

# Aktivitet 5 – System analysis

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# Activity 5 - Systemanalys av konceptet gröna bioraffinaderier

- 5.1 Choices av methods for system analysis (2019-01-01 till 2019-12-31)
- 5.2 Energy systemanalysis green biorefineries (2020 -01-01 till 2021-09-30)
- 5.3 Analysis of climate and environmental effects in different system solutions (2020 -01-01 till 2021-09-30)
- 5.4 Production- och societal economy in the total system (2020 -01-01 till 2021-09-30)

# Who are working

## **Chalmers**

- Christel Cederberg WP-leader
- Oskar Englund, Post-doc (till 30 nov 2019)
- Göran Berndes
- Postdoc Sebnem Yilman Balman (from Feb-20)

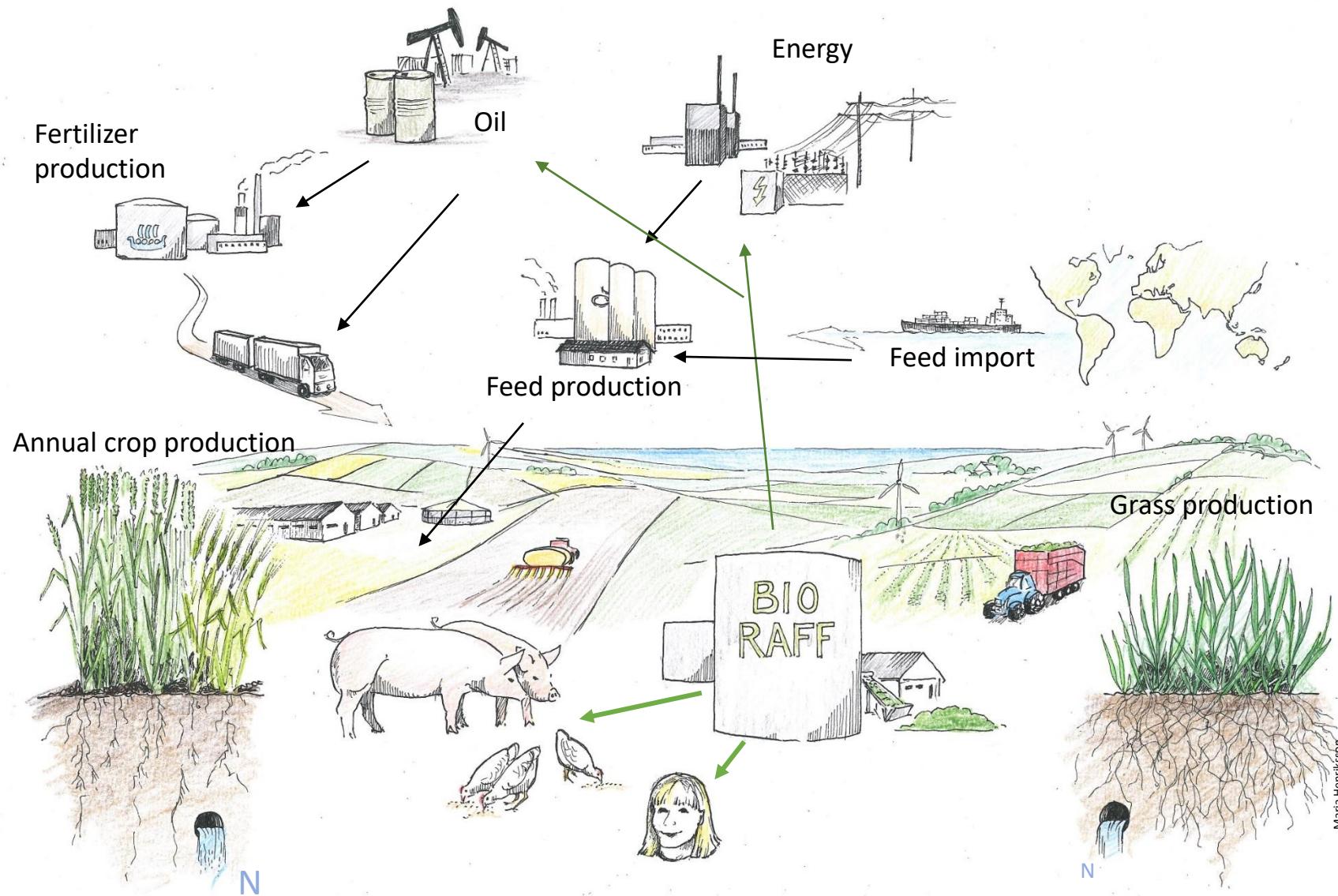
## **Aarhus Agro-ecology**

- Marie Trydeman Knudsen
- Troels Kristensen
- Heidi Mai-Lis Andersen

# Workshop 2019 on methods and data – identified 4 key areas in the system analysis

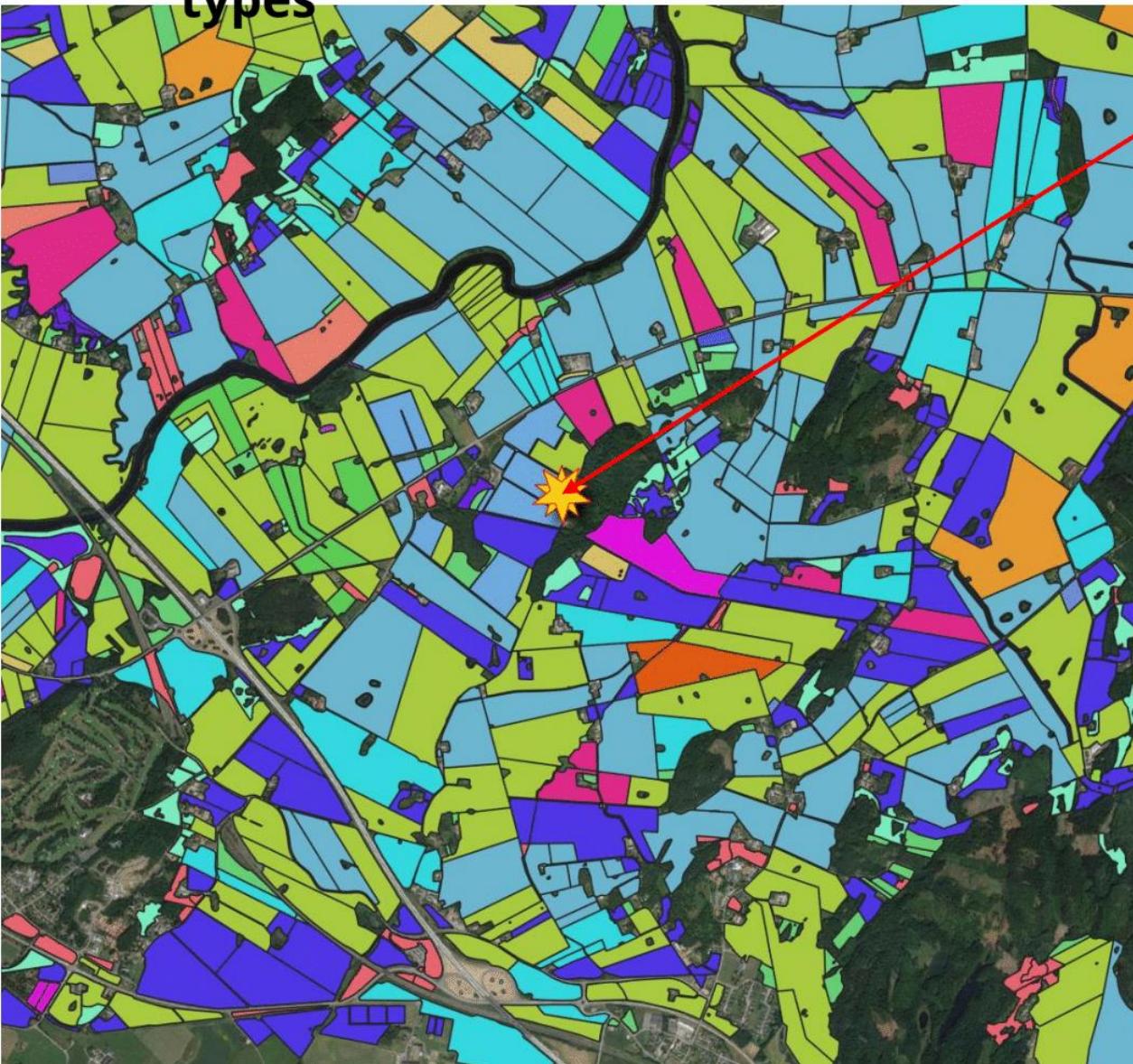
- Intra-landscape modelling (data, indicators)
- Biorefinery-systemanalysis of production (climate, environment, economy)
- Background system "policy for energy, climate and agriculture"
- Background system "environmental aspects of imported soy"

