Coupling Economic and Ecological Models

The biodiversity effects from increased energy grass production

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Background

Bioenergy is expected to play a key role in the transition from fossil fuels to renewable energy sources, with grass biomass pointed out as a potential source for increased **bioenergy production** in Northern Europe.

In this study, we use spatially explicit **coupled modelling** of economic and ecological systems to investigate the potential landscape-scale impacts on **biodiversity** and **climate mitigation** from policies supporting production of energy grass biomass in a mosaic region in Southern Sweden.

Hypotheses

1. Introducing a payment for energy grass production will lead to a decline in grass production for fodder, and in turn also a decline in semi-natural pastures and their associated biodiversity.
2. The resulting biomass production and land-use will have a positive effect on climate mitigation.

Workflow

1. Economic modelling

Study region: Jönköping county (South Sweden)

1.1. Using AgriPoliS (Happe et al., 2006) - a dynamic and spatial **agent-based model** that analyse changes in farm structure responses to policies over time - we made predictions of farming and land-use following an introduction of different levels of hectare-based payment for energy grass.

2. Energy + Spatial output

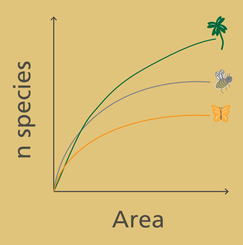
2.1 We calculated the potential energy production from the modelled scenario outputs

2.2 We converted the model results to spatial data of agricultural land use in the study area

All farms and fields from the model were connected to real farms and fields in the studied region (based on farm types and parcels in IACS and LPIS)

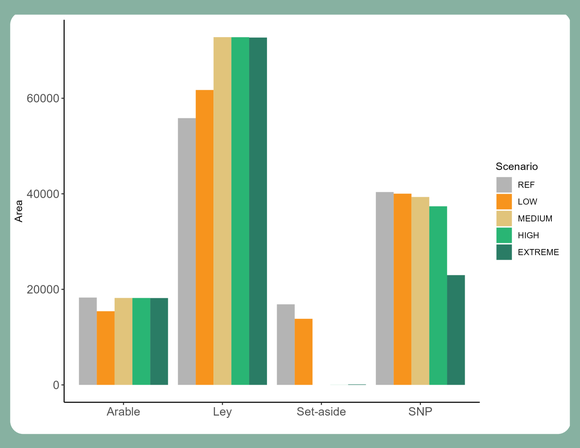
3. Ecological modelling

3.1 Combining the modelled land use data with ecological data (plants, butterflies, and bees) in cSAR (countryside Species Area Relationship) models (Andersson et al., 2022) will inform about the potential ecological impacts of the modelled land-use changes.



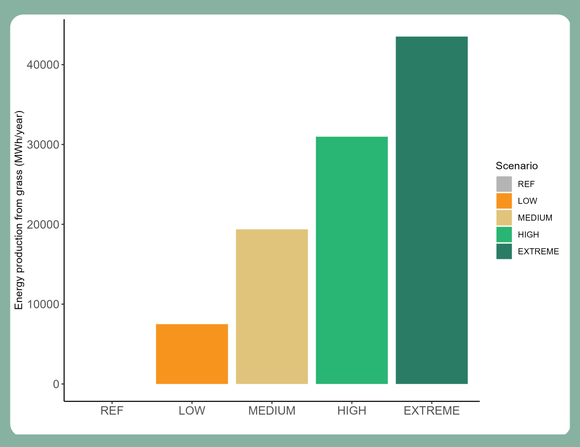
Progress

1. Economic modelling



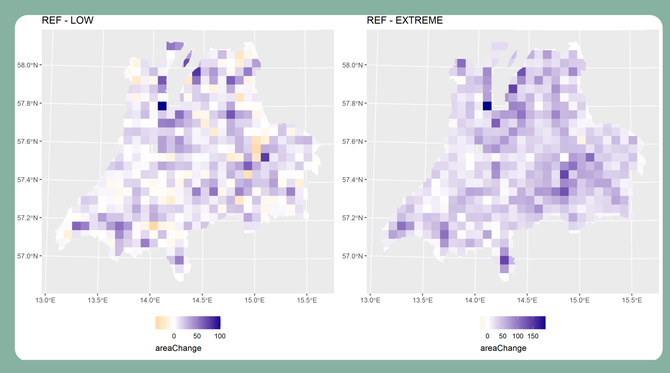
The modelled land use in the reference (BAU) + energy grass scenarios with hectare based payments ranging from low to extreme levels.

2.1 Energy production



The resulting energy output from the modelled scenarios.

2.2 Spatial effects



Rasters showing a comparison of the production of ley between the reference scenario (BAU) and two energy grass scenarios (low and extreme levels of payment), where the difference in production area is shown in each pixel.

Conclusion and next steps

- An introduced payment for energy grass production will result in an increased production of grass on leys (energy outputs up to 4TWh/year), with aggregated production increases across the studied region.
- The increased energy grass production will occur at the expense of set asides and ley production for fodder, but the area of SNP is mainly affected in the highest levels of payments for energy grass production.
- To assess the climate impact of the modelled land-use changes, we aim to combine the energy production with estimates of carbon storage in the respective land uses.
- The ecological impacts of the modelled land-use changes are to be investigated in cSAR models.

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References

Andersson *et al.* (2022) *Biol. Conserv.* **274**: 109728

Happe *et al.* (2006) *Ecology and Society* **11(1)**: 49

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