

Invited MSc Thesis Topic

Environmental Benefits of Hedgerows in Agricultural Landscapes

Language: English

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Background: Hedgerows are linear landscape features composed of shrubs and trees that play a vital role in agricultural ecosystems. Recognized under the EU's Common Agricultural Policy (CAP), hedgerows are valued for providing multiple ecosystem services such as supporting biodiversity and reducing soil erosion. Under the CAP's conditionality framework, farmers must retain and manage hedgerows, which are designated as protected landscape elements.

However, the presence of hedgerows alone does not automatically ensure positive environmental outcomes. The extent to which hedgerows contribute to regulating ecosystem services, such as mitigating soil erosion, enhancing water retention for crops, and promoting biodiversity, depends significantly on their spatial arrangement within the landscape. For instance, hedgerows aligned with field contour lines or situated near bodies of water are more likely to intercept runoff and reduce erosion than those positioned solely to minimize costs or simplify field operations.

Therefore, we hypothesize that hedgerows generate substantial environmental benefits only when they are strategically placed to optimize environmental outcomes rather than being placed to minimize costs. In this context, suboptimal placement may lead to limited or negligible contributions to ecosystem health.

Approach: This project aims to test this hypothesis by using machine learning models for causal inference to estimate the impact of hedgerow quality on various environmental outcomes. Examples of relevant causal inference models can be found in Deines et al. (2023), Stetter et al. (2022), and Schulz et al. (2024). To this end, we will develop a Hedgerow Quality Index (HQI) (e.g., a composite indicator reflecting essential spatial and structural hedgerow characteristics, including total length, density, alignment with slope contours, and proximity to water bodies) that we will use as a treatment variable to explore the heterogeneous effects on multiple environmental outcomes important for the provision of ecosystem services in agricultural landscapes (e.g., plant water availability, soil erosion, soil moisture, etc.).

Goal: The goal is to determine whether spatially optimized hedgerows improve ecological performance. If confirmed, this would have significant policy implications, suggesting that incentivizing the presence of hedgerows under the CAP alone may be insufficient to achieve meaningful environmental benefits. Our findings may instead support a shift toward payment schemes that account for the quality and strategic placement of hedgerows to promote more sustainable agricultural landscapes.

Research Project: The master's thesis is part of the DETECT project (<https://sfb1502.de/>), subproject A06 on processes and determinants of climate-relevant landscape configurations.

Expected skills and interest:

- Interest in environmental and climate policy
- Experience with the concepts and theories of policy impact evaluation (e.g., having attended the Master's course in Impact Evaluation of Conservation and Development Policies)
- Experience with coding in R

References

- Deines, J.M., Guan, K., Lopez, B., Zhou, Q., White, C.S., Wang, S., Lobell, D.B., 2023. Recent cover crop adoption is associated with small maize and soybean yield losses in the United States. *Global Change Biology* 29, 794–807. <https://doi.org/10.1111/gcb.16489>
- Schulz, D., Stetter, C., Muro, J., Spekker, J., Börner, J., Cord, A.F., Finger, R., 2024. Trade-offs between grassland plant biodiversity and yields are heterogeneous across Germany. *Commun Earth Environ* 5, 514. <https://doi.org/10.1038/s43247-024-01685-0>
- Stetter, C., Mennig, P., Sauer, J., 2022. Using Machine Learning to Identify Heterogeneous Impacts of Agri-Environment Schemes in the EU: A Case Study. *European Review of Agricultural Economics* 49, 723–759. <https://doi.org/10.1093/erae/jbab057>