# Design systemanalysis of green biorefineries



# Crop types

Land use in agriculture based on "Blockdatabas" from Farmers' EU-formalia,  
prepared in GIS (total in Sweden 1.1 million separate fields)



Biogas plant

Crop category Falkenberg [874]

- Naturbetesmark bas [80]
- Naturbetesmark extra [2]
- Slätter- och betesvall på åker [219]
- Vallfröodling [4]
- Baljväxter [14]
- Spannmål vårvår [162]
- Spannmål höst [122]
- Oljeväxter vårvår [2]
- Oljeväxter höst [50]
- Majs [11]
- Potatis [9]
- Sockerbetor [6]
- Köksväxter [1]
- Energi- och industrigröda [4]
- Gröngödsling [1]
- Övrigt grovfoder [3]
- Permanenta kulturer [9]
- Våtmark [12]
- Träda [82]
- Skyddszoner [10]
- Anonymt block brukat [5]
- Anonymt block ej brukat [66]

Feature count

Example of agric  
landscape at Falkenberg,  
Halland, with  
"cooperative biogas  
plant"  
Dominance of annual  
crops and pigmanure in  
landscape

# Leaching coefficient

Leaching at the individual field site  
(modelled with GIS based on PLC-6 with



Leaching coefficient (kg N/ha)

0 - 9
9 - 11
11 - 11
11 - 11
11 - 15,17
15,17 - 17
17 - 20,61
20,61 - 20,61
20,61 - 20,61
20,61 - 25,45
25,45 - 28,99
28,99 - 40,69
40,69 - 41,12
41,12 - 47,08
47,08 - 53,06
53,06 - 56,03
56,03 - 60
60 - 60,18
60,18 - 70,61
70,61 - 80,97

