# Modelling environmental impacts of land application of organic waste products with the DAISY model

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**Introduction**

Land application of organic amendments derived from waste materials from urban, industrial or agricultural activities (referred to as organic waste products: OWP) may result in many direct and indirect environmental and agronomic effects, positive as well as negative. Life cycle assessment (LCA) is a powerful method which allows integrating all environmental impacts associated with different waste management options. However, LCA is currently biased due to the lack of consideration of the environmental effects of OWP land application. Complementing the LCA databases with parameters accounting for the environmental impacts of land application of OWP is therefore urgently needed. Using properly calibrated agro-ecosystem models is a powerful approach for this purpose because it allows deriving parameters which are difficult to measure experimentally and to simulate various scenarios. The Daisy agro-ecosystem model has been extensively parameterized and tested with field data and has performed well for deriving parameters for LCA of compost and digestate applications [1]. However, it remains necessary to verify the model results with field measurements and to construct scenarios for new types of OWP under realistic practices as repeated OWP applications. The objective of this study is to derive parameters of the environmental impacts of OWP application relevant for LCA. The Daisy model will be calibrated using data from the Crucial field experiment. Scenarios with different OWP applications will then be constructed to produce relevant environmental impact parameters suitable to complement LCA databases.

**Material and Methods**

*Field experiment.* The Crucial experiment, which was initiated in 2002 is located, near Copenhagen, Denmark. It is cropped with a cereal rotation and includes four OWP treatments: municipal solid waste compost, sewage sludge, cattle slurry which are compared to farmyard manure and to an unfertilized reference treatment and to a treatment with only NPK fertilizer. OWP were applied every year in fall at the target rate of 100 kg or 300 kg mineral nitrogen equivalent. Field measurements included C and N content, bulk density, yearly crop yields measured regularly throughout the experiment period.

*Modelling.* The soil organic matter dynamics module of the Daisy model will be calibrated using C and N mineralisation/immobilisation measurements during laboratory incubations of the OWP. The model outputs of crop yields and C and N dynamics will be compared to field measurements, leading to possible model recalibration to fit with the field data.

**Results**

Results of the Daisy model calibration on OWP laboratory incubation data and the field data will be presented. Output model results for different application scenario will be shown, comprising C and N dynamics at a timescale relevant for LCA (100 yrs), as well as simulations of N leaching, $N_2O$ and $CH_4$ emission and crop production.

**Conclusion and perspectives**

This study is expected to provide new insight on the study of the environmental impacts of OWP land application. The results from different application scenario will be useful to complement LCA databases.

**Reference**

[1] Bruun S, Hansen TL, Christensen TH, Magid J, Jensen LS. 2006. Application of processed municipal solid waste on agricultural land – a scenario analysis. Environmental modelling and assessment 11: 251-265.