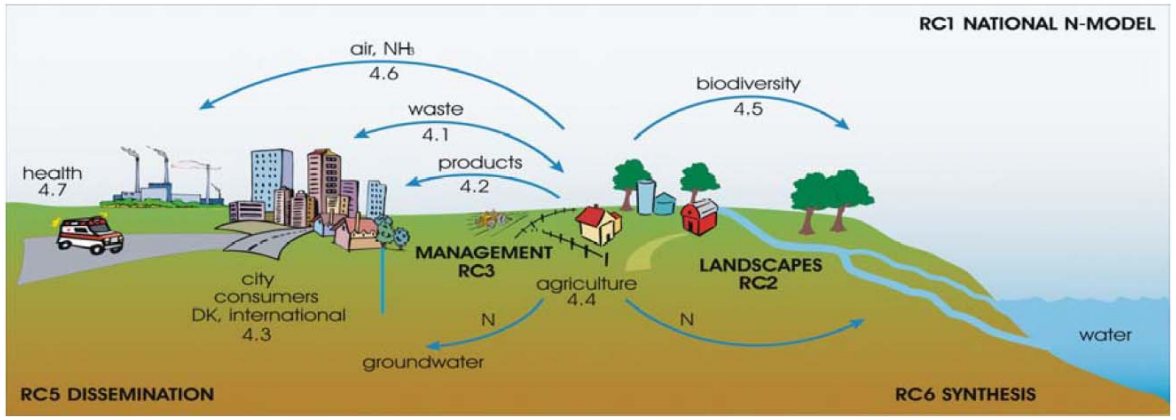
DNMARK RC4: Critical N impact issues

(Lead: Lars Stoumann Jensen, Co-lead: Ole Hertel)



4.1 Urban-rural N recycling from waste
(AGEC, HEDEDK, ORGREST) – *Beatrice+Sean & Lars*

4.2 Cost benefits of N measures to improve surface water quality
(FOI, MEM, MAFF, ENVS) - *Anne & Brian J*

4.3 Sustainable, low N food consumption
(ARTS, WHO, Horsens, AGRO, FOI) - *Sandy and Steen*

4.4 Watershed N Management
(DAAS, AGRO, ARLA, ADVICE, YARA, MUNICIPAL) - *Tommy/Jørgen/Irene*

4.5 N mitigation, Ecosystems Services mapping & biodiversity management
(BIO, AGRO, EEA, ALECTIA) - *Katrine & Tommy*

4.6 Agricultural airborne N-pollution, particle pollution and public health effects
(ENVS, HEALTH, MEM-EPA, OfficeDoctors, ALLERGY, LUNG, DK-HEALTH) - *Robert / Ole*

4.7 Groundwater N-pollution and public health effects
(GEUS, HEALTH, AGRO, OfficeDoctors, MEM-Nature, WaterAalborg) - *Jörg & Birgitte*

RC 4.1 Urban-rural N recycling for waste

Beatriz Gómez Muñoz, Sean Case, Lars Stoumann Jensen, Jakob Magid, Jan K. Schjørring

Very topical subject

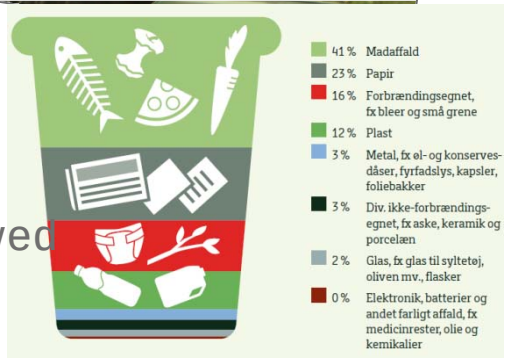
- Government **Ressource Strategy** announced yesterday 7 Oct 2013 – perfect for DNMARK timing!
- Main message: **Recycle more, incinerate less**
- **Fixed goals for recycling** of household waste (>50%), sewage sludge (>80%), manure
- Will increase **public / business awareness**, focus and interest – but also willingness to pay?

Research activity step-up needed!

