### General Information

**Thesis title:** Diversification based agrosystems: design and evaluation for promoting basket of ecosystem services

**Acronym:** EVADIVER

**Disciplinary field 1:** Agronomy

**Disciplinary field 2:** Select an element

**Three keywords:** crop system design, agronomy, modelling, ecosystem services

**Research unit:** UMR 1069 Sol Agro hydrosystèmes Spatialisation

**Name of the thesis director:** Le Cadre, Edith

**Email address of the thesis director:** edith.lecadre@agrocampus-ouest.fr

**Name of the thesis co-supervisor 1 (if applicable):** Carof, Matthieu

**Email address of the thesis co-supervisor 1 (if applicable):** matthieu.carof@agrocampus-ouest.fr

**Name of the thesis co-supervisor 2 (if applicable):** Godinot, Olivier

**Email address of the thesis co-supervisor 2 (if applicable):** Olivier.Godinot@agrocampus-ouest.fr

**Thesis grant (funding origin and amount):** ½ CDE AGROCAMPUS OUEST et ½ Région Bretagne

**Contact(s) (mailing address and E-mail):** UMR SAS, Batiment 8, 65 route de Saint Brieuc, 35042 RENNES

**Recruitment process:** Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website [here](https://ed-egaal.u-bretagneloire.fr). This information is needed for proposal publication.

- [x] Doctoral school contest
- [ ] Interview
- [ ] Other (indicate):

---

All sections must be filled. Once filled, please save the proposal form in pdf format using the following naming: Supervisor Name_Unit_Subject Acronym_EN.pdf
### Socio-economic and scientific context: (10 lines)
Ensuring agricultural production adapted to the needs of the populations while preserving the environment requires a profound renewal of agricultural systems. Agriculture based on greater biodiversity makes possible to replace some of the synthetic inputs by mobilizing biological processes (Duru et al., 2015). The diversification of cultures is in this context an essential lever. However, a major obstacle to designing more diversified systems is the identification of local pedoclimatic and technical-economic constraints. In this context, this thesis will produce scientific references, which can be mobilized by stakeholders, to participate in the agroecological transition of crop livestock territories; the methodology will be generic and transposable.

### Assumptions and questions (8 lines)
We make two assumptions:
1) the increase in biodiversity by the diversification of cultures over time (succession of cultures) and in space (intercropping) improves the supply of ecosystem services of production, support and regulation (Renard and Tilman, 2019).
2) over time, for the same scenario of increasing biodiversity through the diversification of crops, the intensity of the ecosystem services provided varies from one pedoclimatic situation to another and according to the farmer’s practices.

### The main steps of the thesis and scientific procedure (10-12 lines)
Stage 1. Proposal of diversification scenarios - During this first stage, lasting 10 months, the analysis of the trade-offs between ecosystem services (will be carried out by the doctoral student on the basis of existing literature and captured in a conceptual graphic model according to the method of Lamanda et al. (2014).
Step 2. Simulation of diversification scenarios and obtaining the first prototypes - A first phase (5 months) will consist in calibrating a crop model (APSIM) and then simulating the impacts of the diversification scenarios on the ecosystem services of interest.
Step 3. Technical and economic analysis of the prototypes (5 months) - With the help of the panel of farmers and agricultural advisers, the most promising scenarios (the “prototypes”) will be selected on the basis of their technical feasibility and their economic interest. We will use multi-criteria assessment tools such as MASC (Sadok et al., 2009) for this.
Step 4. Spatial simulation of the prototypes selected on the scale of the Breton territory and analysis of long-term effects (cumulative effects of low intensity) - The PhD student will test, in silico, the consequences of their adoption on a scale of a territory (5 months).

### Methodological and technical approaches considered (4-6 lines)
Our approach is therefore to use modeling as a generator of futures. We will use the APSIM (Agricultural Production Systems sIMulator) model. The data necessary for the simulations are available within the UMR SAS (pedoclimatic data, technical conduits, daily spatialized meteorological data), and from farmers thanks to the networks of supervisors.

