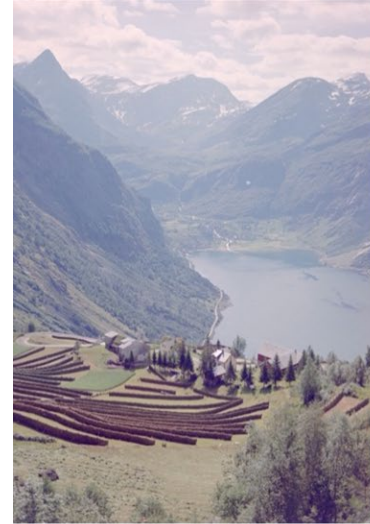


Defining operational sustainability and the need for systems approach in assessing livestock farming

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Failed policies and public interest



What is agriculture?



Methods matter



On the definition the sustainability



Farming systems – diversity



Effects of policies that aims to transform food systems



Conclusions

Terrestrial Animal Source Foods (TASF): Livestock as villains and policy making

Prevailing views

- Agriculture has large climate emissions and livestock is the main cause for this.
 - Livestock should thus be removed from agriculture.
 - By only growing plant food, climate emissions from food production will decrease.
 - Assuming that plants/crops are in essence climate neutral or low impact.
- New diets and dietary guidelines connects diet and agricultural production.
 - Red meat is claimed to be unhealthy and should be minimized.
 - And red meat production is harmful to the environment and the climate, do not eat it.
 - Because one should not eat red meat, it should not be produced either..
 - "..and by the way, red meat is unhealthy anyway".
- The claimed link from red meat to the sustainability of agriculture is never substantiated from a systems perspective.

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Article | Published: 13 September 2021

Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods

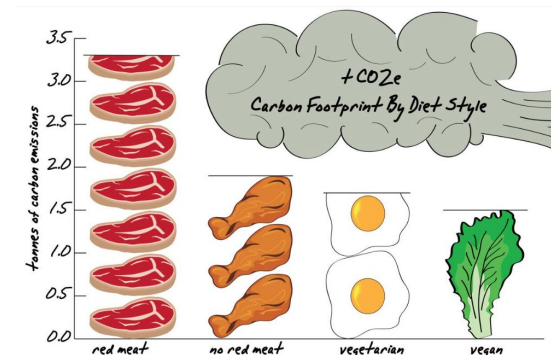
[Xiaoming Xu](#), [Prateek Sharma](#), [Shijie Shu](#), [Tzu-Shun Lin](#), [Philippe Clais](#), [Francesco N. Tubiello](#), [Pete Smith](#), [Nelson Campbell](#) & [Atul K. Jain](#) ✉

CLIMATE | GLOBAL ISSUES

Fact check: How bad is eating meat for the climate?

Wulf Wilde
10/30/2022

More and more people are going vegetarian or vegan in an effort to help fight climate change. But is a



Failed policies

Farmers Won't Save the Climate at Their Own Expense

Pushing farms toward a green transition could result in a big backlash.



By [Anchal Vohra](#), a columnist at *Foreign Policy*.



DAIRY

Ireland Proposes Culling 200,000 Cows to Help Meet Climate Goals, Farmers Push Back



The Irish government estimates the plan would cost the nation \$640 million and assist the agricultural industry in reducing greenhouse gas emissions by 25% over the next seven years.

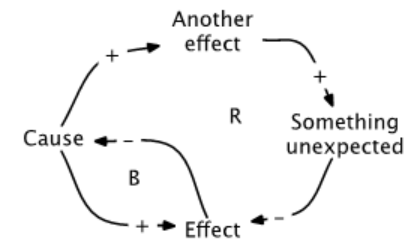
(Canva)

What is agriculture? – A system!

