation of the crop succession

Rotation outputs obtained under pest/disease stress

*1 Climate conditions are favourable to pest/disease presence for the crop to simulate

*2 Climate conditions are highly favourable to pest/disease presence for the crop to simulate

*3 Climate conditions are not favourable to pest/diseases presence for the crop to simulate

**EVALUATION APPROACH**

**Ecosystem services evaluation profile over time**

(Bohanec, 2008)

**MULTICRITERIA EVALUATION**
Assessment of ES based on STICS outputs according to the ecosystem services (CICES) to which those variables contribute

INRAE SAS
Centre Bretagne-Normandie
Rennes – UMR SAS

UMR 1069 SAS, Sol Agro et Hydrosystème Spatialisation, 35042 RENNES
contact : arnaud.delbaere@agrocampus-ouest.fr

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