### Scientific and technical skills required by the candidate
Interests for modelling, statistics, GIS, agronomy and soil sciences
# THESIS SUPERVISION

<table>
<thead>
<tr>
<th>Unit name:</th>
<th>Team name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMR 1069 SAS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit director name:</th>
<th>Team director name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christian Walter</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mailing address of the unit director:</th>
<th>Mailing address of the team director:</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="mailto:Christian.Walter@agrocampus-ouest.fr">Christian.Walter@agrocampus-ouest.fr</a></td>
<td></td>
</tr>
<tr>
<td>33 (0)2 23 48 54 27</td>
<td></td>
</tr>
</tbody>
</table>

## Thesis director
Surname, first name: Le Cadre, Edith  
Position: Full time professor  
Obtained date of the HDR (Habilitation thesis to supervise research): 2016  
Employer: AGROCAMPUS OUEST  
Doctoral school affiliation: EGAAL  
Rate of thesis supervision in the present project (%): 40  
Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 50  
Number of current thesis supervisions/co-supervisions: 1

## Thesis co-supervisor 1 (if applicable)
Surname, first name: Carof, Matthieu  
Position: assistant professor  
Habilitation thesis to supervise research  ☒ yes  ☐ no  If yes, date diploma received:  
Employer: AGROCAMPUS OUEST  
Doctoral school affiliation:  
Rate of thesis supervision in the present project (%): 30  
Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0  
Number of current thesis supervisions/co-supervisions: 0

---

1 In EGAAL Doctoral School, if only one scientist in thesis supervision = 100% of supervision rate; if 2 people involved in thesis supervision = from 50% to 70% of supervision rate for the director; if 3 people involved in thesis supervision = 40% / 30% / 30% of supervision rate distribution among supervisors.
### Thesis co-supervisor 2 (if applicable)

Surname, first name: Godinot, Olivier  
Position: assistant professor  
Habilitation thesis to supervise research: ☒ yes ☐ no  
If yes, date diploma received:  
Employer: AGROCAMPUSS OUEST  
Doctoral school affiliation: EGAAL  
Rate of thesis supervision in the present project (%): 30  
Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0  
Number of current thesis supervisions/co-supervisions: 0

### Private partner (if CIFRE funding, private funding, ...)

Surname, first name:  
Position:  
Employer:  
Rate of thesis supervision in the present project (%):  
Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):  
Number of current thesis supervisions/co-supervisions: 

### International partner (if Cotutelle thesis)

Surname, first name:  
Position:  
Employer:  
Rate of thesis supervision in the present project (%):  
Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):  
Number of current thesis supervisions/co-supervisions: 

### Professional status of previous PhD students supervised by both director and co-supervisors (from 5 years)

**Please provide the following information for each PhD students supervised**

Surname, first name: De Oliveira, Ana Beatriz  
Date of PhD beginning and PhD defence: 01/12/2016 – 05/12/2019  
Thesis supervision: Le Cadre E., Hinsinger P  
Professional status and location: unknown  
Contract profile (post-doc, fixed-term, permanent):  
List of publications from the thesis work:
Surname, first name: Jouan, Julia

Date of PhD beginning and PhD defence: 01/02/2017 – 28/02/2020

Thesis supervision: Ridier, Aude (co encadrant Carof, Matthieu)

Professional status and location: ingénieur de recherche, France

Contract profile (post-doc, fixed-term, permanent): post doc

List of publications from the thesis work:


Jouan, J.; Ridier, A.; Carof, M. SYNERGY: a regional bio-economic model analyzing farm-to-farm exchanges and legume production to enhance agricultural sustainability. Ecological Economics,

Five main recent publications of the supervisors on thesis subject:


THESIS FUNDING

Origin(s) of the thesis funding: ½ AGROCAMPUS OUEST + ½ Région Bretagne

Gross monthly salary: 1540 euros

Thesis funding state : Partly acquired (co-funding)

Funding beginning date/Funding ending date: Oct 2020

Date: avril 2020
Name, signature of unit director: Christian Walter, direction UMR SAS

Name, signature of team director:

Name, signature of thesis project director: Le Cadre Edith