Farming of the Future – How Swedish beef and dairy farming can meet climate targets and contribute to a sustainable food and energy system towards 2050.

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Introduction

In early 2020 stakeholders of the Swedish beef and dairy sector initiated a project to identify and quantify the potentials to reduce climate impact of Swedish beef and dairy production systems by 2050.

The collaboration was one of the first of its kind and addressed a knowledge gap where an overall approach handling beef and dairy production simultaneously had been missing. While the potentials were identified from a climate perspective, other sustainability aspects like animal and planet health as well as farm profit and were also taken into consideration.

The results were published in a report in October 2021 and have been used in dialogue with farmers, politicians, research institutes and universities as well as other stakeholders in the food chain.

The report and the collaboration are a major contribution to describing the role of cattle in a sustainable food and energy production system in Sweden into the future.

Method

The method included studies of literature, surveys, calculations, interviews and workshops with researchers, experts, and stakeholders. The scope of the study was from field to farm gate.

Separate targets for the three greenhouse gases

As the greenhouse gases have different properties and climate impact, potentials were quantified for the three gases separately. The UN IPCC states that between 2020 and 2050, carbon dioxide emissions should be reduced to net zero, methane emissions reduced by about 65 percent and nitrous oxide emissions by around 40 percent. It has also been described that expressing methane emissions as carbon dioxide (CO₂) equivalents, using GWP-100, overstates the effect of constant methane emissions on global surface temperature by a factor of 3-4 over a 20-year horizon (Lynch et al., 2020). As the number of ruminants in Sweden steadily has decreased and productivity simultaneously has increased over time, a 10% reduction over 20 years target for biogenic methane was therefore adopted (Allen et al., 2018).

Common definition of sustainable production

A definition of sustainable beef and dairy production was adopted, resting on animal health and welfare, planet, productivity, and farm profit.

Four example farms used to quantify potential to reduce climate impact

A simulation model was developed to describe the theoretical potentials for climate. Four example farms were defined based on statistics and to be as representative as possible for Swedish production. To avoid some complexity, farm areas were kept intact from 2015–2030–2050, as well as the number of breeding stock per farm.

Example farms:
- Small dairy farm in mixed forestry and agricultural area: 85 ha, 60 cows in production, 9900 kg ECM/year milk yield
- Large dairy farm in lowland: 256 ha, 240 cows in production, 10,400 kg ECM/year milk yield
- Beef suckler farm in mixed forestry and agricultural area, 95 ha, 76 animals incl. 30 cows, 28 animals to slaughter per year
- Dairy bull beef farm in lowland: 56 ha, 131 dairy bulls in production indoors, 105 animals to slaughter per year

Results

Carbon dioxide emissions can reach net zero and carbon sequestration increase further by 2050. Carbon sequestration was larger than CO₂ emissions on the large dairy farm already in 2015, and all example farms can reach net zero by 2030.

Methane emissions can decrease so that no additional climate impact occurs, with good margin to the target of -10% over 20 years, and the dairy example farms also approach the IPPC target of -65%.

Nitrous oxide emissions can decrease faster than IPCC advocates on all farms

Key areas for development

- Animal health & lifetime production
- Breeding for healthy cattle
- Feeding strategy
- Roughage production
- Feed ingredients & feed additives
- Fossil free farming

To realise the identified potentials, collaboration through the entire value chain is necessary. Management on farm is also key, as well as a more holistic approach to a future sustainable food system and increased farm profitability. While a lot of the knowledge and techniques required already are available, further innovation and development is necessary going forward. More accurate methods to calculate climate impact and sustainability of food are needed. New technology within digitalization and sensors including precision farming of livestock as well as ley and new development within cattle and plant breeding are necessary. There are also great opportunities within the area of feed efficiency, ingredients and additives, including methane reducing methods. The area of roughage production harbors large potential from several sustainability aspects. Animal health and lifetime production will also remain in focus.

The cost of the required on-farm investments must be shared between the stakeholders in the food chain. A smaller price increase for consumers, that goes directly to primary production, can enable technology leaps and further development of the sector.

Conclusions / Significance

Beef and dairy production is central to sustainable food systems of the future in Sweden. Climate impact can be reduced in line with the Paris agreement, without compromising biodiversity, animal health and welfare, while increasing food and bioenergy production.

Within the framework of the “global methane budget”, it is important that a higher proportion of cattle are kept where conditions are most suitable and sustainable, and in all, this can be seen as a growth opportunity for Swedish beef and dairy production in the future.

Securing on farm investment in sustainable solutions and facilitating sector collaboration is key.

References / Links


Allen et al. (2018), Climate metrics for ruminant livestock, Oxfordmartin publications