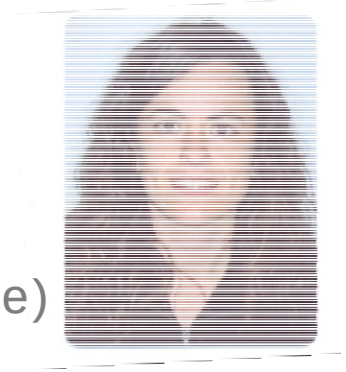
- **DNMARK (16 mth postdoc) +**
- ReUseWaste 9 (+9=18) mth postdoc
- Billund Biorefinery 2-3 mth postdoc
- Marie Curie EUFP7 fellow 24 mth postdoc ???




- 36 appl.
- 5 interviewed
- 2 selected



Beatriz Gómez Muñoz, postdoc



Nationality: Spanish

Supervisors: Lars S. Jensen, Jakob Magid, Jan K. Schjørring

Start date: 1st Sep 2013 (12 mth 2013-14 + evt 2y Marie Curie)

Educational background:

2006 M.Sc. in Agro-Environmental Engineering, Univ. of Castilla La Mancha, Spain
2011 Ph.D. Environmental Science, University of Jaen, Spain. Supervised by: Prof. Roberto Garcia Ruiz (UJAEN) and Dr. Roland Bol (North Wyke, Rothamsted, UK)

Research and work experience:

PhD thesis:

Development and optimization of a protocol of fertilization in organic olive orchards

Publications – 5 international peer-reviewed so far:

Gómez-Muñoz B., Hatch D.J., Bol R., García-Ruiz R. 2013. Agrochemical characterization of composted olive mil pomace currently produced in southern Spain. *J Plant Nutr Soil Sci* in press

García-Ruiz R., Gómez-Muñoz B., Hatch D.J., Bol R., Baggs E. 2012. Soil mineral N retention and N_2O emission following combined application of ^{15}N-labelled fertiliser and weed residues. *Rapid Commun Mass Sp*. 26:2379-2385.

García-Ruiz R., Ochoa V., Hinojosa M.B., Gómez-Muñoz B. 2012. Improved soil quality after 16 years of olive mill pomace application in olive oil groves. *Agron Sustain Dev*. 32:803-810.

Gómez-Muñoz B., Bol R., Hatch D.J., García-Ruiz R. 2011. Carbon mineralisation and distribution of nutrient within different particle-size fractions of commercially produced olive mil pomace. *Bioresource Technol*. 102(21):9997-10005.

Gómez-Muñoz B., Hatch D.J., Bol R., Dixon E.R., García-Ruiz R., 2011. Gross and net rates of nitrogen mineralisation in soil amended with composted olive mil pomace. *Rapid Commun Mass Sp*. 25:1-7.

Sean Case, postdoc

Nationality: British

Supervisors: Lars S. Jensen, Jakob Magid, Jan K. Schjørring

Start date: 15th June 2013 (6 mths in 2014-15)

Currently employed by related ReUseWaste EU-MC-ITN project "Screening and selecting manure and organic derived biofertiliser products, and evaluation of their market acceptability"

Educational background:

2008 M.Sc. Land Management from Cranfield University, Bedfordshire, UK

2013 Ph.D. "Biochar amendment and greenhouse gas emissions from agricultural soils" from the Centre for Ecology and Hydrology, Lancaster, UK & University of Edinburgh

Earlier research and work experience:

PhD thesis: "Biochar amendment and greenhouse gas emissions from agricultural soils",2013, Univ. of Edinburgh

Publications, 2 international peer-reviewed so far:

Case, S.D.C., McNamara, N.P., Reay, D.S., Whitaker, J., 2012. The effect of biochar addition on N_2O and CO_2 emissions from a sandy loam soil – The role of soil aeration. Soil Biology and Biochemistry 51, 125–134.

Case, S.D.C., McNamara, N.P., Reay, D.S., Whitaker, J., 2013. Can biochar reduce soil greenhouse gas emissions from a Miscanthus bioenergy crop? GCB Bioenergy, Early view online.

