

Quantifying and incorporating biomass carbon sequestration by trees in LCA

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Abstract

- There is no consensus on accounting for biomass C sequestration in LCA.
- This study reviews methods to estimate biomass C sequestration and integrate it into LCA using a Danish case study.
- Considerable variability exists among these methods due to methodological differences.
- Methods used to account for climate impact of biomass C in LCA are time-sensitive.
- A systematic LCA approach should consider complexity, temporal aspects, reference state, and uncertainties to accurately estimate C removals/emissions.

Introduction

- A global 10% increase in tree cover on existing agricultural land could sequester 18 petagrams of C (Zomer et al., 2022).
- Yet, accurately quantifying tree biomass carbon and its climate impact is challenging.

Therefore, this study aims to:

- evaluate the methodologies for estimating the tree biomass C sequestration and inclusion in LCA.
- Analyze variation among these methods considering long-term C sequestration, e.g., 100 years, using a Danish case study.

1200

1000

——— Specific Allometric model

(Mg ha ⁻¹)

Results

- C sequestration increased over time for all methods.
- General models estimated 25-49% higher biomass C than Yield-SAFE (Fig. 1)
- Specific allometric model and Yield-SAFE gave comparable biomass estimates.
- General models tend to overestimate, especially over longer time periods.
- Methods to include C sequestration in LCA are sensitive to rotation time/assessment period (Fig. 2).
- Among methods to consider temporary C storage in LCA, ILCD method show higher consistency over time.

- CO,FIX

---- IPCC method

Discussion

- General allometric models may overestimate because they are not calibrated for a specific specie and region.
- Methods to account biogenic C in LCA behave differently over various timescales.
- The IDF method may overestimate climate impact for shorter durations, while Moura-Costa overestimates for longer periods.
- Lashof and ILCD characterization methods gave more consistent climate impact results across different time horizons.
- It is important to select an appropriate characterization method based on the goals and time frame of the LCA study.

Conclusions

Materials and Methods

Methods to estimate biomass C sequestration

- Allometric models
 - \circ Specific allometric models
 - o General allometric models
- Carbon simulations models
 - Country-specific
 - Models with extended

scope

Methods to estimate climate impact of sequestered C

- Moura-Costa method
- Lashof method
- International Dairy foundation (IDF) method
- ILCD method







- Method choice impacts C sequestration estimates.
- Challenges in tree C sequestration in LCA: complexity, timescales, data limits, dynamic pools.
- Methods to incorporate C in LCA are time-sensitive, with varying results based on approach and time frame.
- Updating LCA tools with new methodologies aids precise C removal/emission estimation.







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