

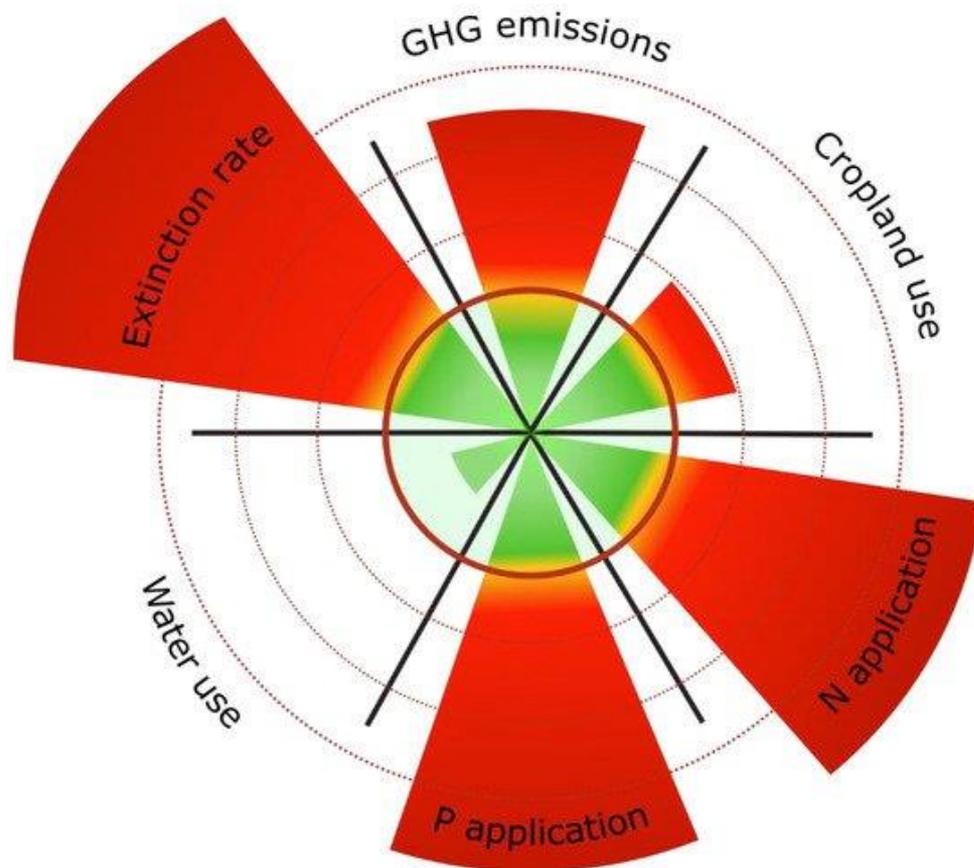


SCIENCE AND
EDUCATION **FOR**
SUSTAINABLE
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Designing a future food vision for the Nordics through a participatory modeling approach

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The Swedish diet is highly unsustainable



What will happen to semi-natural pastures if meat consumption decreases?



First study in Sweden

Food Policy 58 (2016) 1–13

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Limiting livestock production to pasture and by-products in a search for sustainable diets 

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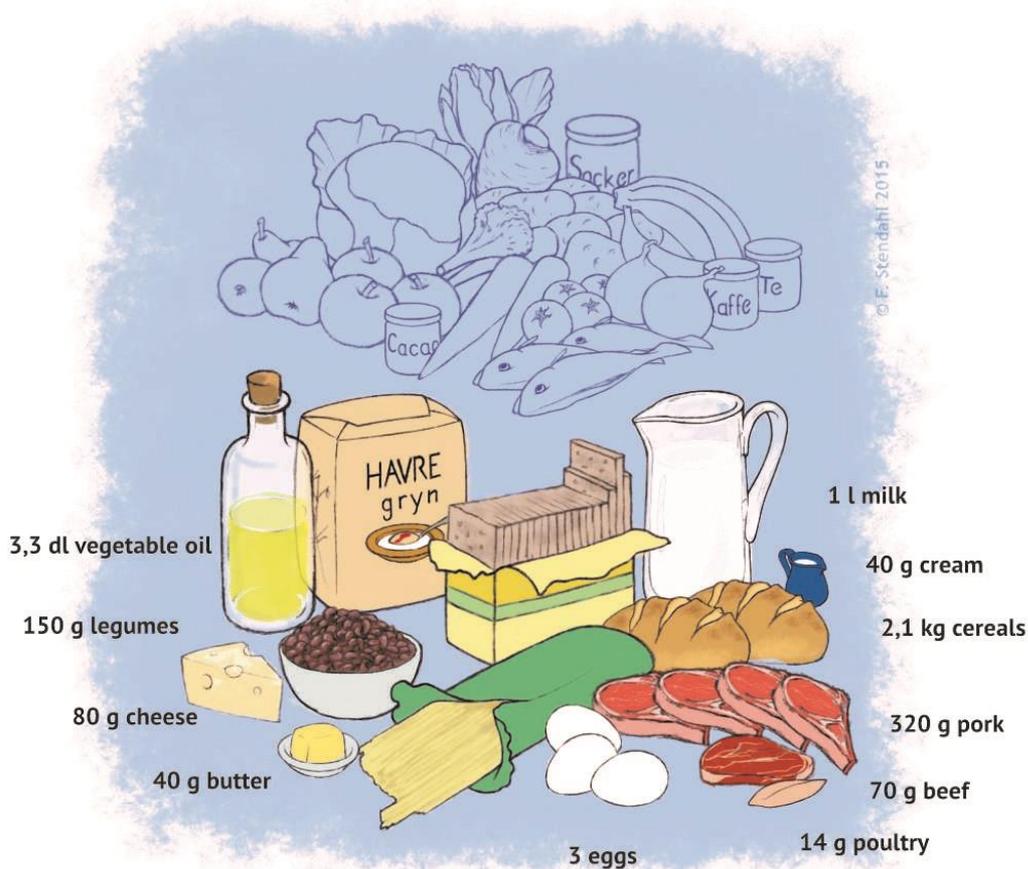
ABSTRACT