RC 4.1 Urban-rural N recycling for waste

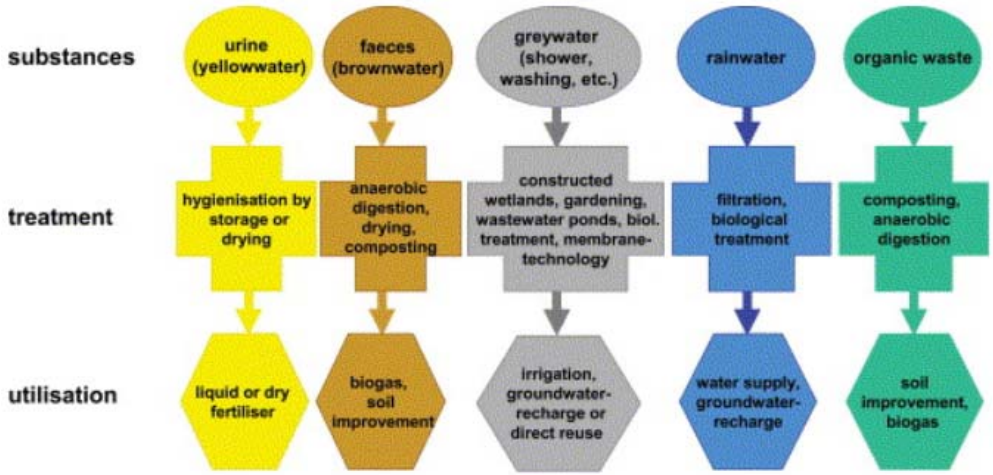
European N Assessment (Oenema O. et al., 2011):

Recycling nitrogen (& phosphorus) from waste water systems

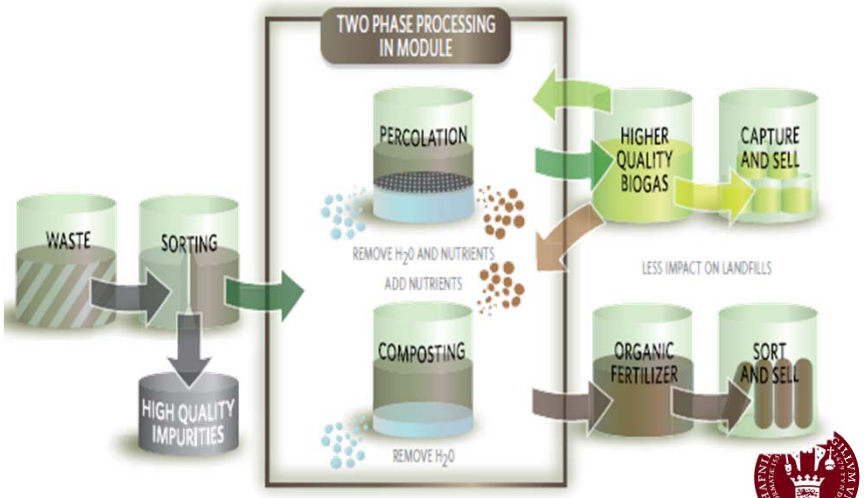
Danish WW treatments (mechanical, biological and chemical treatments) can remove up to 85-95% N and 90-95% P.

New technologies:

ECOSAN



AIKAN



Research questions:

i) Will N in new waste residuals be sufficiently available for efficient plant recovery?

i) Can waste residual be modified to achieve higher fertilizer value, without increasing emissions to the environment?

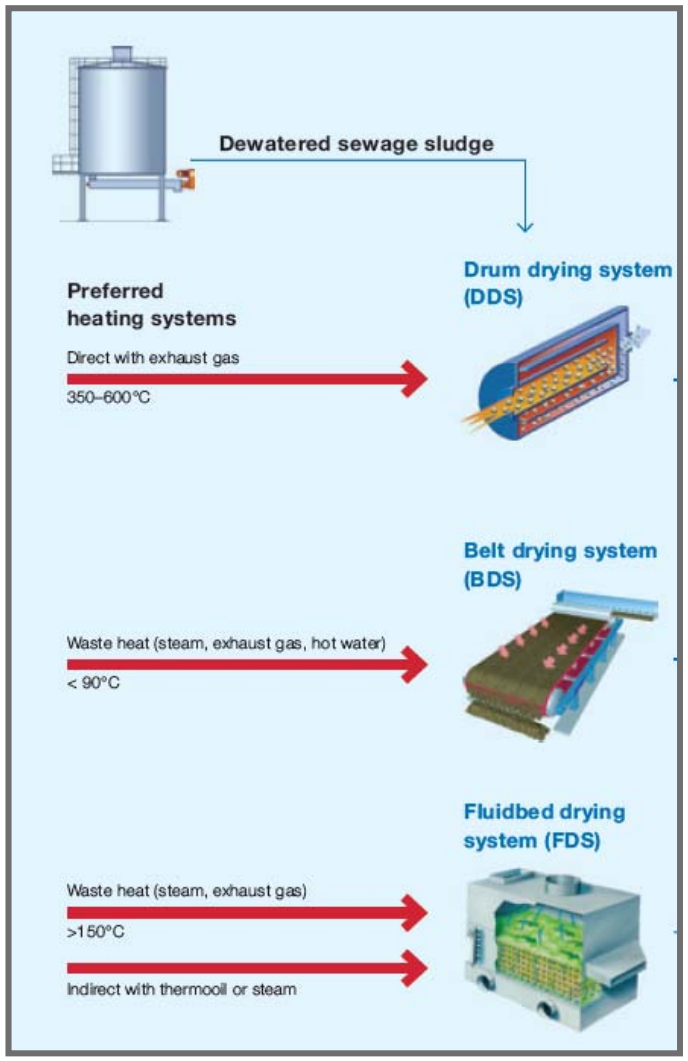
i) What are the medium to long-term effects on soil quality and potential environmental impacts?

