



**HAL**  
open science

# Nitrogen cycle regulation and associated ecosystem services in agroforestry systems. A methodology linking field, lab and modeling experimentations in the context of climate change in Brittany (France)

Romane Mettauer, Olivier Godinot, Mathieu Emily, Edith Le Cadre-Barthélemy

## ► To cite this version:

Romane Mettauer, Olivier Godinot, Mathieu Emily, Edith Le Cadre-Barthélemy. Nitrogen cycle regulation and associated ecosystem services in agroforestry systems. A methodology linking field, lab and modeling experimentations in the context of climate change in Brittany (France). International Congress of the European Society for Agronomy (ESA) 2022 "Diversification & Digitalization – Trends that shape future agriculture", Aug 2022, Postdam, Germany. hal-04548971

**HAL Id: hal-04548971**

**<https://hal.science/hal-04548971>**

Submitted on 16 Apr 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Nitrogen cycle regulation and associated ecosystem services in agroforestry systems. A methodology linking field, lab and modeling experimentations in the context of climate change in Brittany (France)

Mettauer Romane<sup>1</sup>, Godinot Olivier<sup>1</sup>, Emily Mathieu<sup>2</sup>, Le Cadre Edith<sup>1</sup>

<sup>1</sup>SAS, Institut Agro, INRAE, 35042 Rennes, France 65 rue Saint-Brieuc

<sup>2</sup>Institut Agro, Univ Rennes, CNRS, IRMAR, 35000, Rennes, France

## Introduction:

- Nitrogen losses are of great concern as they threaten ecosystems. They are expected to increase with the intensification of extreme climate events.<sup>1</sup>
- Agroforestry - whereby trees are integrated on a plot with crops and/or livestock- is considered as a lever to address this threat.<sup>2,3</sup>
- This PhD aims to explore the potential benefits of trees to improve nitrogen cycle regulation and associated ecosystem services, by taking a focus on the impact of two agroforestry designs on a key process driving the production of reactive nitrogen, the nitrification.

Review of the literature and discussions between ecologists and statisticians to design a causal conceptual model to study the impact of trees and agricultural practices on the nitrification through structural equation modeling.

