MSc thesis topic announcement

Soil carbon in diversified agroforestry systems in Brandenburg

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Background and problem:

Agroecology has been proposed to foster climate change mitigation and adaptation (FAO, 2018; HLPE, 2019; Marrero et al., 2022). Incorporating agroecological principles (see Wezel et al., 2020) into farming practices has been shown to mitigate climate effects across the globe. For example, agroforestry significantly increases soil organic carbon in croplands (Beillouin et al., 2023). Furthermore, agroforestry was put forward as an effective option to climate adaptation by the IPCC (2023).

In Brandenburg, mostly short rotation alley cropping has been studied looking into the development of soil organic carbon (Kanzler et al., 2021), microclimatic effects (Kanzler et al., 2019), and economic performance (Thiesmeier, 2024), and agroforestry systems in general by analysing actors' perspectives (Litschel et al., 2023), and land-use conflicts (Unger & Lakes, 2023). Since a comparison of effects on climate mitigation and adaptation between different agroforestry systems has not yet been done, the Agroecology4Climate project will aim to do so and collect to this point scarcely available data on aboveground and belowground carbon inputs of various agroforestry systems in Brandenburg (Mayer et al., 2022).

In this context, this Master project will collect soil samples within specified agroforestry systems from farms in Brandenburg during autumn this year. This master thesis will be embedded in ongoing project work (e.g., field trips to farms in Brandenburg) and contribute to at least one scientific publication within the project.

Objectives and research questions:

The Agroecology4Climate project aims to analyse the climate mitigation and adaptation potential of agroecological farms in Brandenburg using agroforestry systems. To do this, we have interviewed around 50 farms across Brandenburg and will select fields and farms over summer from which we want to collect the soil samples and above ground carbon in autumn. A second master thesis will investigate the above ground carbon effects. Fieldwork trips will be organized collectively within the project team.

The following overarching research question has been defined for the Agroecology4Climate project:

How does agroecology, with the example of agroforestry, enable climate resilience of farms in Brandenburg?

Within this broader research question, the MSc thesis can answer (might be narrowed or adapted according to the research process):

How does soil organic carbon change along a diversification gradient of agroforestry systems?

Methods:

1. Literature review on soil carbon in diversified farming systems and agroforestry in temperate regions and refining the scope of the MSc thesis
2. Collection of soil samples from about 30 (+/-) fields across Brandenburg and preparation for analysis (communication with the ZALF soils lab will be essential in this process)
3. Analysis of soil data (organic carbon) using general statistics and interpretation of findings

Expected outcome and time plan:

This work will constitute a MSc thesis and can potentially contribute to one scientific publication.

Task	Month					
	1	2	3	4	5	6
Literature review and definition of scope						
Data collection						
Data analysis						
Write thesis						

Relevant literature (see listed references as well):

Kanzler, M., Böhm, C., & Freese, D. (2021). The development of soil organic carbon under young black locust (Robinia pseudoacacia L.) trees at a post-mining landscape in eastern Germany. *New Forests*, *52*(1), 47–68. https://doi.org/10.1007/s11056-020-09779-1

Kanzler, M., Böhm, C., Mirck, J., Schmitt, D., & Veste, M. (2019). Microclimate effects on evaporation and winter wheat (Triticum aestivum L.) yield within a temperate agroforestry system. *Agroforestry Systems*, *93*(5), 1821–1841. https://doi.org/10.1007/s10457-018-0289-4

Funding is available for 40 hours/month for 3 months to support the data collection for the MSc thesis. For more information and/or submitting your application in either German or English, as one PDF file, send an email to both: maria.kernecker@zalf.de and julia.fritzsche@zalf.de by September 7th, 2025.

References:

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Mayer, S., Wiesmeier, M., Sakamoto, E., Hübner, R., Cardinael, R., Kühnel, A., & Kögel-Knabner, I. (2022). Soil organic carbon sequestration in temperate agroforestry systems – A meta-analysis. *Agriculture, Ecosystems & Environment*, *323*, 107689. https://doi.org/10.1016/j.agee.2021.107689

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Unger, M., & Lakes, T. (2023). Land Use Conflicts and Synergies on Agricultural Land in Brandenburg, Germany. *Sustainability*, *15*(5), Article 5. https://doi.org/10.3390/su15054546

Wezel, A., Herren, B. G., Kerr, R. B., Barrios, E., Gonçalves, A. L. R., & Sinclair, F. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Agronomy for Sustainable Development*, *40*(6), 40. https://doi.org/10.1007/s13593-020-00646-z