

## PhD proposition in global agronomy

*A PhD project is proposed at Bordeaux Sciences Agro (Univ. Bordeaux) and INRAE on the following topic:*

### **Could organic farming expansion be limited by the availability of soil phosphorus? A systemic analysis at the global scale.**

#### **Context**

Organic farming is often presented as a way to both feed the planet with safe and healthy products and to attenuate the negative environmental impacts of agriculture. This results in a very strong expansion of this way of farming in France, Europe and the World. The organic guidelines are based on the strict ban of chemical, inorganic fertilisers for fertilising cropland soils. For nitrogen, this ban is compensated by the higher frequency of nitrogen-fixing legume species in organic crop rotations.

For phosphorus (P), the situation is a bit more complicated. This is because the fertilising resources that may contain some P – and that are allowed by organic guidelines, such as animal manure – are in fact fairly limited. Organic farming expansion may therefore result in a stronger competition among organic farms to get those fertilising resources. This is even more true if organic farms continue to specialise: in 2018, around 50% of organic farms in France did not have any livestock animals. In addition, negative feedbacks may appear in organic systems if soil P availability decreases. A decrease in soil P may lead to limited crop and pasture growth, resulting in lower availability of feed products for livestock animals, and possibly to lower production of animal manure to fertilise cropland soils. Finally, although organic farms are sometimes allowed to import manure from conventional farms, organic regulations may become stricter in the near future. This would result in lower material availability for supplying P to organically managed cropland soils.

Organic farming expansion is therefore facing serious P issues. Those issues may or may not affect crop growth depending on soil P legacy that results from chemical fertilisation prior to the conversion to organics. Those issues have triggered new interests for urban waste and sewage sludge recycling as alternative fertilising materials for organically managed soils (although this is not allowed by organic guidelines currently).

#### **Objectives**

This PhD proposal aims at exploring the consequences that organic farming expansion could have on the global P cycle and on crop production. The core hypothesis is that soil P availability could affect crop production in scenarios of large organic farming expansion at the global scale, in particular in the regions that do not benefit from strong soil P legacy.

The PhD will be based on the combination of several spatially explicit models developed in our research group. Those models will include (i) different scenarios related to organic farming expansion (eg, from 0 to 100% of the agricultural usable area, with or without conventional manure and urban waste to fertilise cropland soils), (ii) the GOANIM model (Barbieri 2018) that simulates material flows within organic systems (with specific focus on crop-livestock interactions), (iii) a biogeochemical model (Ringeval et al. 2017) that estimates soil P availability in response to cropping practices and soil background and (iv) a simple relationship between soil P availability and crop yields. The PhD will focus on the major arable crop species and grasslands. It will consider two specific spatial scales: the national scale of France (a country with large soil P stocks resulting from chemical fertilisation prior to conversion to organics) and the global scale (with much more various soil P conditions).

### 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 and within a research group.

### Supervision and working conditions

The PhD student will be co-supervised by Prof Thomas Nesme (Univ. Bordeaux) and Dr Sylvain Pellerin (INRAE). The PhD student will be engaged in a small group (three permanent scientists, one postdoc, three PhD students) working on nutrient cycling and modelling at large spatial scale (district, country, planet). The PhD student will benefit from the experience of the group (e.g., in biogeochemical modelling or about organic farming) as well as collaborations with other groups in France or abroad. A short stay of 3-4 months in a research group abroad will be organised.

The PhD student will be part of ISPA department (joint unit between INRAE and Univ. Bordeaux on Interactions between Soil, Plant and Atmosphere, <https://www6.bordeaux-aquitaine.inrae.fr/ispa>), located at INRAE campus, just 15 minutes cycling from Bordeaux downtown. The PhD student will graduate from Bordeaux Univ.

The PhD student will be offered a three years contract with INRAE, whose funding is entirely secured. The gross salary will be 1770€ per month (including social security for illness, maternity and unemployment, as well as financial help for public transportation and lunches). The PhD is expected to start by the autumn 2020.

### How to apply?

Any student interested in this proposal is invited to send his/her CV and a motivation letter to Thomas Nesme ([thomas.nesme@agro-bordeaux.fr](mailto:thomas.nesme@agro-bordeaux.fr)) and Sylvain Pellerin ([sylvain.pellerin@inrae.fr](mailto:sylvain.pellerin@inrae.fr)) **before June 15<sup>th</sup>, 2020**. The letter will illustrate how the candidate considers his/her skills and experiences match our expectations. In parallel, the candidate is requested to register to the competitive examination organised by the [Doctoral School](#) of Bordeaux Univ. *before June 15<sup>th</sup>, 2020*.

The applications will be pre-selected by Prof Nesme and Dr Pellerin. The pre-selected candidates will be invited to an oral discussion (through videoconference) on **June 17<sup>th</sup> or 18<sup>th</sup>, 2020**. The final selection will be done by the Doctoral School through its competitive examination to be held on July 15<sup>th</sup>-17<sup>th</sup>, 2020.