**Ph.D. PROPOSAL FOR THE DOCTORAL SCHOOL**

**“Ecologie, Géosciences, Agronomie, Alimentation”**

# **GENERAL INFORMATION**

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| **Thesis title:** Role of livestock in closing biogeochemical cycles and in the interaction between organic and conventional agriculture in the territories |
| **Acronym:** elevAB |
| **Disciplinary field 1:** Agronomy  **Disciplinary field 2:** Ecology |
| **Three keywords**: circularity; organic agriculture ; territorial metabolism |
| **Research unit:** INRAE UMR SAS |
| **Name of the thesis director:** AUBIN, Joël  **E-mail address:** [joel.aubin@inrae.fr](mailto:joel.aubin@inrae.fr)  **Name of thesis co-supervisor 1:** HARCHAOUI, Souhil  **E-mail address:** [souhil.harchaoui@inrae.fr](mailto:souhil.harchaoui@inrae.fr)  **Name of thesis co-supervisor 2:** WILFART, Aurélie  **E-mail address:** [aurelie.wilfart@inrae.fr](mailto:aurelie.wilfart@inrae.fr) |
| **Thesis grant (funding source and amount):** 50% INRAE (PHASE division), 50% (Brittany Regional Council) |
| **Contact(s) (mailing address and e-mail):** UMR SAS, 65 rue de Saint Brieuc, CS 84215, 35042 Rennes cedex, [joel.aubin@inrae.fr](mailto:joel.aubin@inrae.fr) ; [souhil.harchaoui@inrae.fr](mailto:souhil.harchaoui@inrae.fr) ; [aurelie.wilfart@inrae.fr](mailto:aurelie.wilfart@inrae.fr) |
| **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/fr/5_recruter-des-doctorants-dans-led-egaal). This information is needed for proposal publication.  **Doctoral school contest  Interview  Other (indicate)**  **Application deadline: 12 sept 2022** |

# **SCIENTIFIC DESCRIPTION OF THE Ph.D. PROJECT**

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| **Socio-economic and scientific context (10 lines)**  Agricultural intensification associated with the decoupling of crop and livestock production has led to the disruption of biogeochemical cycles and generated significant negative impacts on the environment. In this context, the thesis project is situated at the intersection of three research themes: the closing of biogeochemical cycles in livestock and territories (Van Zanten et al., 2019), the relationship between conventional and organic agriculture (OA) (Nowak et al., 2013), and the circular economy in territories (Dourmad et al., 2019). While the circularity paradigm has recently been highly developed from a theoretical point of view (Muscat et al., 2021), there are still very few studies that show the limits and implications of improving degrees of circularity for a territory. We seek to position the role of livestock by distinguishing between ruminants and monogastrics in the closing of biogeochemical flows of carbon, nitrogen and phosphorus (Peyraud et al., 2019) by modeling the exchange of flows between OA systems on the one hand and between conventional and OA systems on the other. |
| **Assumptions and questions (8 lines)**  Two hypotheses are formulated: H1. Local biophysical characteristics define the livestock’s potential central role in closing nutrient cycles within the territory and H2. there are optimums on the one hand of allocation of biomass between human food, feed, energy production and on the other hand of manure management practices which support circularity. Our research raises three scientific questions: i. how to evaluate the degree of circularity of nutrient flows in a territory? ii. what influence does the development of OA have on the role of livestock, distinguishing between ruminants and monogastrics? iii. what are the drivers of livestock systems that contribute to the circularity of nutrients and energy within a territory? |
| **Main steps of the thesis and scientific procedure (10-12 lines)**  The first step will consist in clarifying the dependency links between OA systems and between OA and conventional agriculture on a territory. This step is based on a literature review and survey data from the circulAB project co-led by INRAE and the network of organic farmers in Brittany (GAB-FRAB). This project is co-financed by the Brittany Region in the call for Research and Society projects. These surveys will be built on emblematic cases of farms that have nutrient flow exchanges already integrated into territorial circularity schemes. After this step, a first framework is built to model livestock systems (ruminants and monogastrics), farming systems in OA and conventional agriculture. The second step is to build a tool for modeling territorial metabolism and indicators of circularity of nutrient and energy flows. The aim is to identify the variables associated with livestock systems in the metabolism and impacting the nutrient and energy cycles. At the end of this second step, a model of territorial metabolism integrating OA and conventional farming systems is expected. Finally, the last step implements the calibration of the model on one or two small agricultural regions in Brittany. |
| **Methodological and technical approaches considered (4-6 lines)**  The research project mobilizes the concept of territorial metabolism applied to agricultural territories (Harchaoui and Chatzimpiros, 2018). Territorial metabolism refers to all material, nutrient and energy flows mobilized and transformed in the territory. By combining the approaches of material flow analysis and material balances, we reconstruct the flows and transformations of biomass production from agricultural statistics. The model should also integrate the different production systems in the territory by distinguishing between the different levels of organization in OA and conventional agriculture (Billen et al., 2021). |
| **Scientific and technical skills required by the candidate**   * A Master’s or engineering degree in agronomy and/or zootechny, livestock production, industrial ecology, ecology, modelling or equivalent * Applicants will need to have a strong interest in modelling and an aptitude for mathematics and statistics. Knowledge of programming tools such as R or Python will be appreciated. Awareness of issues related to ecology and sustainable development of agricultural systems will be welcome. * The ability to communicate in French and English (oral and written) and to work in an interdisciplinary and international research teach is essential. * Managing a thesis project requires strong motivation for the subject, good self-sufficiency, an interest in scientific research and the ability to commit to a subject over the long term. |

