

Effective and sustainable organic agriculture Experiences from a case study farm in central Sweden.

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Situated in "Roslagen" in a mosaic landscape composed of glacial drift hills and valleys with decomposing peat



A photograph of a red wooden barn with a corrugated metal roof. The barn is made of vertical wooden planks and has several windows. The text is overlaid on the barn's wall.

The farm:

8 ha arable land

3,5 ha meadows

5,5 ha pastures

18 ha forests (partly grazed)

The project: Future Agriculture

The project aim was to, on an actively used farm, perform a management shift to intensive food production based on locally and renewable resources, with different livestock combinations and crop rotations. And to assess how the production of different biofuels compete with, and affects, food production output and nutrient fluxes.



Participatory research; kick off 2009

Our scenario 2030 (based on IPCC and FAO)

- Emissions of less than 1 ton CO₂eqv per person and year
- Every ha of arable land has to provide at least 5 capita with food (today 2.5 capita/ha in Sweden).
- The era with access of cheap fossil oil is ended and P fertilizer of good quality (stocks expected to be finished within 30-40 years) is a limited resource
- More insect species, previously restricted by low winter temperatures, will be established.
- Weeds, adapted to grow under prevailing limited light conditions during autumn, winter and early spring, will due to increased temperatures become a problem.
- Risk for frost damages increase
- Longer drought periods during summer and lower groundwater tables.
- Milder and more rainy winters with increased risk for nutrient leaching



Field trials for exotic species

	Harvest date	% germination without irrigation
Quinoa	20-30 September	40, 50 resp 75
Amaranth	After 1 November	60
Teff	20 September	0
Sorghum, Nigrum	30 September	30
Millet I, (plymhirs)	5 September	25
Millet II, (kolvhirs)	20 September	70
Sesame	After 1 November	0
Green lentils	10 September	70
Buckwheat	10 August	0
Sunflower, Lilia	5 September	70
Atriplex hortensis	30 August	75

Buckwheat



Nutrient supply

- P application by human urine/feces, slaughter waste, and ash
- N supplied by N fixating crops
- Other nutrients are supplied through weathering of mineral soil material. (Increased availability through high humus content, good soil structure, high soil biological activity)
- Reallocation of nutrients from pastures and forests to arable lands by livestock

Relation between choice of biofuel and number of people supplied with food.

Three scenarios; ethanol from wheat and potatoes and one workhorse/one rapeseed oil driven tractor were compared with a pure diesel alternative regarding number of people supplied with food and nutrient recirculation

Impact of the choice of fuel on the amount of people the farm could supply with food, expressed as number of people and % of the diesel scenario

	Diesel	Rapeseed oil/ horse draft	Wheat ethanol	Potato ethanol
Number of people	69	65	53	57
% of diesel scenario	100	94	77	82