A method was developed for designing 'fair' diets (not using more than globally available arable land per capita) and for assessing the sustainability of such diets. The diets were based on the principle of 'ecological leftovers' for livestock production, i.e. raising livestock on pasture and by-products not suitable for or wanted by humans. The method was applied to Sweden using three different scenarios for livestock production, all taking the starting point that semi-natural pastures should be grazed by ruminants for

We looked at a food system in which:

- Pastures are used for meat and dairy production – three scenarios with different intensities
- Monogastric are mainly raised on 'ecological leftovers' (Garnett, 2009)
- The population eats a nutritious diet (NNR) from local (Swedish) land
- No more than 0.21 ha per person per year is used for food production -> produce food for 13.5 million in Sweden
- Agriculture is made fossil-free by producing bioenergy from waste and some ley

Results presented



- ❖ Agricultural production -> diets
- ❖ GHG emissions
- ❖ N and P flows
- ❖ No of working hours
- ❖ Accidents
- ❖ Toxicity exposure



Approached by five Nordic NGOs



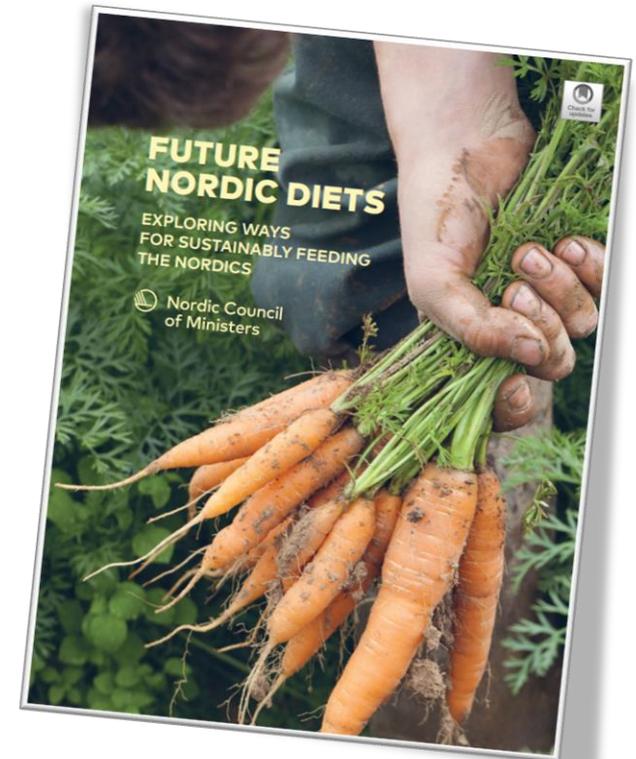
Norsk Bonde-
og Småbrukarlag



A vision for Future Nordic Diets

“To develop a new Nordic **agricultural and food system** that will contribute to global sustainable food systems and **climate mitigation** building on an **agroecological approach**”

- **Iterative process including stakeholder workshops**
- **Food vision**
 - Production within the Nordics
 - Nordic Nutrition Recommendations
 - Organic farming
 - Avoid food-feed competition: “Livestock on leftovers”
 - Fossil free agriculture: Agriculture self-sufficient
- **Mass flow model of the food system**



*Karlsson et al. (2017). Future Nordic Diets :
Exploring ways for sustainably feeding the Nordics.
Copenhagen: Nordisk Ministerråd.*

