

## PhD proposition in global agronomy

*A PhD project is proposed at INRA Bordeaux about the ability of organic farming to lower agricultural greenhouse gas emissions at the global scale.*

PhD title: **Systemic evaluation of the potential of organic farming to mitigate agricultural greenhouse gas emissions at the global scale**

### Context

Achieving drastic mitigation of greenhouse gas (GHG) emissions by agriculture is necessary to respect the Paris agreement on Climate Change. Organic farming (OF) is a promising way of farming in order to strongly attenuate agricultural GHG emissions. In particular, its ban of chemical nitrogen fertilizers as well as its promotion of cultural practices that sequester carbon in soils (e.g., large organic carbon input to soils, great frequency of temporary grasslands in crop rotations) are in favour of low GHG emissions. Several studies have reported low GHG budgets of organic cropping and farming systems at the field scale, in both experimental and farming conditions.

However, these good GHG performances have been reported in a context of very little expansion of organic farming on, e.g., only 6 and 1% of the agricultural area in Europe and at the global scale, respectively. In contrast, because of systemic feedbacks that may appear when upscaling organic farming, strong uncertainties remain about the actual GHG performances that this way of farming would achieve if it were to develop dramatically. These systemic feedbacks are –in a context of large organic farming expansion- due to (i) increased competition between organic farms for organic materials to fertilize agricultural soils, (ii) direct land-use change resulting from differences in crop rotations between organic and conventional farming systems, and (iii) indirect land-use change resulting from lower crop productivity in organic farming and, consequently, the need for greater cropland expansion. A major consequence of these feedbacks is that the good GHG budgets exhibited by current organic farming systems at the local (e.g., field) scale may not be conserved if this way of farming greatly expands at the global scale. Estimating GHG emissions that organic farming would achieve in a context of large expansion of this way of farming is therefore of great importance for both organic farming and climate policies.

### Objectives

This PhD proposal aims at filling the gap of knowledge highlighted above by using a modelling approach about GHG emissions of organic farming at the global scale. Particular attention will be paid to systemic feedbacks that may occur when shifting from field-scale to global scale results, when considering direct and indirect land-use changes related to organic farming expansion and when accounting for interactions between crop and livestock productions.

The PhD project will develop a mathematical model simulating direct, indirect and induced agricultural GHG emissions and accounting for organic farming particularities. The PhD student will then design a series of scenarios regarding large OF expansion at the global scale (e.g., up to 20, 50 or 100% of global agricultural area). Finally, the mathematical model will be used to assess those scenarios in terms of GHG emissions. The PhD project will benefit from the model developed by Pietro Barbieri about

nitrogen cycling in organic systems (including crop-livestock interaction) at the global scale. No experimental fieldwork is expected but contacts with organic farming stakeholders will be encouraged. This project will contribute to the development of global agronomy as an emergent scientific field.

### **Expected profile**

- Master student with sound bases in agricultural sciences or in ecology with clear interest in agricultural issues. Experience in mathematical modelling or scenario assessment is an asset.
- Interest for large scale studies (country, planet)
- Excellent writing skills, fluent in English. If possible, some French notions.
- On top of that, you are rigorous, autonomous, creative and motivated by working in a research environment.

### **Supervision and working conditions**

The PhD student will be co-supervised by Thomas NESME (professor at Univ. Bordeaux) and Sylvain PELLERIN (senior scientist at INRA). He/she will be engaged in a small group (3 permanent scientists) working on nutrient cycling modelling at large spatial scale (from the district to the planet). He/she will benefit from the experience of that group (e.g., in biogeochemical modelling or about organic farming) as well as cooperations with other groups in France (mostly INRA Paris and Rennes) or abroad (mostly UBC, Vancouver, Canada; Karlsruhe Institute of Technology, Germany; and Organic Research Centre, UK).

The PhD student will be part of ISPA department (joint unit between INRA and Univ. Bordeaux on Soil, Plant and Atmosphere Interactions, <https://www6.bordeaux-aquitaine.inra.fr/ispa>), located at INRA campus, just a few minutes from Bordeaux downtown. He/she will graduate from Univ. Bordeaux.

The PhD student will be offered a three years contract with INRA. The gross salary will be 1890€ per month (including social security for illness, maternity and unemployment, as well as financial help for public transportation and canteen). The PhD is expected to start by the autumn 2018.

The funding is secured for half (from INRA meta-program “Organic farming and food”). The second half of funding is to be requested to ADEME, the French funding institute about environmental protection and energy saving.

### **How to apply?**

Any Master student interested in this project is required to send his/her CV and a motivation letter to Thomas NESME ([thomas.nesme@agro-bordeaux.fr](mailto:thomas.nesme@agro-bordeaux.fr)) **before March 12<sup>th</sup> 2018**. The letter should illustrate how the candidate considers his/her skills and experiences match our expectations.