Research tasks / activities:

1. Screen current market (EU level) for waste-water derived residuals with a potential use as fertilizers. Use contacts to:
   - *Danish Innovation Alliance for P Recovery from Sewage Sludge*
   - *HedeDanmark, BGORJ*
   - *Billund Biorefinery (new innovation project)*
2. Selection of a representative set of samples for further characterisation. Work on modification procedures to enhance N availability and handling properties (*on-going work*)
3. Field based testing of a limited number of WWR and modified products in the CRUCIAL field trial (long-term urban residuals experiment) or Nutrient Depletion Trial (low PK status)
4. Dissemination and discussions with stakeholders and waste water industry on the feasibility and economy of such alternative solutions, when taking all effects on fertilizer substitution, emission reductions and processing costs into account – interactions with Sean's ReUseWaste project

Example of on-going work :

Thermal drying of sludge – effects on N turnover



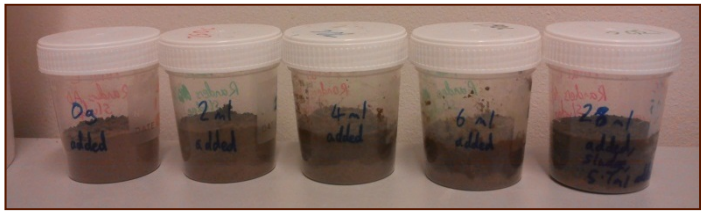
- Inlet temperature can have a wide range (90 to > 350°C)
- Drying temperature generally < 200°C (from scientific literature)
- Can be added to soil to increase soil fertility + provide nutrients to plants

+	-
Low volume = low transportation costs	Expensive – energetically and economically
Nutrient rich	Dusty product
Low pollutant content	Effect on nitrogen (N) cycle and soil greenhouse gas emissions unknown