- "What is agriculture?"
 - Agriculture is the art and science of cultivating the soil, growing crops, and raising livestock. (National Geographic)
 - Agriculture **encompasses crop and livestock production, aquaculture, fisheries and forestry** for food and non-food products. (Wikipedia)
 - Agriculture is the **practice of cultivating natural resources** to sustain human life and provide economic gain. (Maryville university)
- **Photosynthetic primary production**; Everything upwards in the system depends on it. Production and economy and ecosystem services;
- A challenge to **totally capture agriculture in calculations and models**
- **Sustainability is a measure of the survivability** of the system
- No change can be done to the whole system before **consequences have been assessed with proper models**

Methods matter – aligning methods with sustainability goals

- Must be able to **define sustainability**
 - **Quantitative and operational** definition of sustainability
 - Setting **goals with numbers** and estimate gap
 - Setting numerical **gaps**
- Must be able to do **systems assessment** and see the **feedbacks** of the system.
 - Involves advanced **system dynamics** modelling
 - Must be **mass- and energy-balance consistent**
- Social impacts are **as important as economical and physical aspects**
 - Democracy must prevail
 - Social disruptions involve huge risks



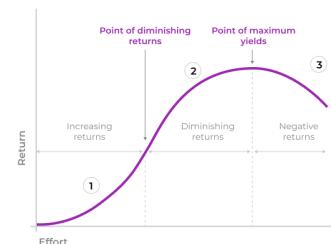
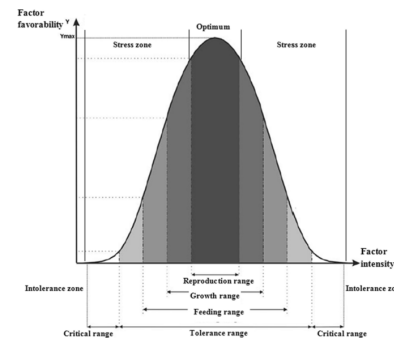
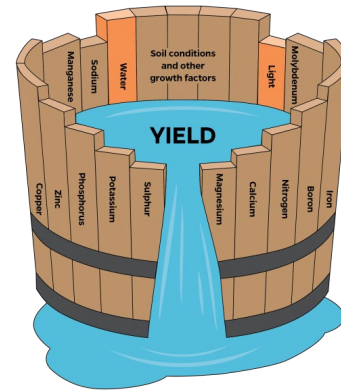
On the definition the sustainability of food production and food products

1. **Sustainability** of food production is a **systems property**. Products from a sustainable production system unit (farm), are all equally sustainable **primary products**
2. Most food production systems in the Nordic area are coupled, multi-product systems using an **integrated animal-plant-land system**. This must be represented in the assessments.
3. Sustainability must have **quantitative values to make sense**. Gap-closure must be done

Gap closure in policy is about going from understanding to make models, and then use models to develop design

Basic principles of sustainability must include:

- 1. Limits to growth** Liebig's Law of maximizing the harvest output to the limiting resource input for growth of plants. Grand scale sustainability: Stay within planetary limits for key natural resources (Critical annual use).
- 2. Ecological niche.** Ecological conditions envelope and conditions limits, corresponding to Shelford's Law of Tolerance. No environmental pollution over critical load to the environment or food that creates unacceptable disturbance to ecosystem status of function.
- 3. The Law of diminishing returns** is based on efficiencies towards thermodynamic maximums. No conversion is 100%, there is always a loss.
- 4. Economic sustainability.** Each farm unit must be economically profitable, and as a system be positive in the National accounts
- 5. Social sustainability principles** Efficient institutions, without social disruptions, social trust, democracy



Sustainability assessment cover many aspects

1. Nutrient supply

- I. Nitrogen and phosphorus sufficiency needs more attention to be sustainable, animals are key for closing loops and using all lands.