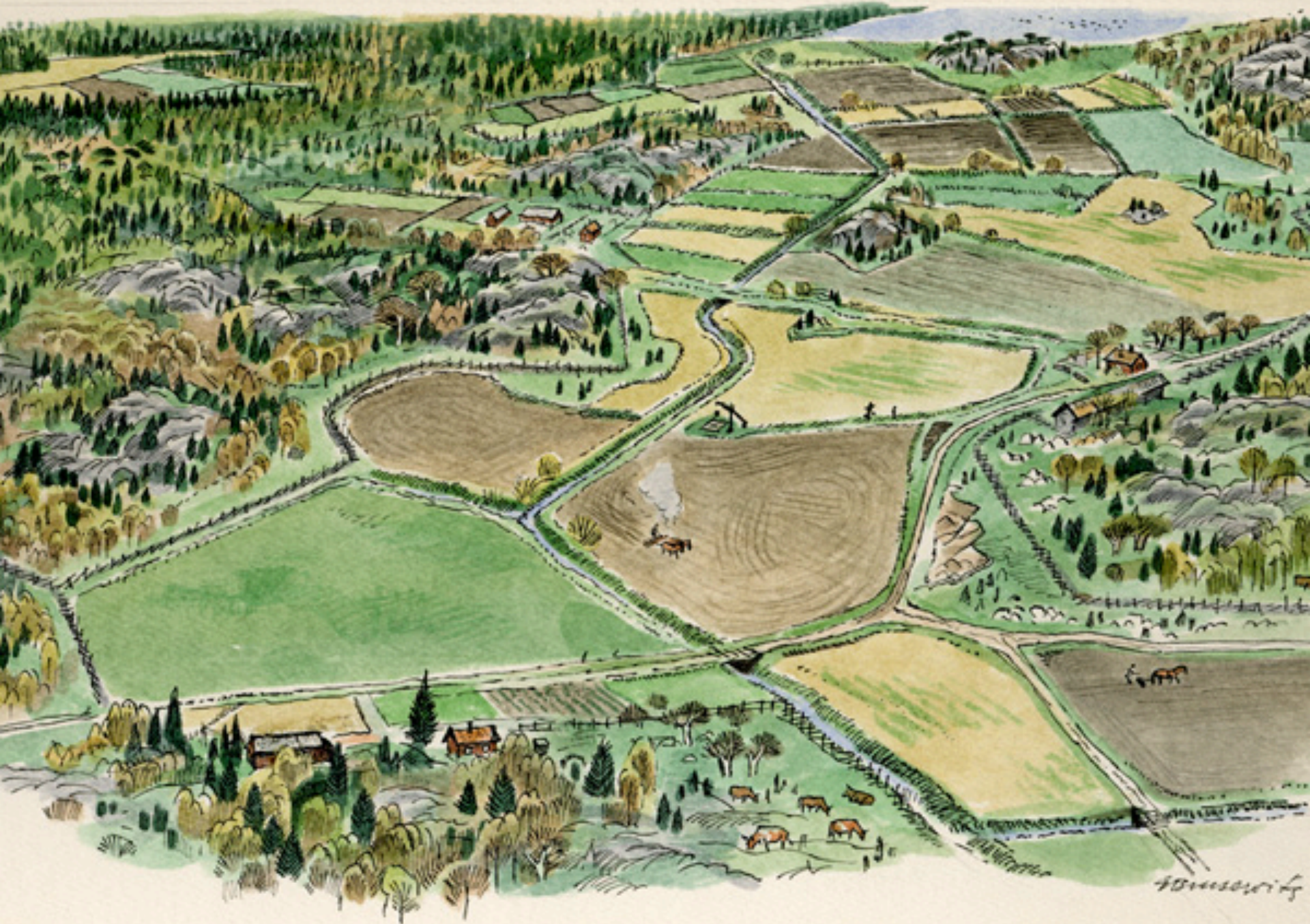
Number of persons supplied with food with different mixtures of livestock.

Case	Case description	Scenario I Conventional diesel	Scenario II 1 horse and rapeseed oil
1	17 large cows, 1 sheep, 65 hens	69	65
2	17 small cows, 37 sheep, 70 hens	47	44
3	158 sheep, no cows, 70 hens	35	33
4	22 small cows, 2 sheep, 64 hens	51	48
5	15 large cows, 19 sheep, 68 hens	67	62



Concluding remarks

- The results suggest that high biodiversity on farm level, if skilfully used, is a tool to increase food production i.e. combining high food production and high biodiversity seems to be a win-win solution
- High food production demands livestock
- High food production demands well-functioning ecosystem services e.g., pest control and pollination.
- The choice of biofuel affects both the food production output and the nutrient fluxes. Horsesdraft seems to be one of the most energy efficient biofuels.
- Knowledge of how to design the on-farm landscape to achieve high production of food, relaying solely upon ecosystem services generated by the livestock and wild organisms, is crucial for the future!