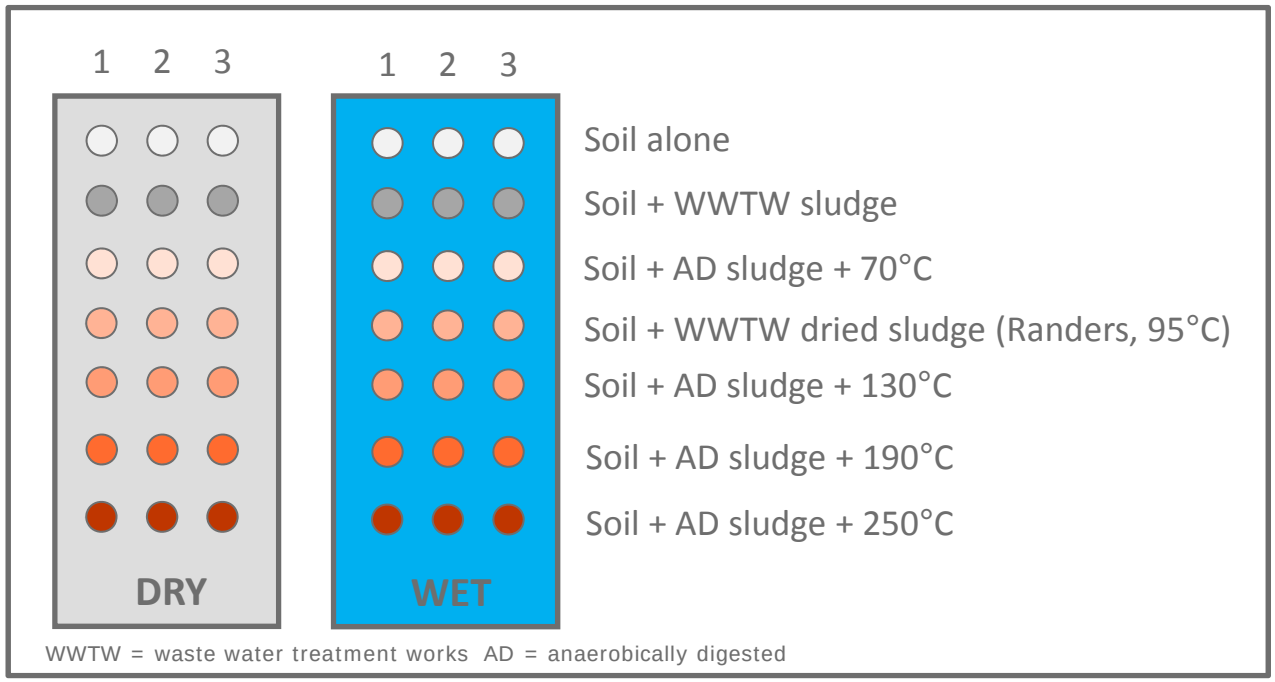
Research gaps

- The effect of sludges dried at different temperatures on the availability of nitrogen (N) to plants is unknown
- Greenhouse gases following the addition of dried sludge to soil are unknown
- The varying effects under dry and wet soil conditions are unknown

Experimental setup

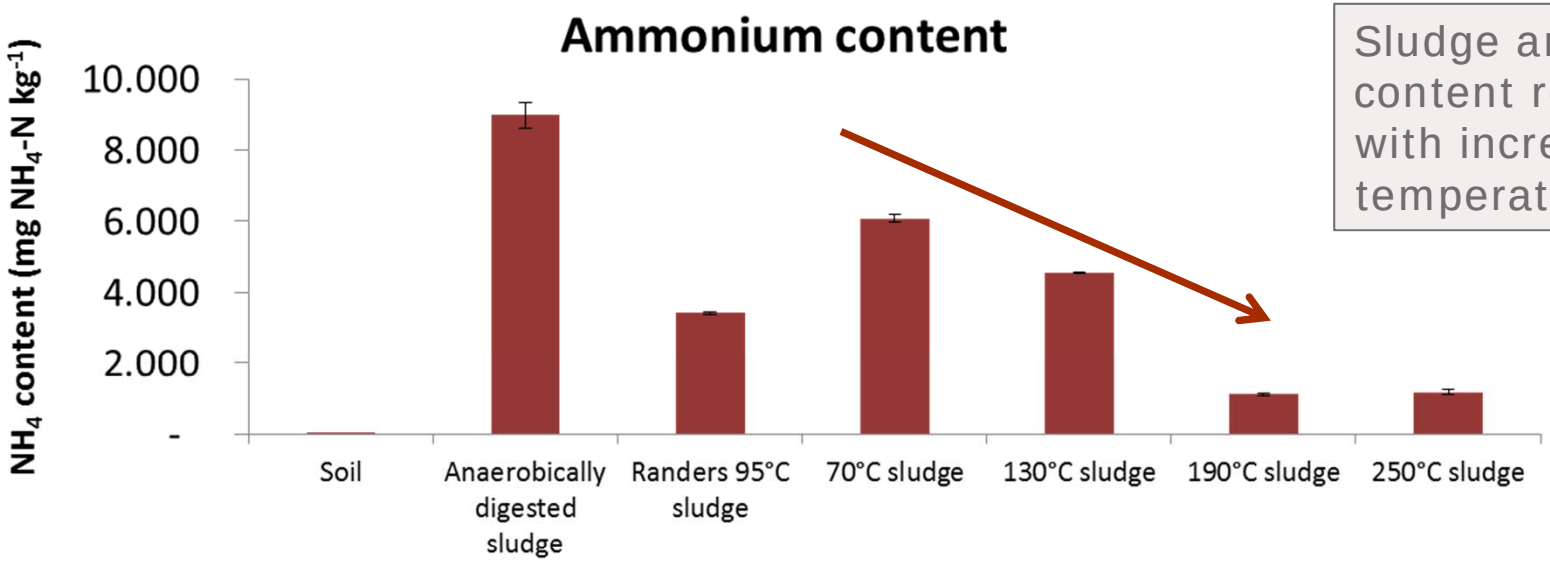


- Soil collected from arable field in Taastrup
- Anaerobically-digested sludge delivered from Randers waste water treatment plant, Denmark
- Sludge added in laboratory and monitored for 160 days

