

MODELLING POSSIBILITIES OF THE EFFECTS OF SEWAGE SLUDGE DEPOSITION ON ECOSYSTEM CARBON EXCHANGE PROCESSES - A CASE STUDY ON ARABLE LANDS IN SOUTHEAST HUNGARY

Márton Kiss, Károly Barta, Ágnes Gulyás, Emese Krajcsi,
Andrea Farsang

University of Szeged, Hungary

Institute of Geography and Geology



Motivations



Background: circular economy,
Life Cycle Assessments

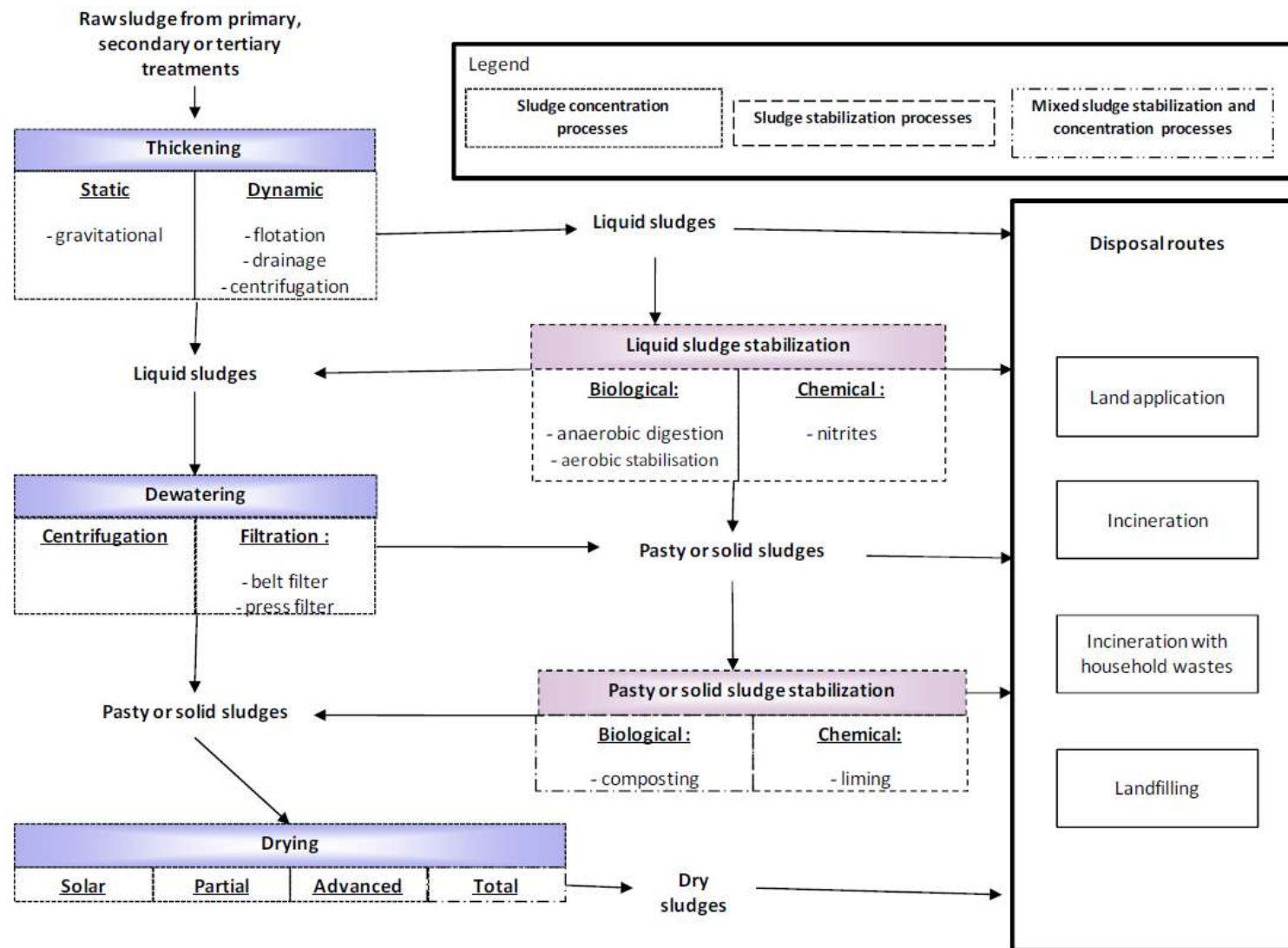


Need for integrated assessment methods
for practical (policy) applications



Development of targeted (modelling) tools

Carbon footprint of sewage sludge treatment



e.g. GESTABoues – Pradel - Reverdy 2012



Possible knowledge gap: external effects on CO₂ fluxes in agroecosystems

Methodological aspects:

- complex system processes, future practical applications
→ model-based assessment
- process-based modelling
- need for detailed characterization of management interventions
- annually varying management options
- well-described, documented model (to enable incorporation to integrated assessment tools)