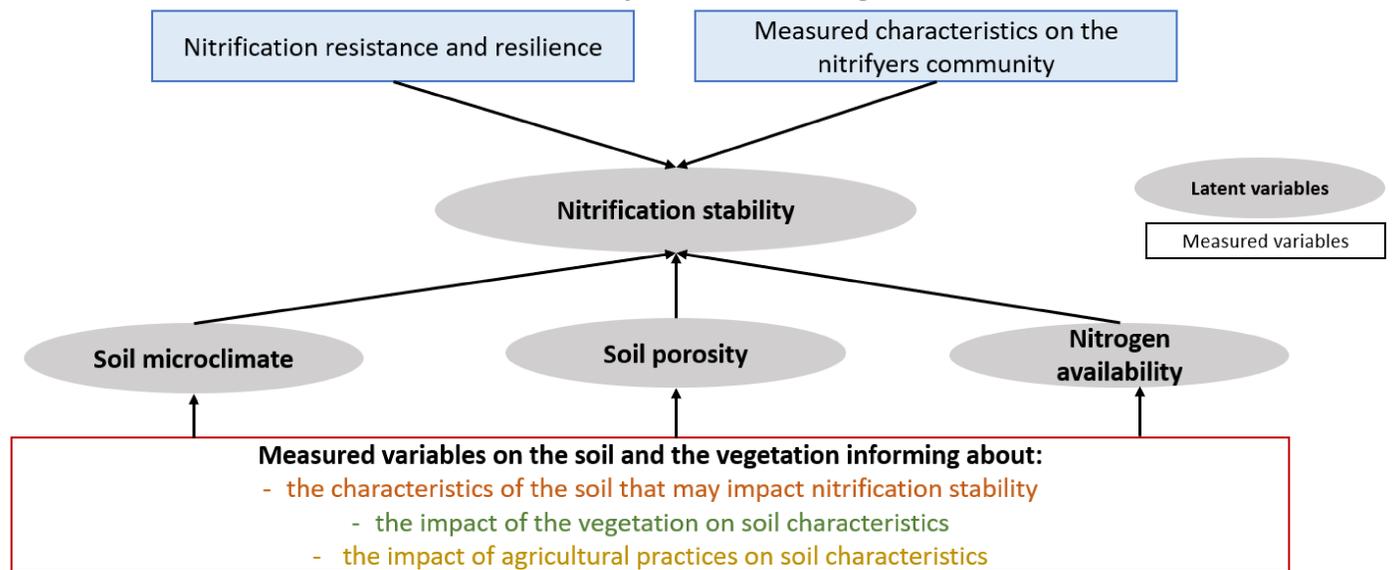


Figure 1: Design of the causal conceptual model which aims to link presence of trees and agricultural practices and nitrification functioning under extreme precipitation events.

inform ↑

↑ inform

Field-work to collect data on soil and vegetation characteristics according to two agroforestry designs (alley-cropping agroforestry and hedgerows) and for three distances from the trees

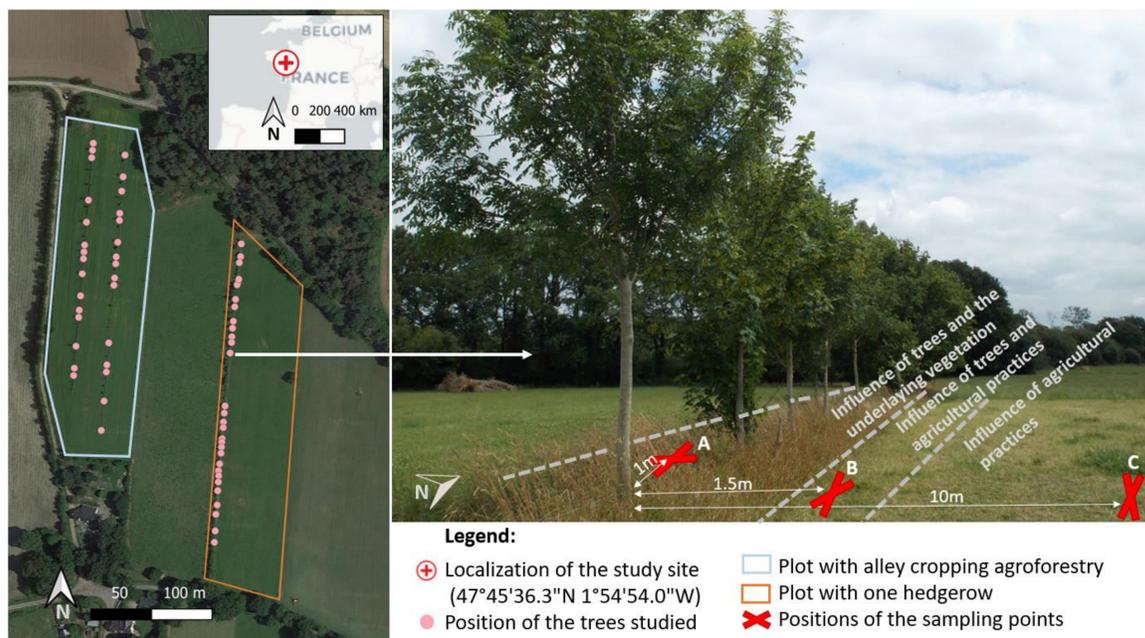
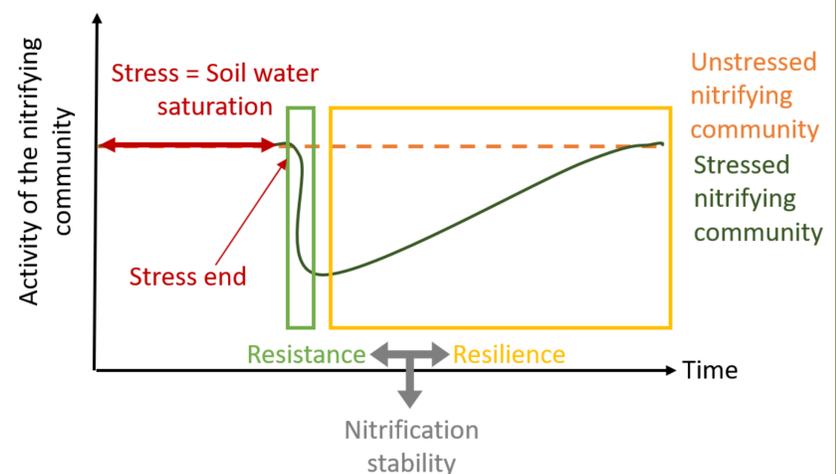