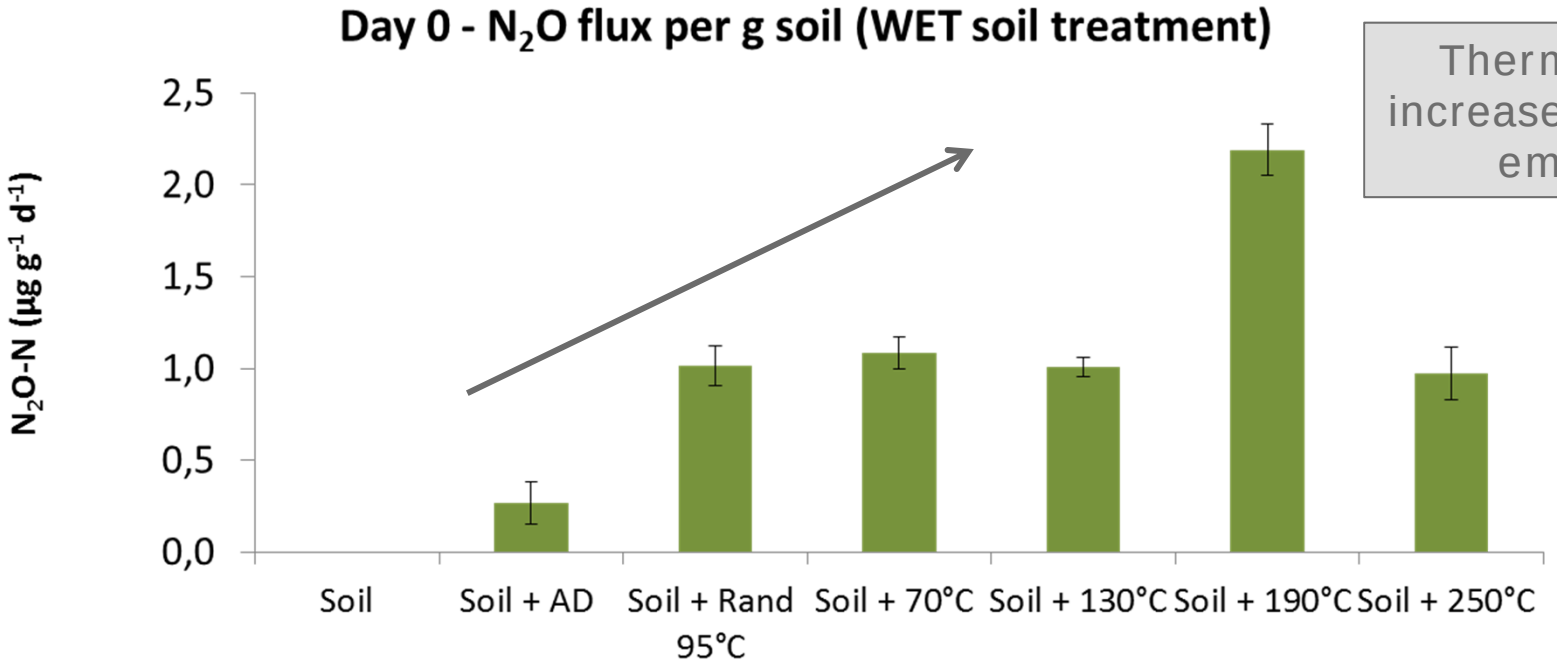


Analysed for:

- Greenhouse gas emissions (CO_2, CH_4 and N_2O emissions) and
- N-min dynamics (ammonium + nitrate contents, for N availability to plants)



Sludge ammonium content reduces with increasing temperature



Thermal drying increases initial N_2O emissions