2. Environment

- I. Nitrogen
- II. Phosphorus
- III. Carbon

IV. Soil genesis and soil erosion

3. Economy

- I. Farm level
- II. National accounts level

4. Social

- I. Farm level
- II. National social dynamics
- III. European level dynamics

5. Systems level farm

- I. Interconnectedness allowing for system interactions and optimization

6. Society and institutions

- I. National farm system connections functioning
- II. Proper market functionality, publicly supervised arena under rule of law and arbitration
- III. Absence of oligopolies and monopoles
- IV. Accountable and effective public institutions

7. Society

- I. System resilience, back-ups and stability
- II. Self-sufficiency

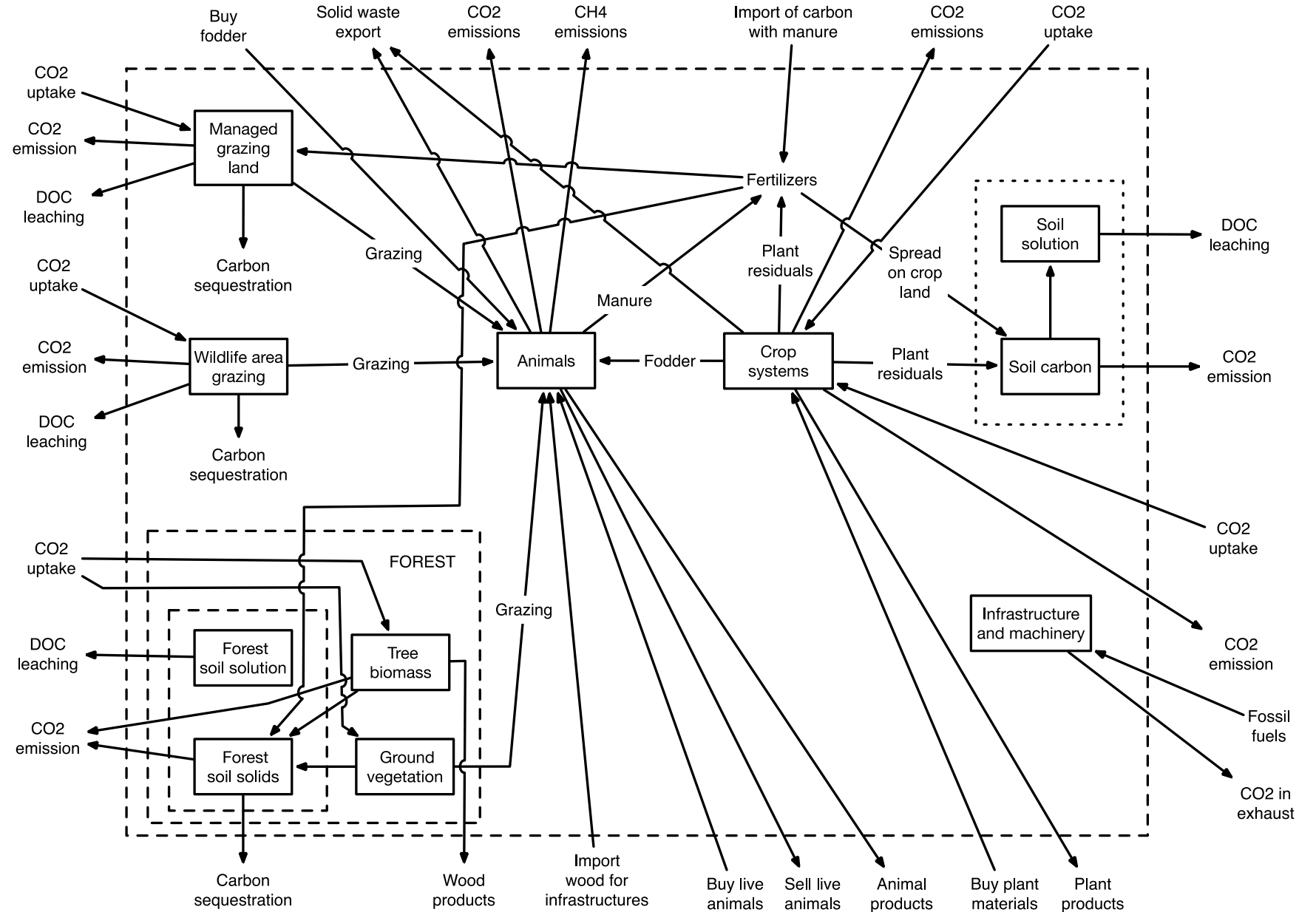
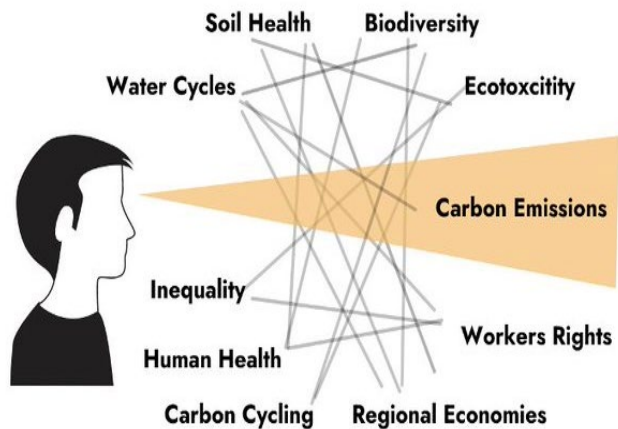
Nordic agriculture: diversity and integration

