Master of Science Internship – 6 months

Towards a better inclusion of biodiversity in global food systems models

Context and scientific questions

Because of the influence of international trade on human diets worldwide, agricultural strategies that meet human food demand have to be considered at the global scale (D'Odorico et al., 2014). The local implementation of alternative management practices or cropping systems can lead to certain levels of crop productivity but some feedback loops can exacerbate or dilute this effect at the global scale. For example, organic farming produces 20% to 30% less than conventional farming on average at the field scale (Seufert et al., 2012; Ponisio et al., 2015). However, organic farms also rely on synthetic nitrogen fertilizers embedded in animal manure sourced from conventional farms. Therefore, nitrogen availability might limit agricultural production under large scale organic farming expansion due to the cessation of inputs sourced from conventional farms. Likewise, estimates from Barbieri et al. (2021) suggest that producing food only through organic farming globally can reduced crop productivity by 57%. Such global food system models have been widely used for analysing the influence of nutrient flows on global food security (Barbieri et al., 2021; Billen et al., 2018). However, nutrient flows are not the only factor limiting crop productivity. Biodiversity is an important factor that may provide ecosystem services supporting crop production (e.g. pollination) as well as disservices (e.g. pests and diseases damages to crops) (Dainese et al., 2019; Savary et al., 2018). On the one hand, a growing body of literature shows that biodiversity contributes substantially to crop productivity (Muneret et al., in prep.), while on the other hand, biodiversity may be impacted by agriculture through land use change (e.g. deforestation) or agricultural practices (e.g. pesticides), forming a feedback loop. Such relationships between biodiversity and agriculture have been overlooked in global food system models (Ortiz et al. 2021). Therefore, how to best include biodiversity in global food system models is a key question – especially to assess scenarios of agroecological farming systems expansion on biodiversity and agricultural production at the global scale.

Objectives

The first objective of this internship is to perform a systematic literature review of available global food system models with (i) a description of model structure (system boundaries, sub-systems and equations), (ii) model data requirement, (iii) a description of how biodiversity is accounted for when included. An expected outcome of this work is to identify/propose possible ways of including biodiversity in global food system models in such a way that feedback loops between biodiversity and agricultural production are captured. Among currently available global food system models, the most suitable ones for including biodiversity will be identified.

What we offer

The intern will benefit from an inspiring working environment. The agronomy lab is composed by about 40 public sector workers located within the AgroParisTech center. International interactions with the Adrian Mueller's team are planned (located in Frick, Switzerland) as well as with Pietro Barbieri (located in Bordeaux).

Starting: Between January and March 2024 at the laboratory Agronomie (INRAE-AgroParisTech-University Paris Saclay, 22 place de l'Agronomie, Palaiseau) for six months.

Gratuity: about 600€/month + 50% of the PassNavigo (about 43€/month)

Expected qualifications, knowledge and skills

Student with 5 years of higher education with a Master's degree in one or some of the following fields: agronomy, ecology, agroecology, food systems. Applicants should be interested in large-scale studies of the global food system. Good communication skills as well as a strong interest in reading and writing of scientific publications in English are key qualifications. The student is expected to have basic skills in R software and statistical analysis or modelling.

How to apply?

Supervisors: Dr. Lucile Muneret *https://www.researchgate.net/profile/Lucile_Muneret* and Dr. Nicolas Guilpart *https://www.researchgate.net/profile/Nicolas-Guilpart-2*

Please send a CV and a cover letter at lucile.muneret@inrae.fr and nicolas.guilpart@agroparistech.fr before the 31st of October.

Scientific references

Barbieri, P., Pellerin, S., Seufert, V., Smith, L., Ramankutty, N. & Nesme, T. (2021). Global option space for organic agriculture is delimited by nitrogen availability. *Nature Food*, 2, 363–372.

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Muneret, L., Carbonne, B., Laurent, E., Felten, E., Matéjicek, A., Ducourteux, C., Henon, N., Chauvel, B., Petit, S. Weed seed predators increase by 25% wheat productivity. *In prep.*

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