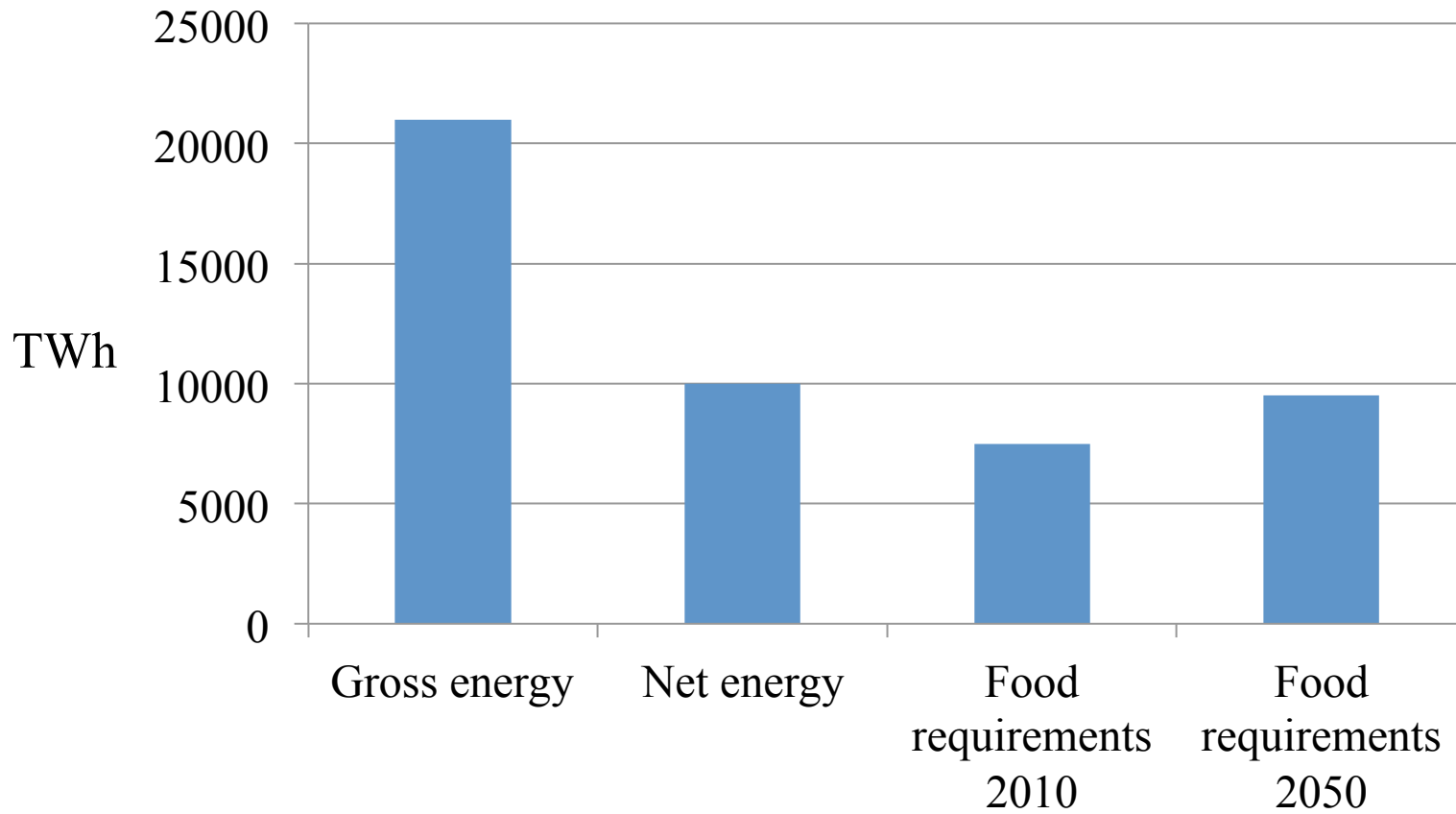
Bussow



W. Blawie



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From Johansson 2013

1 l petroleum (diesel) = 12 kWh = 15 SEK

30 hrs biking = 12 kWh = 9000 SEK

8 l wood = 12 kWh = 5 SEK

Sweden: Energy consumption 616 TWh/year

Total wood harvest : 40 Mton/year = 180 TWh/
year