- Integrates animal, plants, land
- Diversity of farming systems in Norway:
 - A mixture of farms with different types of land areas
 - different flexibilities
 - different aspects of sustainability



Complete carbon mass balances are needed

Carbon Tunnel Vision



Scenarios on the impact of reductions of livestock (50% - 85%-100%) on Norwegian and Swedish food production from policy suggestions

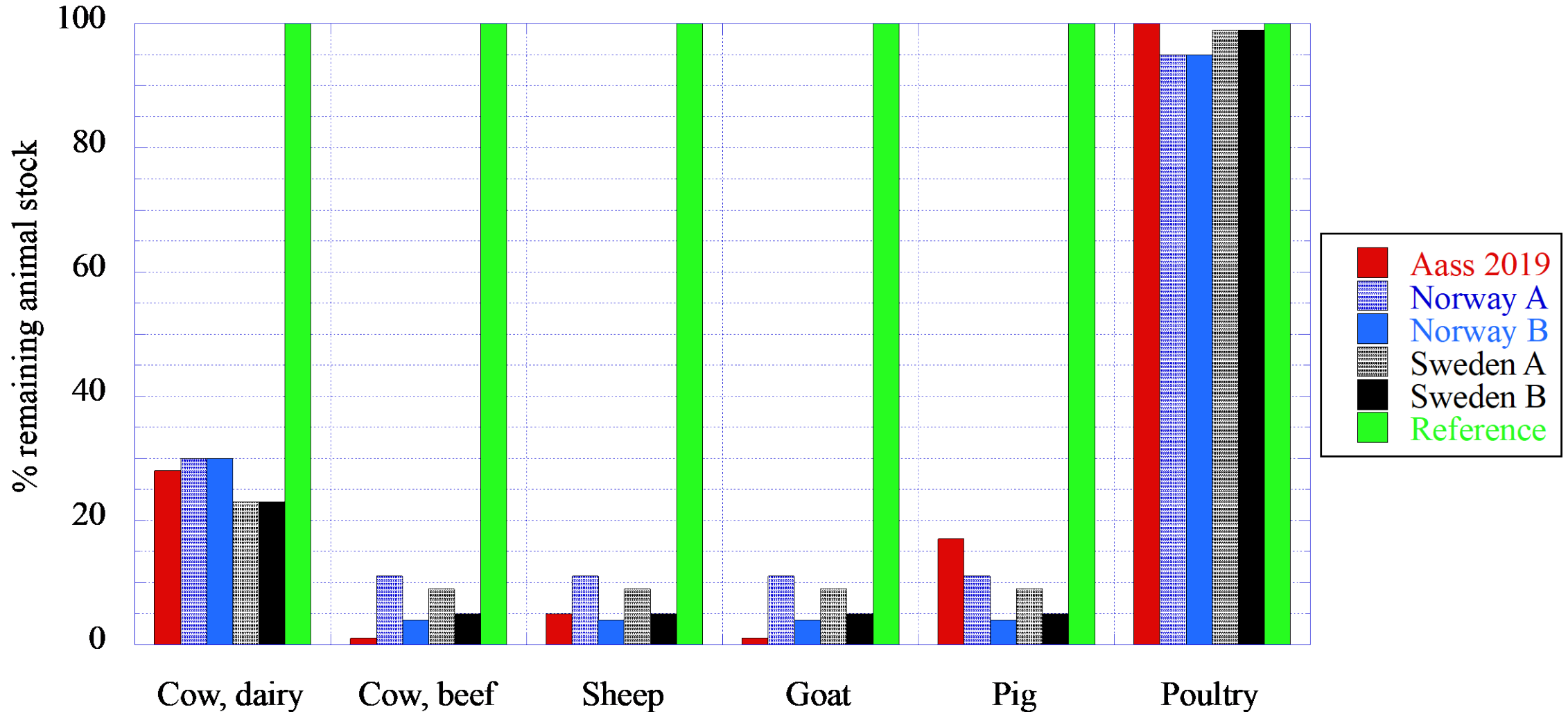
Inputs and calculations

- Inventory: available land, land use, land suitability, climate factors
- Livestock production, livestock fodder and human food production
- Estimation of total potential for human food crops

Outputs

- Livestock population
- Total domestic food production
- Effects on Self-sufficiency, Carbon sequestration/balance, Production value

Change in livestock when enforcing the planetary diet (-85% livestock), as remaining animal food production



A= red meat allowance 30 kcal per capita and day; B= Meat from dairy cows included