Stakeholders defined the vision – researchers translated to model input

	Normative decisions	Implications for the scenario
Food consumption oriented	Future diets should be based on the type of food currently consumed and seek to fulfil Nordic nutrient recommendations.	<ul style="list-style-type: none"> - A sample diet resembling current consumption was used as a 'baseline' diet from which the scenario diets were produced. - No novel foods (insects, synthetic meat, algae etc.) were included.
	Food waste should be reduced compared to current levels.	<ul style="list-style-type: none"> - Avoidable food waste in the retail and consumer stage of the food chain was assumed to be halved compared to current levels.
	Future diets should facilitate equitable consumption based on local resources.	<ul style="list-style-type: none"> - Arable land was allocated to grow most plant based food needed for nutritionally adequate diets for as many as possible. - A global 'fair share' of wild caught fish was included in the diets.
	Food should be produced locally, but food not possible* to produce locally should be imported.	<ul style="list-style-type: none"> - The amount of vegetables cultivated in greenhouses was reduced by half compared with the 'baseline' diet and replaced with shelf stable vegetables and roots able to grow on open fields.
Production oriented	The food should be produced in an organic farming system acknowledging agroecological principles.	<ul style="list-style-type: none"> - Tropical fruits, tea, coffee and cocoa was assumed to be imported and included in the diets.
	More durable breeds of grazing animals should be used to be able to graze in rough terrain.	<ul style="list-style-type: none"> - At least one-third of arable land in rotation was allocated for grass legume leys to facilitate biological nitrogen fixation. - Rapeseed and legume cultivation was limited to 17% and 10% of arable land. If needed, additional ley was included in order not to exceed these limitations. - Current yield levels were factored with literature values for the yield gap between organic and conventional farming.
	Some land currently used for annual cropping is unsuited for this and should be left for nature conservation.	<ul style="list-style-type: none"> - Livestock production parameters were chosen to represent organic practices with respect to time spent on pastures, growth rates, feed, etc.
	Semi-natural pastures should be grazed by livestock to promote biodiversity and preserve the cultural landscape.	<ul style="list-style-type: none"> - A relatively low milk yield of 6,000 kg milk per year from dairy cows was assumed. - Drained and cultivated peatlands were excluded from the

Two scenarios – Different number of animals

We assume that at least **1/3** of the arable land is cultivated with **grass legume leys**.

Fix **nitrogen** and manage **weeds** in **organic crop rotations**.

Sufficiency (SY) – Limiting animal numbers

- **Ruminants** (cattle and sheep): Enough to graze all **Semi-natural pastures**.
- **Monogastrics** (pigs, poultry, aquaculture): **By-products**

Efficiency (EY) – Producing more food by using all resources

- **Ruminants:** Use all **grass-legume leys** grown in the **organic crop rotations** + **Outfield areas** in Norway
- **Monogastrics:** **By-products** + **Grains**

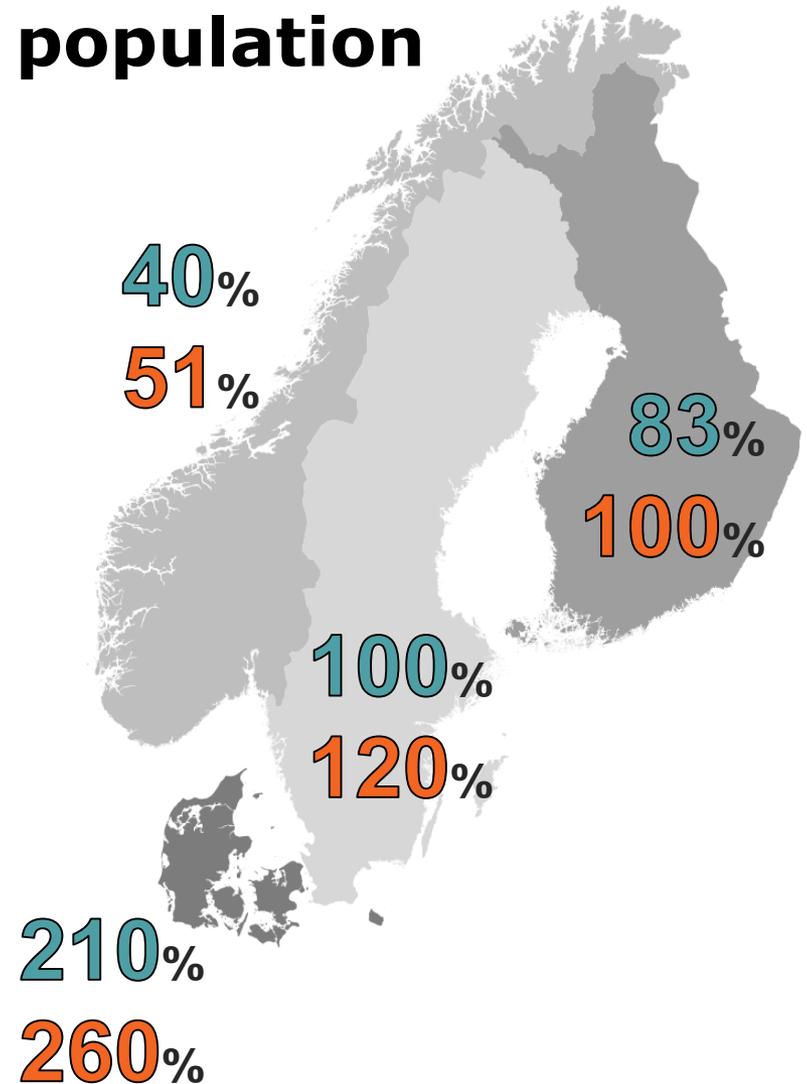
Potential to feed a large population

The Nordics:

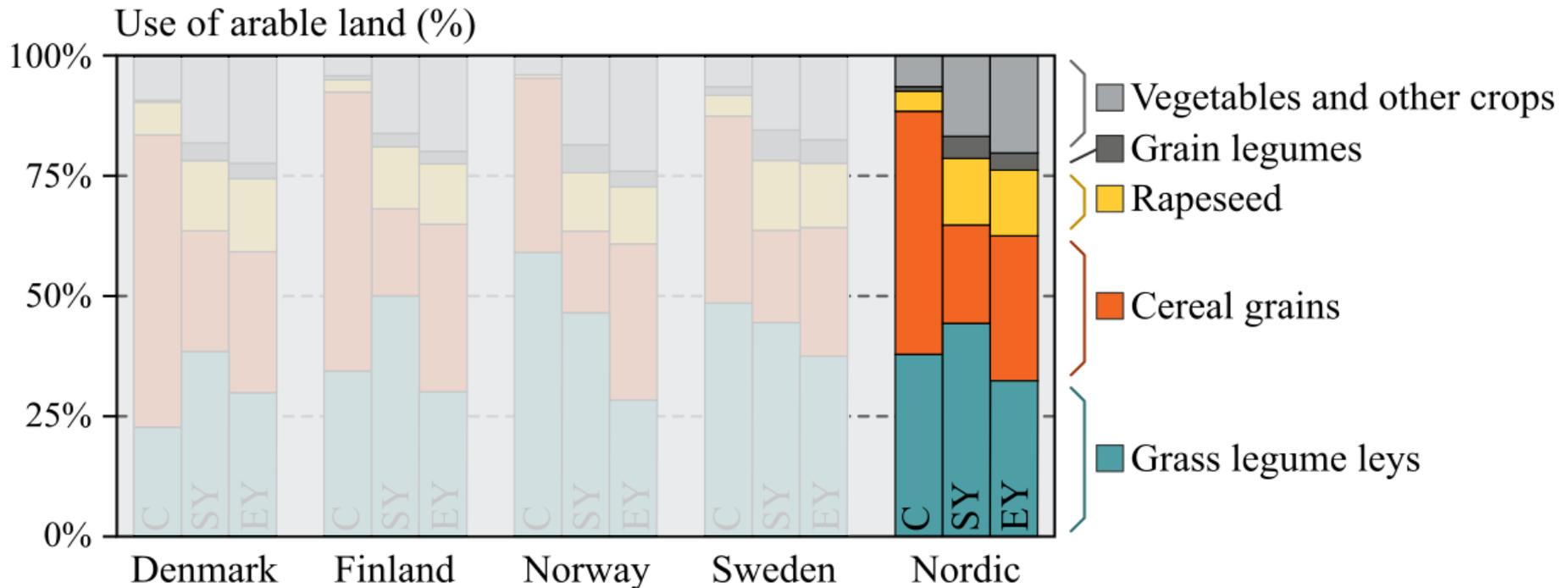
Projected (2030): **28**

Sufficiency (SY): **31**

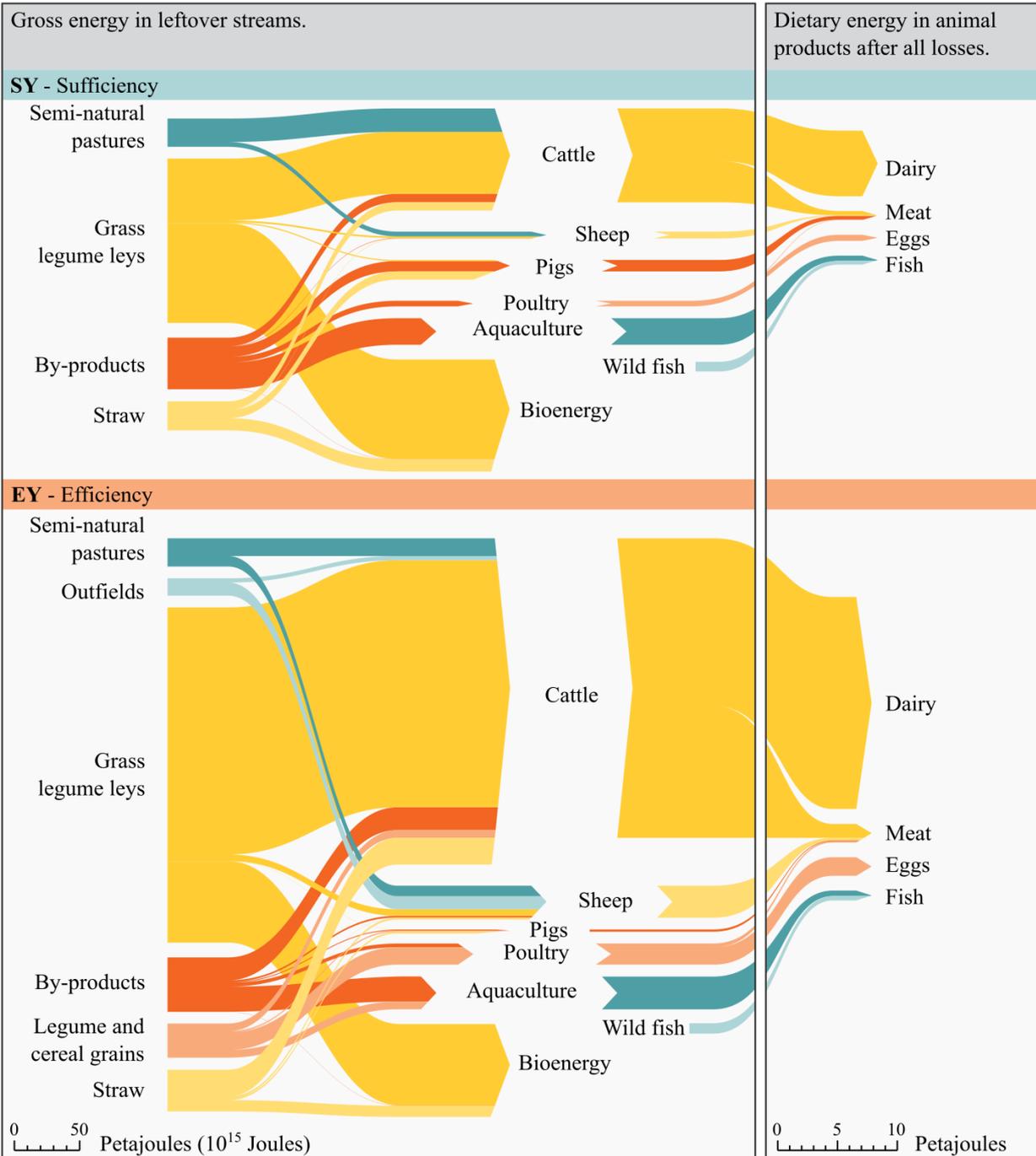
Efficiency (EY): **37**



Use of arable land



- **SY Scenario:** Grass legume leys **left on the field**
- **EY Scenario:** All grass legume leys **used**
Feed cereals introduced to crop rotations