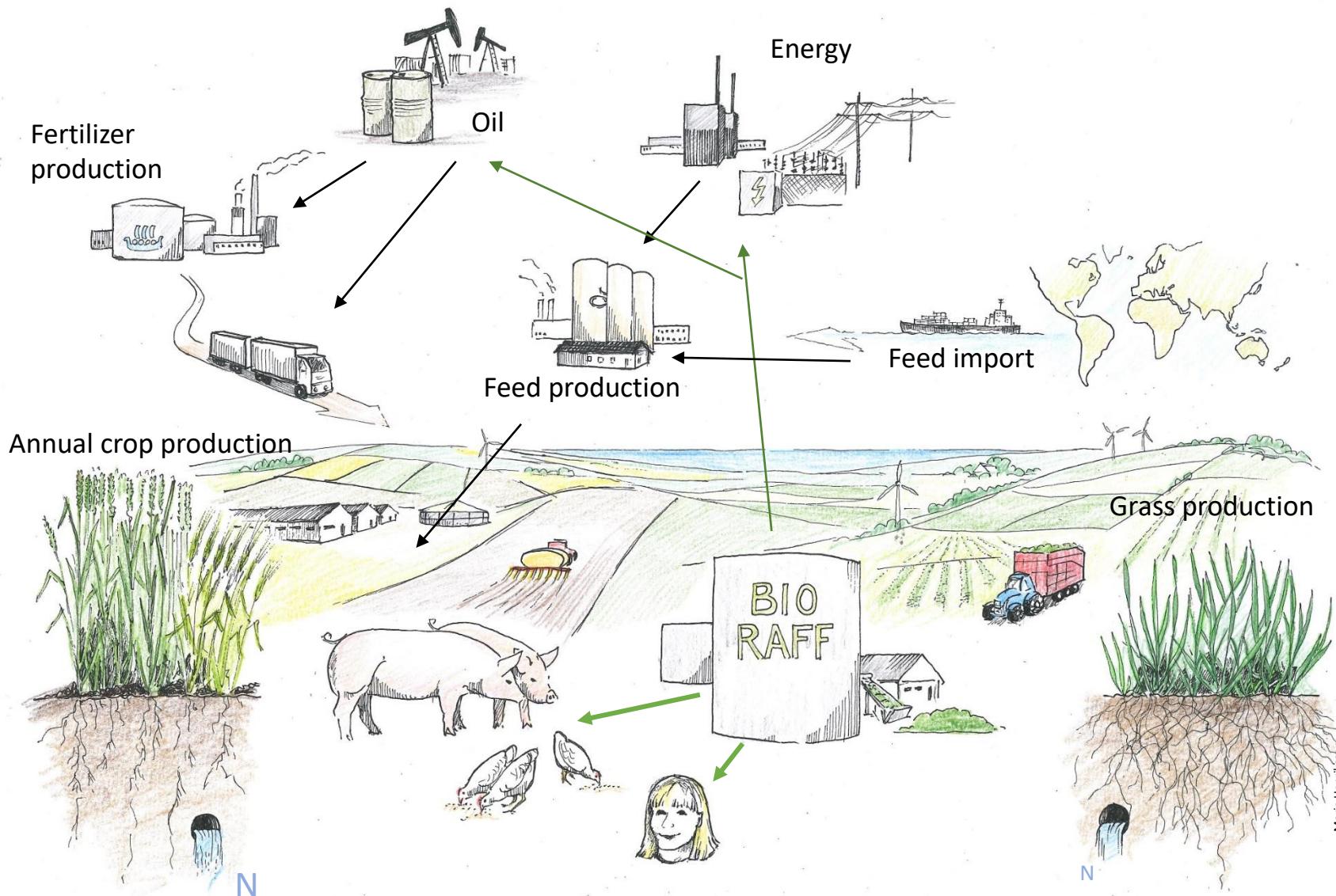
Based on:

- Crop type
- Soil type
- Production area



Leaching  
coefficients in a  
different region  
(Skaraborg)  
showing greater  
differences

# Design systemanalys av gräsbaserad bioraffindarier



**"Foreground system"**  
Intra-landscape  
modelling  
Data &  
indicators

**"Foreground system"**  
LCA of  
production  
and use of  
products

Maria Henriksson

# Biorefineries – system analysis

## System analysis with LCA

### "Traditional Environmental impacts"

- Energy use
- Climate including soil-C changes
- Eutrophication and acidification
- Land use – but only quantitative

### Additional important and necessary impacts

Pesticide effects

Soil quality – proxy-indicator soil-C...

Biodiversity – e.g. crop diversity in landscape,  
different crops/LU impact indicators



New paper by van der Werf,  
Trydeman Knudsen, Cederberg

*"Towards better representation of organic agriculture in Life Cycle Assessment,*  
Nature Sustainability,  
March 16 2020

# Design systemanalys av gräsbaserad bioraffindarier

"Background system"

Energy systems  
in Denmark  
and Sweden

"Background system"