Production summary for enforcing the planetary diet in Norway and Sweden

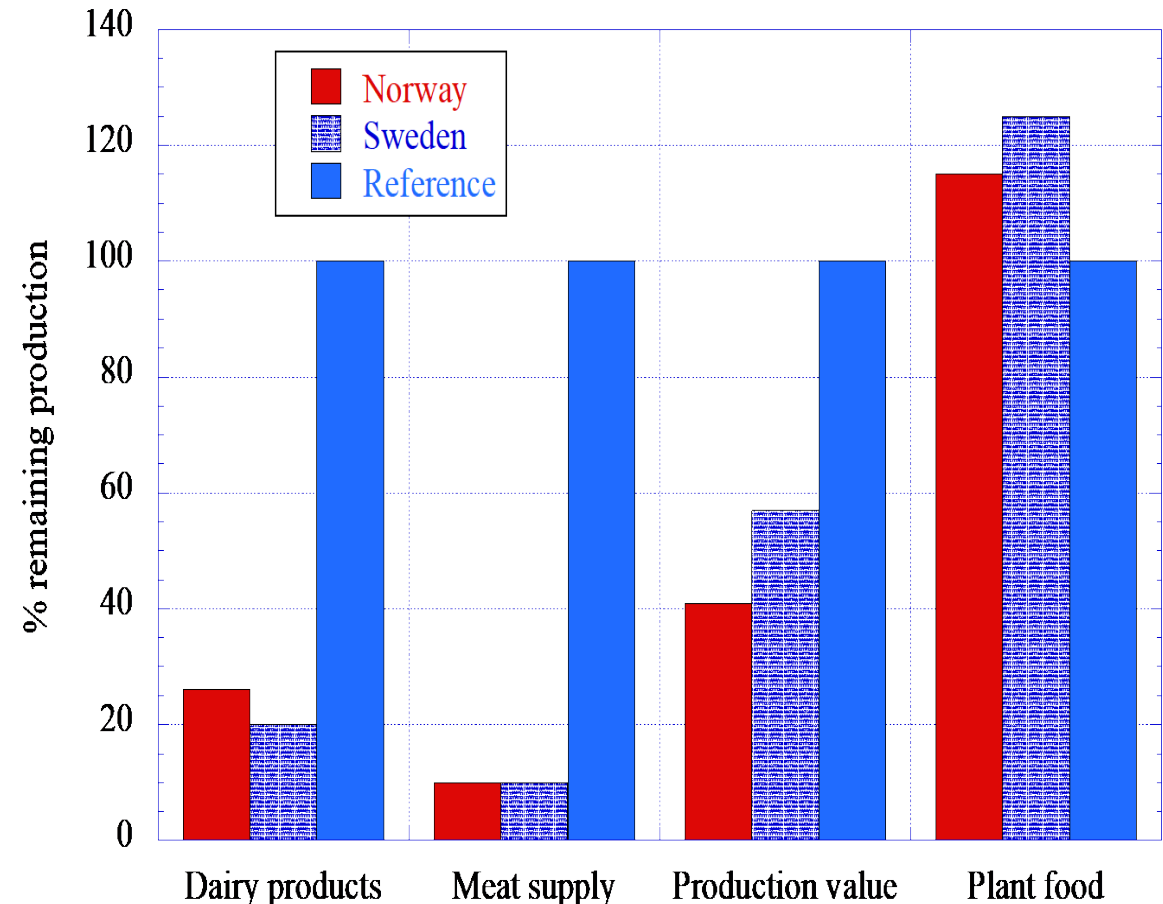
Expressed as remaining food production

Norway:

1. 74% reduction of dairy cows and dairy