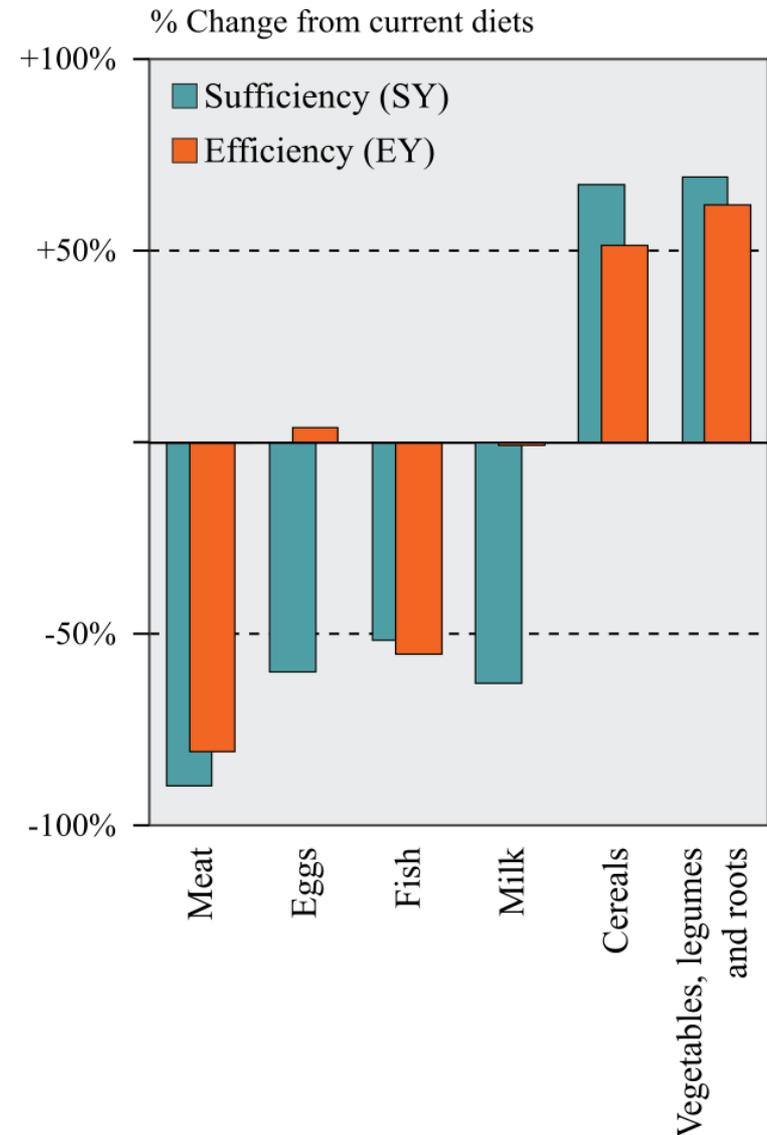


Change in animal numbers

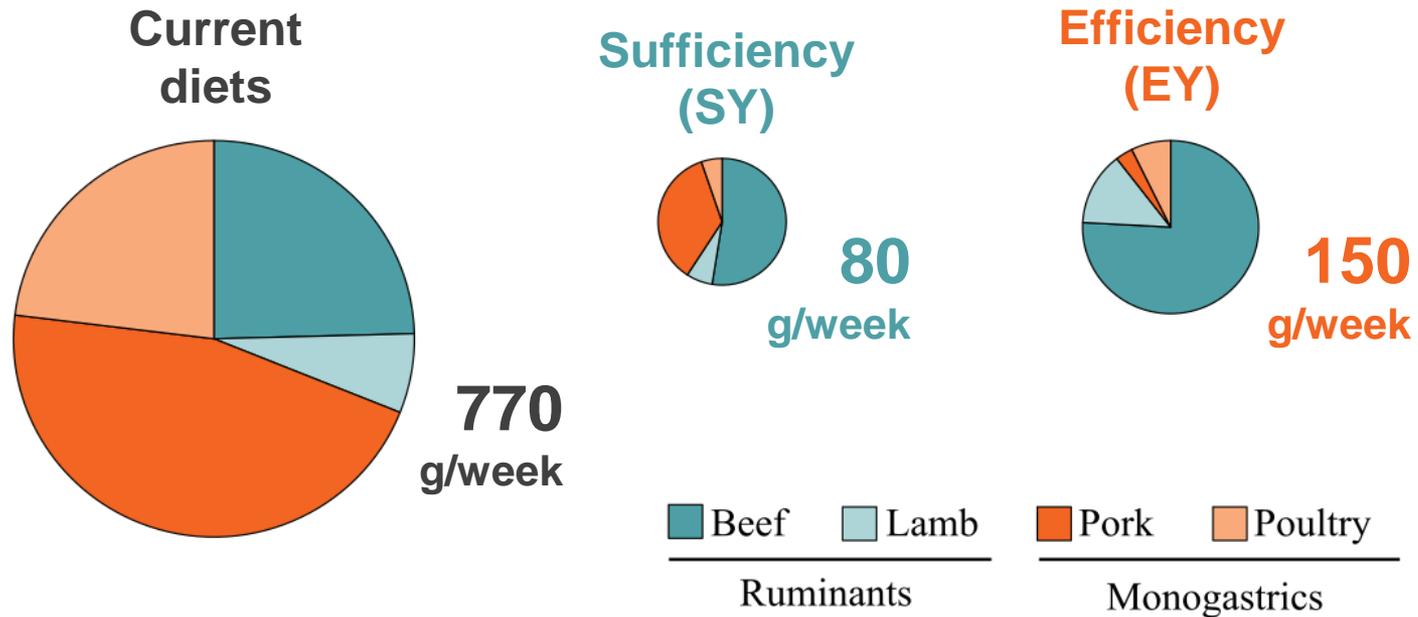
	2014	SY	EY
Livestock (million heads)			
Cattle	4.8	1.3 	4.1 
Sheep and goats	3.2	0.9 	4.4 
Poultry	39	11 	34 
Pigs	16	1.1 	0.2 
Fish (Live weight Mton)			
Aquaculture	1.4	0.5 	0.5 
Wild caught	3.4	0.2 	0.3 

Changed diets

- **80-90% reduced meat consumption**
- More **legumes, vegetable oils** and **cereals** to fill the **protein and fat “gaps”**
- More **vegetables and roots** – recommended diet
- High **carbo hydrate** content
- Some **vitamins and minerals challenging**
 - Vitamins A (animal/carrot) and D (fish/fort.)
 - Iodine (fort.), selenium (fort.) and iron (whole grain)