Experimental study: investigating the usability of Biome-BGC MuSo model for sewage sludge impact assessment

Biome-BGC MuSo model

suitable for various terrestrial ecosystems

developed and updated version of the popular Biome-BGC model
(Thornton 2000)

several specific modules for analyzing the different management
activities' effects

multilayer soil description, daily time step

Aim of the present work: testing the model (~sensitivity analysis),
based on parameterization potentially usable for SS disposal,
based on a real case (intensively utilized agricultural area)



Study site in Southeast Hungary:
chernozem soil with wheat (*Triticum aestivum*)
disposal + control site

photo: Barta et al. 2020



Local parameterization based mainly on soil survey,
ecophysiological parameterization based mainly on literature
data, element contents of biomass measured in laboratory

Sewage sludge added technically as fertilizer

3 scenarios, with different amount of sludge (4500 – 8500 – 30000
kgDM/ha); 5 years (2015-2019)



Results / discussion

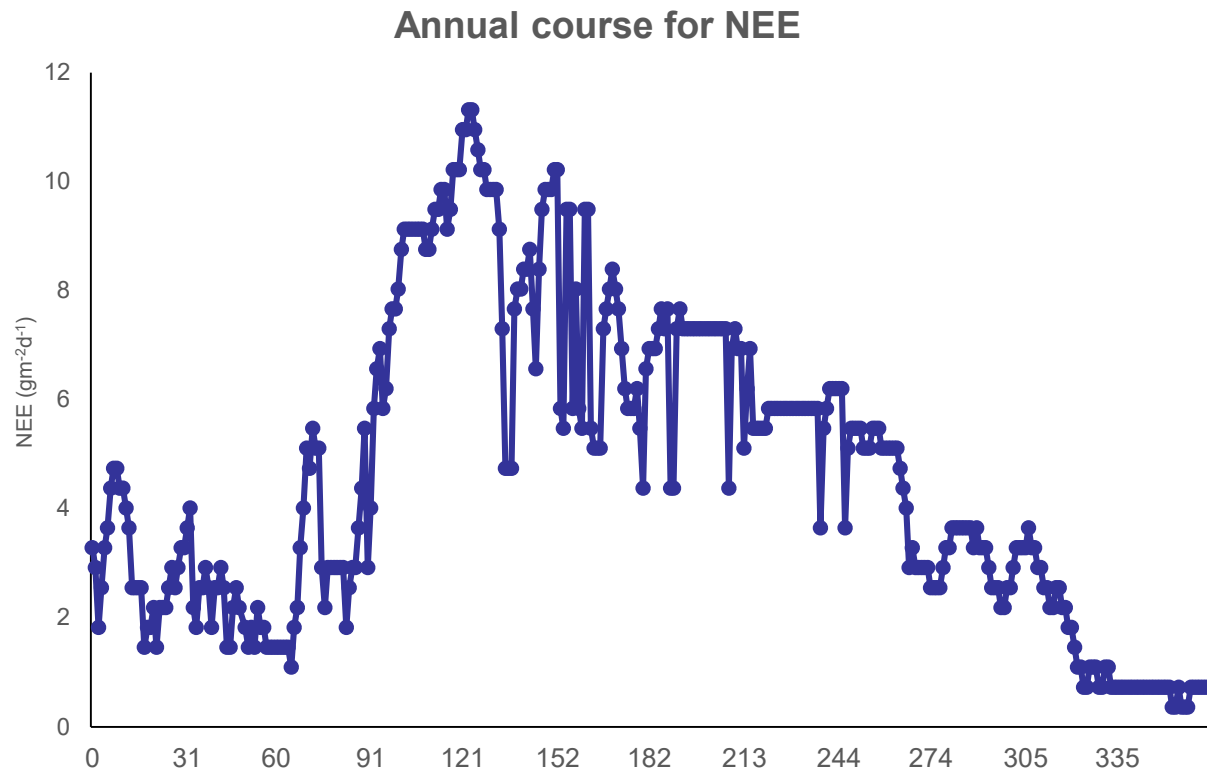
NEE (kgm ⁻² yr ⁻¹)	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
4500	3,4	3,1	2,9	2,9	2,8
8500	5,1	4,8	4,6	4,8	4,6
30000	14,5	14,2	14,1	14,9	14,6
Control	1,4	1,1	0,9	0,8	0,7

The model seems to reflect on the additional organic matter input, in terms of carbon fluxes as well.

Modelled NEE are often overestimated.



Results / discussion



Discussion

Similarly to the case of the ecosystem's normal functioning, there is inter-annual variability, which makes discussing the results more difficult.

These first results are definitely not suitable for drawing general consequences about the sewage sludge effects, nor for absolute values. More evidence needed, together with as many field-based studies as possible on the topic, for cross-comparisons and to derive general theoretical statements.

But we consider that the model itself is suitable for analyzing the problem.