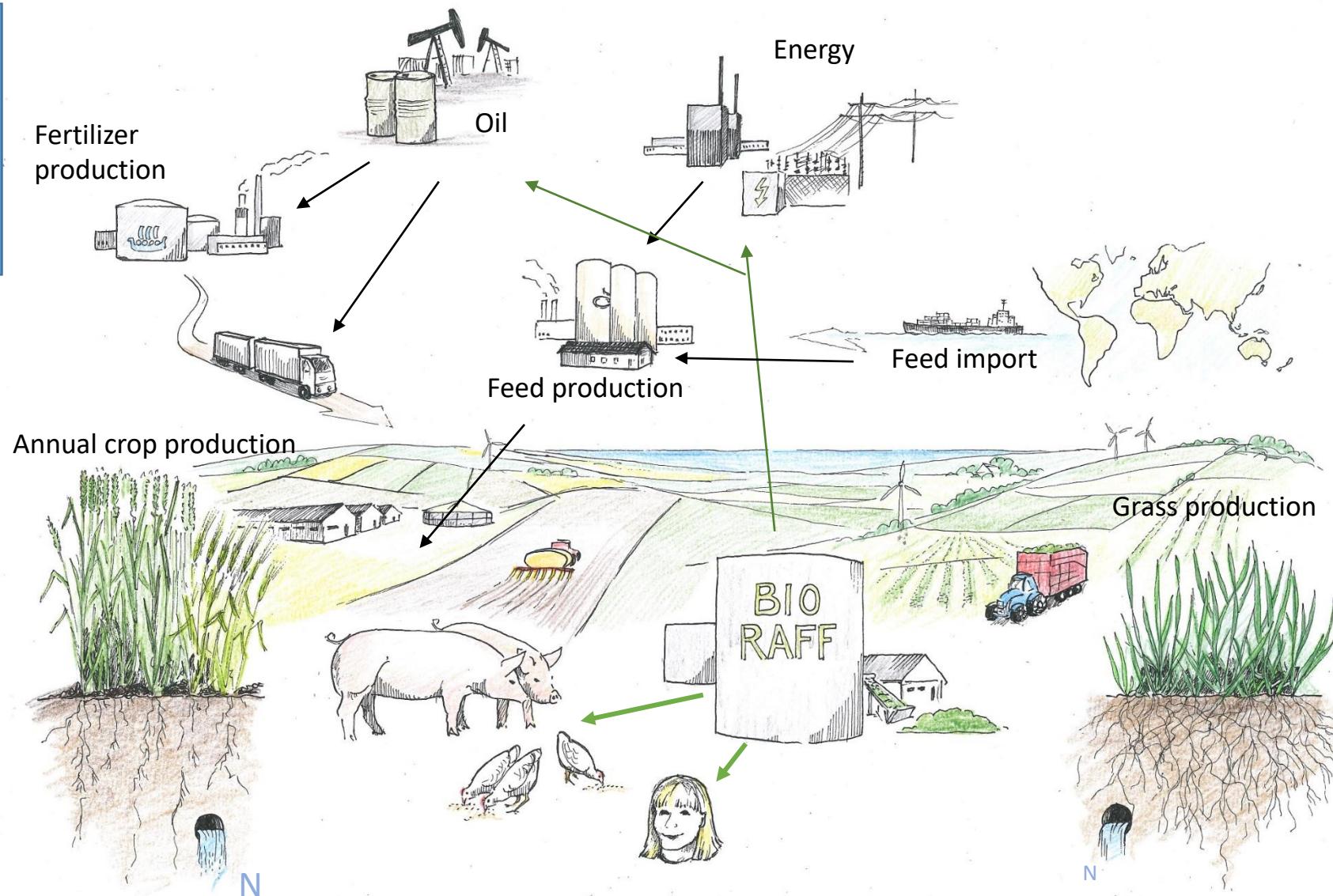
Soybean from  
Brazil

"Foreground system"

Intra-landscape  
modelling  
Data &  
indicators

"Foreground system"

LCA of  
production  
and use of  
products



Maria Henriksson

# Work plan coming 6 months

- Data gathering and processing for modeling biogas and biorefinery integration in landscape with increased grassland acreage
- As above, on the Sötåsen test-pilot specific
- Finish Master thesis on pesticide footprints of Brazilian soy
- Start economy calculations ("Upphandling av ekonomisk konsult")
- Calculate Carbon footprint of organic pig meat (on "green protein")