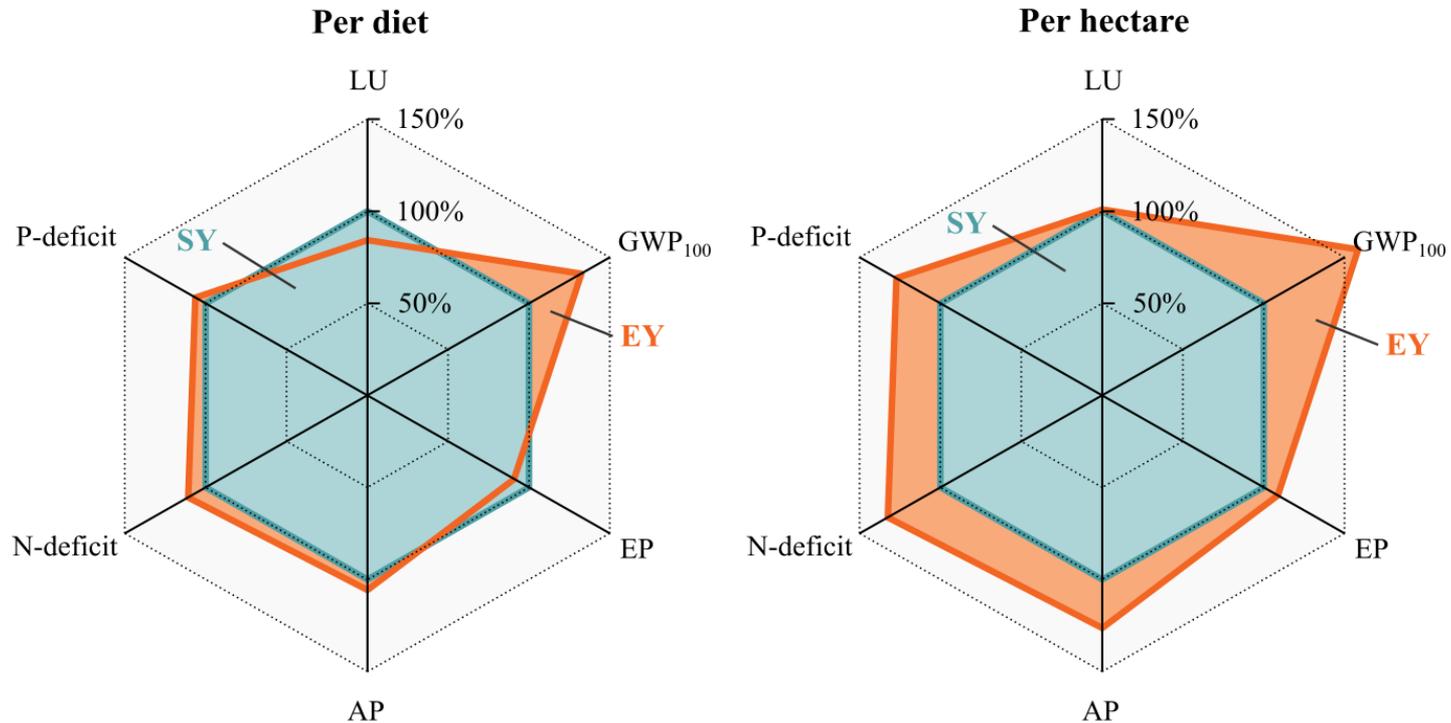


Changed meat consumption



Relatively **more meat from ruminants**, especially in the EY scenario

Environmental impacts



GHG emissions of **0.36 (SY)** and **0.48 (EY)** tCO₂e cap⁻¹ year⁻¹.

Estimated GHG emissions from agriculture to produce the **current Nordic diets** range between **1.3 – 1.9** tCO₂e cap⁻¹ year⁻¹

Two papers on this study

Agronomy for Sustainable Development (2018) 38: 59
<https://doi.org/10.1007/s13593-018-0528-0>

RESEARCH ARTICLE



Designing a future food vision for the Nordics through a participatory modeling approach

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Abstract

The development of future food systems will depend on stakeholders. Scenario modeling is an adequate tool for debate, it is important to make explicit and transparent how an approach working with five NGOs, we developed a future vision for Sweden) through an iterative process of defining the scenario was reached. The impacts on food production, land use, and bioenergy were modeled using a mass flow model of the food system. Food is produced locally and livestock production is linked to forage from pastures and perennial grass/clover mixture

Land Use Policy 85 (2019) 63–72