# **THESIS SUPERVISION[[1]](#footnote-1)**

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| **Unit name:**  Sol Agro et hydrosystème Spatialisation (SAS) | **Team name:**  The unit is not organised into teams. |
| **Unit director name:**  Christian WALTER | **Team director name:** |
| **Mailing address of the unit director:**  [christian.walter@agrocampus-ouest.fr](mailto:christian.walter@agrocampus-ouest.fr) | **Mailing address of the team director:** |
| **Thesis director**  Surname, first name: AUBIN, Joël  Position: research engineer  Date when HDR (authorisation to supervise thesis research) obtained: 24 March 2015  Employer: INRAE UMR SAS  Doctoral school affiliation: EGAAL  Percentage of thesis supervision in the present project (%): 30%  Total percentage of thesis supervision and co-supervision in ongoing theses (%): 0%  Number of current thesis supervisions/co-supervisions: 0 | |
| **Thesis co-supervisor 1**  Surname, first name: Harchaoui, Souhil  Position: research fellow  HDR (authorisation to supervise thesis research) obtained?  yes  no  Employer: INRAE UMR SAS  Doctoral school affiliation: EGAAL  Percentage of thesis supervision in the present project (%): 40%  Total percentage of thesis supervision and co-supervision in ongoing theses (%): 0%  Number of current thesis supervisions/co-supervisions: 0 | |
| **Thesis co-supervisor 2**  Surname, first name: WILFART, Aurélie  Position: research engineer  HDR (authorisation to supervise thesis research) obtained?  yes  no  Employer: INRAE UMR SAS  Doctoral school affiliation: EGAAL  Percentage of thesis supervision in the present project (%): 30%  Total percentage of thesis supervision and co-supervision in ongoing theses (%): 0%  Number of current thesis supervisions/co-supervisions: 0 | |
| **Professional status of previous Ph.D. students supervised by both director and co-supervisors (last 5 years)**  Surname, first name: WILLOT, Pierre-Alexandre  Date of Ph.D. beginning and Ph.D. defence: November 2016 to December 2019  Thesis supervision: Joël Aubin and Aurélie Wilfart  Professional status and location: self-employed – plan to work in agriculture  List of publications from the thesis work:  Willot, P.-A., Aubin, J., Salles, J.-M., Wilfart, A., 2019. Ecosystem service framework and typology for an ecosystem approach to aquaculture. Aquaculture 512, 734260, <https://doi.org/10.1016/j.aquaculture.2019.734260>. | |
| **Five main recent publications of the supervisors on the thesis subject:**  **Harchaoui, S.,** Chatzimpiros, P., 2018. Energy, Nitrogen, and Farm Surplus Transitions in Agriculture from Historical Data Modeling. France, 1882-2013.: Energy, Nitrogen, and Farm Surplus Transitions. J. Ind. Ecol. https://doi.org/10.1111/jiec.12760  Peyraud, J.-L., **Aubin, J.,** Barbier, M., Baumont, R., Berri, C., Bidanel, J.-P., Citti, C., Cotinot, C., Ducrot, C., Dupraz, P., Faverdin, P., Friggens, N., Houot, S., Nozières-Petit, M.-O., Rogel-Gaillard, C., Santé-Lhoutellier, V., 2019. Quelle science pour les élevages de demain ? Une réflexion prospective conduite à l’INRA. INRAE Prod. Anim. 32, 323–338. https://doi.org/10.20870/productions-animales.2019.32.2.2591  Peyraud, J.L., **Aubin, J.,** Barbier, M., Baumont, R., Berri, C., Bidanel, J.P., Citti, Ch., Cotinot, C., Ducrot, C., Dupraz, P., Faverdin, P., Friggens, N., Houot, S., Nozières-Petit, M.O., Rogel-Gaillard, C., Santé-Lhoutellier, V., 2020. Réflexion prospective interdisciplinaire Science pour les élevages de demain. Rapport de synthèse. 53 pp. https://doi.org/10.15454/X83C-0674  Borghino, N., Corson, M., Nitschelm, L., **Wilfart, A.,** Fleuet, J., Moraine, M., Breland, T.A., Lescoat, P., Godinot, O., 2021. Contribution of LCA to decision making: A scenario analysis in territorial agricultural production systems. J. Environ. Manage. 287, 112288. https://doi.org/10.1016/j.jenvman.2021.112288 | |

# **THESIS FUNDING**

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| **Sources(s) of the thesis funding:** INRAE (50%) and Brittany Regional Council (50%) |
| **Gross monthly salary:** 1975 € |
| **Status of thesis funding: Acquired** |
| **Funding beginning date/Funding ending date:** 2022-2025 |

**Date:** 16 May 2022

**Name, signature of unit director:** WALTER, Christian



**Name, signature of thesis project director:** AUBIN, Joël



1. [↑](#footnote-ref-1)