2. 90% reduction of beef, sheep, pig, reindeer
3. 80% primary food production decrease
4. 59 % loss of "gross production value" in agriculture
5. Self-sufficiency falls from 49% to 14%

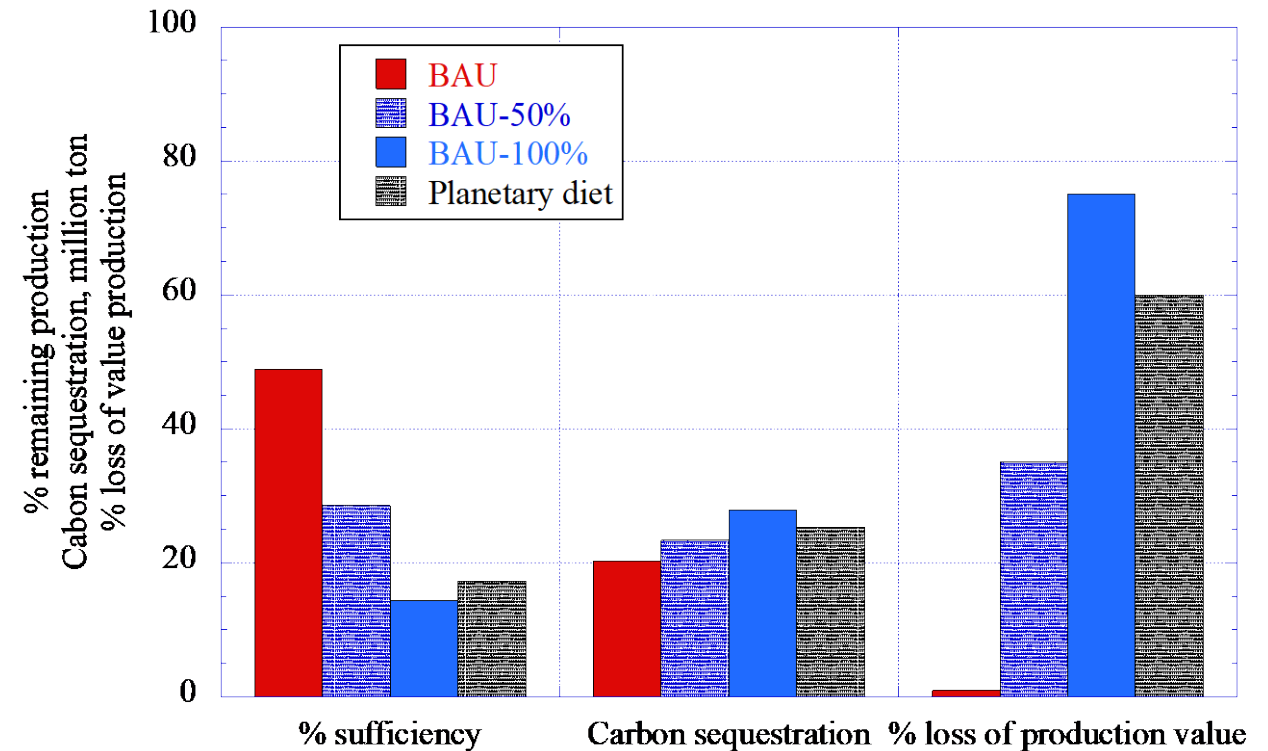
Sweden:

1. 80% reduction of dairy cows and dairy
2. 90% reduction of beef, sheep, pig, reindeer
3. 70% food production decrease
4. 43 % loss of gross production value in agriculture
5. Self-sufficiency falls from 55% to 22%



Consequences of implementing *the planetary diet* and reduction of livestock at 50% and 100% in Norway/Sweden

- The reference is for setting the scale between 0 and 100%.
- Self-sufficiency drops from about 49% to about 14% (in -100% livestock)
- Carbon balance increased some
- Production value losses are very substantial as compared to Business as Usual.
- Farms are carbon sequestration producers. Nordic farms sequesters about 200 million C ton/year
- Calculations show at present production, **Nordic farmers produce animal products that are sustainable with respect to carbon from a systems perspective**



Huge losses in self sufficiency and production value with small gains in carbon balance



Conclusions

1. **Get reality:**

1. No human food production possible without livestock.

2. **Flawed tool uses:**

1. The previous ways of assessing food systems fall short in capturing the complexity of farming,
2. overestimates harms of livestock farming, and
3. are unsuitable for policy decisions

3. **Shit in-Shit out:**

1. LCA has no past, no future, no time.
2. Poorly defined system boundaries.
3. All dynamics and feedbacks have been ignored.

4. **Ideological bias:** Full farm systemic estimations should be used – allocation to products inside farms are deceptive and nonsense

5. **Get the system boundaries right:** Impacts beyond farms with landscape, social cohesion and societal benefit must be included

New report

Aspects of sustainability, Resilience food supply capabilities in Norwegian Agriculture and Food Systems

The role of animals combined with crops and an assessment of the consequences of different potential changes in the Norwegian food production system.



A report compiled by

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Aspects of sustainability, Resilience food supply capabilities in Norwegian Agriculture and Food Systems - The role of animals combined with crops in the Norwegian food supply, and an assessment of the consequences of different potential changes in the Norwegian food production system

universities in Belgium, Netherlands

Thank You for your attention

Stefan Hellstrand¹, Anders Herlin², Harald Ulrik Sverdrup³

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Table of contents

| Chapter | Page |
|--|------|
| 0 Executive summary | 3 |
| 1 Context and frame of the report | 7 |
| 2 Methods matters | 13 |
| 3 The Norwegian food system, a simple overview | 25 |
| 4 Formally defining operational sustainability | 39 |
| 5 Applying operational sustainability and filling in the numbers | 57 |
| 6 Dietary recommendations and the scientific basis | 92 |
| 7 Nordic Integrated Food System Assessment Model | 104 |
| 8 Conclusions and policy advice | 109 |
| 10 References | 112 |
| 11 Some about the authors | 133 |



System dynamics and Serious games
Inland Norway University of Applied Sciences
Hamar, Norway
2023

