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Global implications of lignocellulosic crop-based BECCS for terrestrial vertebrate biodiversity

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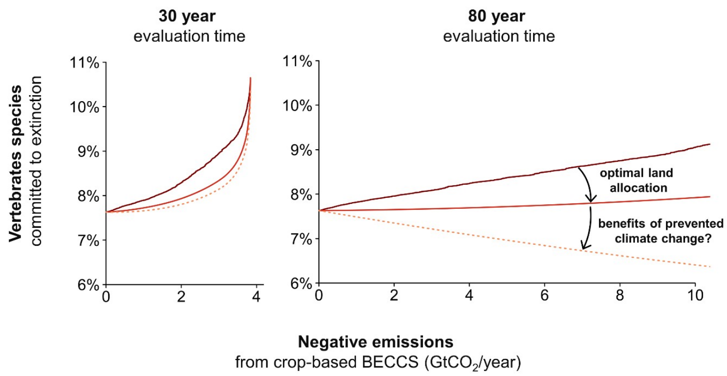
Bioenergy with carbon capture and storage (BECCS) based on purpose-grown lignocellulosic crops can provide *negative* CO_2 emissions to mitigate climate change, but its land requirements present a threat to biodiversity. Here, we analyse the implications of crop-based BECCS for global terrestrial vertebrate species richness, considering both the land-use change (LUC) required *for* BECCS and the climate change prevented *by* BECCS. LUC impacts are determined using global-equivalent, species-area relationship-based loss factors. We find that sequestering 0.5–5 Gtonne of CO_2 per year with lignocellulosic crop-based BECCS would require hundreds of Mha of land, and commit tens of terrestrial vertebrate species to extinction. Species loss per unit of negative emissions decreases with: i) longer lifetimes of BECCS systems, ii) less overall deployment of crop-based BECCS, and iii) optimal land allocation, i.e., prioritising locations with lowest species loss per negative emission potential, rather than minimising overall land use or prioritising locations with lowest biodiversity. The consequences of prevented climate change for biodiversity are based on existing climate response relationships. Our tentative comparison shows that for crop-based BECCS considered over 30 years, LUC impacts on vertebrate species richness may outweigh the positive effects of prevented climate change. Conversely, for BECCS considered over 80 years, the positive effects of climate change mitigation on biodiversity may outweigh the negative effects of LUC. However, both effects and their interaction are highly uncertain and require further understanding, along with analysis of additional species groups and biodiversity metrics. We conclude that factoring in biodiversity means lignocellulosic crop-based BECCS should be used early to achieve the required mitigation over longer time periods, on optimal biomass cultivation locations, and most importantly, as little as possible where conversion of natural land is involved, looking instead to sustainably grown or residual biomass-based feedstocks and alternative strategies for carbon dioxide removal.


30 year
evaluation time
80 year
evaluation time
Vertebrates species
committed to extinction
11%
10%
9%
8%
7%
6%
0
2
4
6
8
10
optimal land
allocation
benefits of prevented
climate change?
Negative emissions
from crop-based BECCS (GtCO2/year)