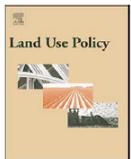
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Resource-efficient use of land and animals—Environmental impacts of food systems based on organic cropping and avoided food-feed competition



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ABSTRACT

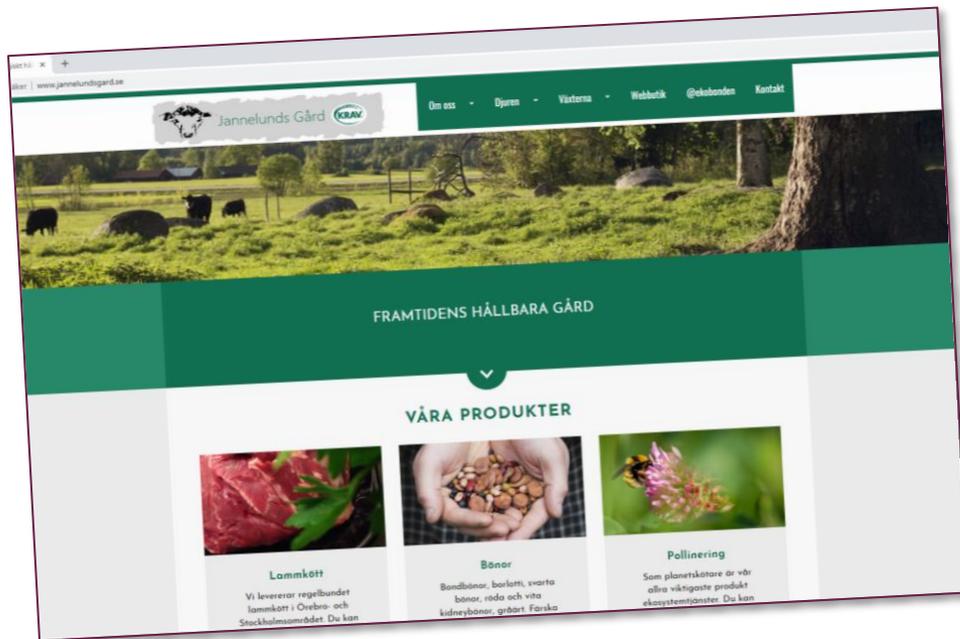
Current food systems are resource-inefficient, as farm animals consume large quantities of human-edible crops and large amounts of external fossil fuel-based inputs are used for energy and fertilisers. In this study, we assessed the production capacity and environmental performance of an alternative theoretical regional food system based on organic production, avoided food-feed competition and agriculture that is self-sufficient in bioenergy. Livestock in the system are reared solely on feeds that do not compete with food production, i.e. grass from permanent pastures, temporary grass-clover leys and food industry by-products. We modelled the effect of this food system on food production, land use, environmental impacts and nutrient flows, using the Nordic region as a case. As crop rotations under organic farming need leguminous forage crops to supply nitrogen and