Figure 2: Experimental design for in-field measurement according to two factor: (i) the agroforestry design and (ii) the distance to the tree row.

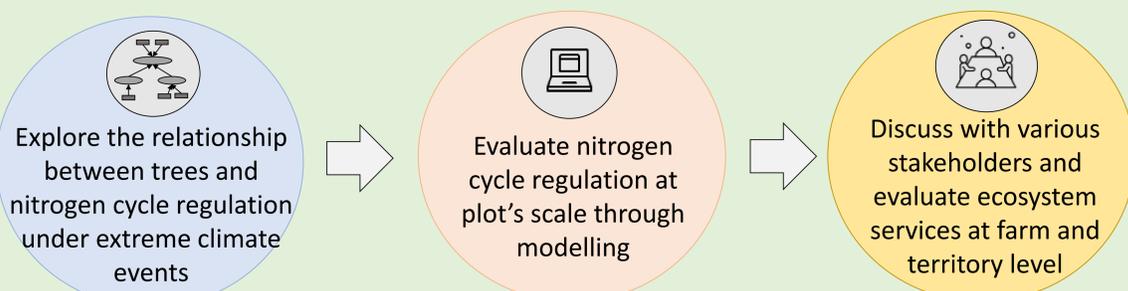
Lab-work to collect data on the nitrification stability, i.e. the biological response of nitrifying microbial communities to a disturbance, here to extreme precipitation events



Lab work on soil cores sampled in the field for each agroforestry designs and position to the trees

In mobilizing field and lab measurements, structural equation modeling is a promising tool for exploring causal relationships within complex agroecosystems such as agroforestry.

Perspectives : from ecological understanding at plot's scale to the assessment of nitrogen cycle associated ecosystem services



Keep in touch !

[romane.mettauer@agrocampus-ouest.fr](mailto:romane.mettauer@agrocampus-ouest.fr)

@RomaneMettauer



**Acknowledgment:** Field and lab work has been possible thanks to the implication of Margaux Malige, undergrad intern, as well as many colleagues from SAS Laboratory, Agrobio 35, Idele and Chambre d'Agriculture de Bretagne. Special thanks to Christian Guemené, who gave us access to his fields.

## Bibliography:

<sup>1</sup>Greaver, T.L., C.M. Clark, J.E. Compton, D. Vallano, A.F. Talhelm, C.P. Weaver, L.E. Band, et al. « Key ecological responses to nitrogen are altered by climate change | Nature Climate Change ». *Nature Climate Change* 6 (2016): 836-43. <https://doi.org/10.1038/nclimate3088>.

<sup>2</sup>Caubel, Virginie. « Influence de la Haie de ceinture de fond de vallée sur les transferts d'eau et de nitrate ». Ecole nationale supérieure agronomique de Rennes, 2001.

<sup>3</sup>Beule, Lukas, Marife D. Corre, Marcus Schmidt, Leonie Göbel, Edzo Veldkamp, et Petr Karlovsky. « Conversion of Monoculture Cropland and Open Grassland to Agroforestry Alters the Abundance of Soil Bacteria, Fungi and Soil-N-Cycling Genes ». *PLOS ONE* 14, n° 6 (2019): e0218779. <https://doi.org/10.1371/journal.pone.0218779>