**6 months internship offer**

**Can cereal-legume intercropping contribute to adaptation to climate variability and climate change across West Africa – a metamodeling approach**

*Background:*

Land-constrained sub-Saharan Africa is characterized by low yields due to disappearing fallows, low availability of organic inputs, and limited access to mineral fertilizers. Cereal-legume intercropping is one option for sustainable intensification to secure food and feed production. Intercrops can increase productivity and yield stability compared to sole crops thanks to greater resource use efficiency (water, light, nutrients). Soil-plant models help evaluate *in silico* the agronomic performance of cereal-legume intercropping but they are time and computationally costly when considering different spatial scales and coupled with many different management options (e.g. sowing date, cultivars, fertilization). Summary statistical metamodels based on processed-based model outputs offer a good trade-off between estimation performance and simulation speed. This internship will help design a metamodel to explore the spatio-temporal intercropping performance in West Africa for contrasting crop management and environments. Such output is crucial to help smallholder farmers design resilient cropping systems.

*Objectives:*

This internship aims at exploring the spatial and inter-annual variability of intercropping performance in West Africa, for contrasting crop management (e.g. sowing date, fertiliser input) and environments (climate, soil texture). In a first step, the intern will be in charge of building a summary model, trained with the Stics processed-based model simulations data. The intern will then perform some spatial prediction of the performance of intercropping with the summary model, for crop management that is of interest of local experts within the FAIR project (ecological intensification of agriculture to increase the resilience of farms in the Sahel).

*Materials and methods*

The work will build on the outputs the Msc work of Mathilde de Freitas (https://agritrop.cirad.fr/606888/). The Stics soil-crop model has been calibrated for sorghum, millet, and maize, in sole cropping or intercropped with cowpea, in semi-arid and sub-humid sites of West Africa with on-station experimental data in Sénégal, Mali and Burkina Faso. Long-term simulations have been performed with historical climate and contrasting N inputs at these sites. The intern will be in charge of building a summary model, trained with the simulated data described above. Different machine learning algorithms will be tested, and their skills assessed. Once the summary model is selected the intern will perform spatial prediction of the performance of intercropping, for crop management that is of interest to FAIR local experts.

*Internship conditions*

The internship will be based at Cirad headquarters in Montpellier. Cirad carries cutting-edge research on the sustainability of food systems across the tropics. The intern will benefit from the direct supervision of Antoine Couëdel and Benjamin Heuclin based in Montpellier and benefit from interactions with Madina Diancoumba (ZALF) and Gatien Falconnier (CIRAD) and from local experts in West Africa.

*Desired skills:* Statistics or agronomic background with interests with statistical analyses and handling large datasets. Interests in modelling. Good oral and writing english proficiency. Affinity with smallholder farming.

*Duration:* 6 months starting in February, March or April 2023 (flexible date). Stipend is ~550 euros per month.

*Supervision:* Antoine Couëdel (CIRAD - UR AÏDA, Montpellier), Madina Diancoumba (ZALF), Benjamin Heuclin (CIRAD - UR AÏDA, Montpellier) and Gatien Falconnier (CIRAD - UR AÏDA, Zimbabwe)

Please apply no later than December 15th, 2023 by email only to antoine.couedel@cirad.fr

Key words: modelling, metamodeling, machine-learning, intercropping, STICS, Sub-Saharan Africa