Summary/conclusions

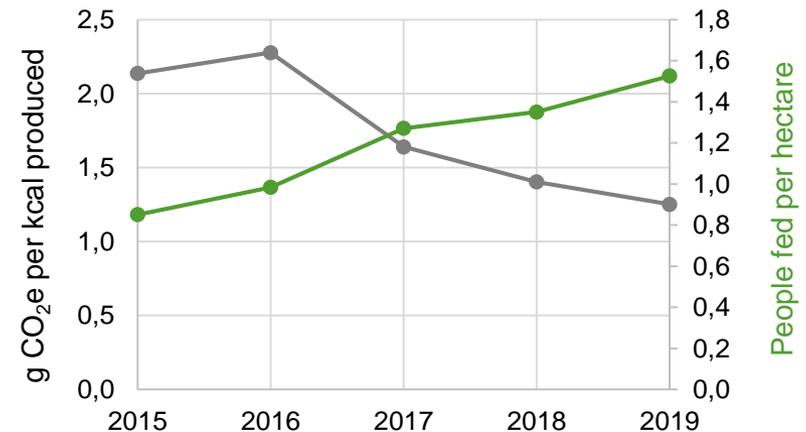
- Potential to **feed the projected Nordic population in 2030** and more **despite lower yields** by utilizing “room” gained in the food system from **reduced food-feed-competition**.
- **Reduced consumption of meat** (80 – 90%) but relatively more beef remaining
- **Diversified agriculture**: Cereals and ley → Vegetables, legumes, oil crops
- **Reduced climate impact of diets**
- **Nitrogen and phosphorous deficits**, circulation from society would be needed but not enough



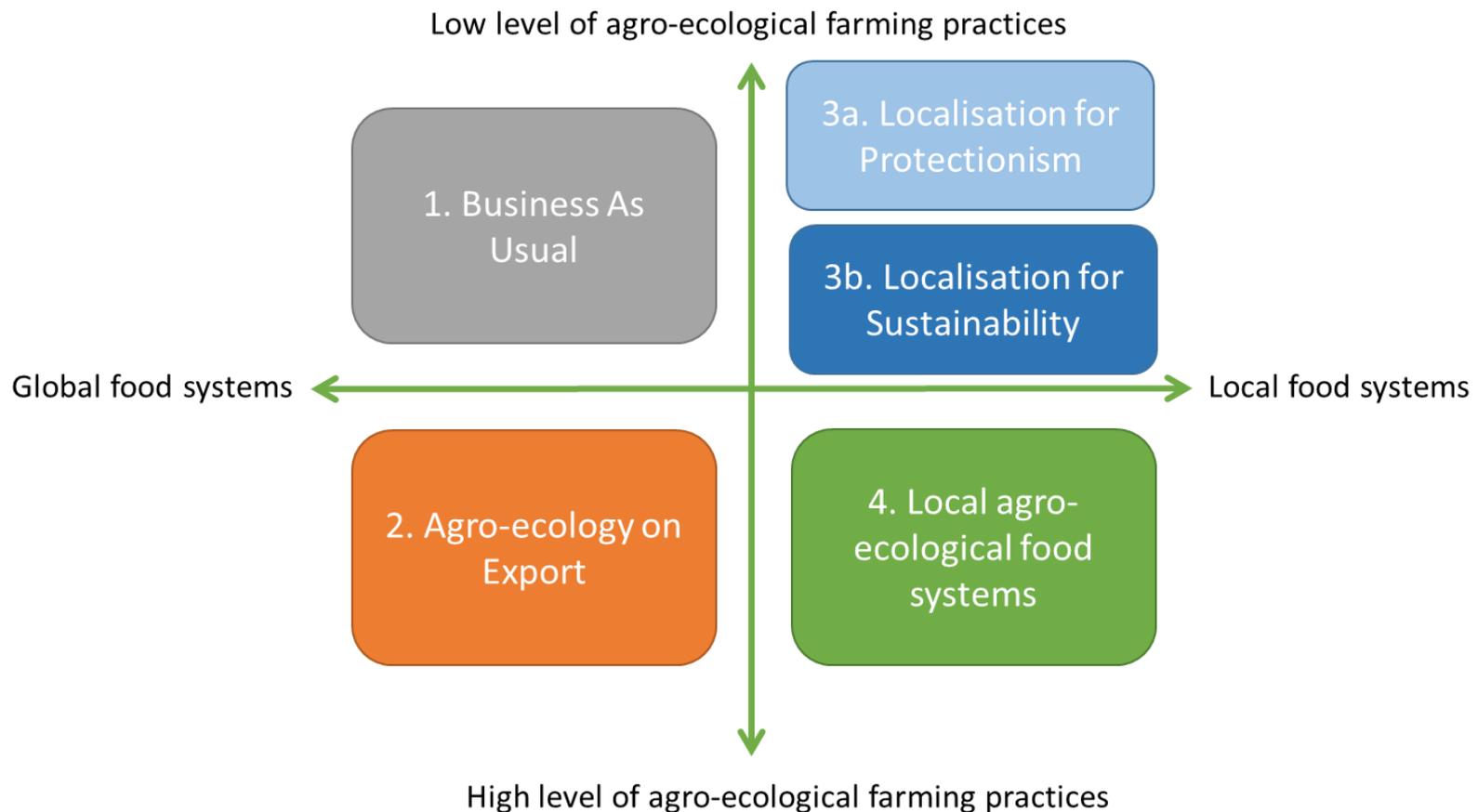
Farm level implementation – diversification of livestock farms



“ Animals fill a central place at Jannelunds Gård today, and will continue to do so in one way or another. But instead of rationalizing and expanding our animal production, we see growing plant protein for human consumption as a great opportunity.”



Five scenarios for agro-ecology in the EU





Thanks!

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