Foraging in outdoor organic pig production - modelling environmental consequences

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Introduction

The objective was to assess the technical and environmental performance at farm level of rearing free-range growing-finishing pigs foraging directly in the range area, as compared to the current Danish organic pig production with sows on pasture and growing-finishing pigs housed indoors with access to outdoor runs.

Materials and methods

Three scenarios were modelled based on a synthesis of key figures from organic pigs farms, empirical data from on-farm studies and experimental data. The three types of organic pig production systems were: The Reference scenario (**Indoor finishing**), Alternative scenario 1 (**Free-range grass-clover**) and Alternative scenario 2 (**Free-range alternative crops**: alfalfa, grass-clover, Jerusalem Artichokes). The starting point for all three scenarios was 84 ha and 100 annual sows with a production of 1925 finishers (110 kg live weight).

Results

Regarding **nitrogen balance**, overall in the alternative scenarios the imported feed was reduced (145 and 140 kg N ha^{-1} for **Free-range grass-clover** and **Free-range alternative crops** scenarios, respectively) compared to the **Indoor finishing** scenario (164 kg N ha^{-1}). However, the **Free-range alternative crops** scenario had the highest N leaching, which could be attributed to the high input of N, through fixation from alfalfa. **Green house gas (GHG) emissions** were highest in the **Free-range grass-clover** scenario. However, when including Soil C changes and Indirect Land Use Change the GHG emissions were considerably lower in the **Free-range alternative crops** scenario.

Table 1. Farm N balance (kg N ha^{-1}), green house gas emissions (kg CO_2 eq) and Land Use (m^2 $year^{-1}$) in three organic pig production systems

Farm N balance*	**Indoor finishing**	**Free-Range grass–clover**	**Free-Range alternative crops**
Total input	214	202	210
Total output	72	72	72
Balance	**143**	**130**	**139**
N losses:			
Ammonia	49	24	20
Denitrification	3	6	6
Soil N	-8	4	4
N leaching	99	100	110
Green house gas (GHG) emissions**			
Total	**2.17**	**2.40**	**2.00**
Thereof home-produced feed	1.01	1.09	0.94
Thereof imported feed	0.96	1.07	0.84
Total soil changes	0.36	0.13	0.13
Land use	8.11	8.05	6.90
Indirect Land Use Change	1.16	1.15	0.99
Total GHG emissions	**3.69**	**3.68**	**3.12**

Concluding remarks:

- The Free-range grass-clover scenario had a nitrogen leaching comparable to the Indoor finishing scenario, but various management options must be considered in order to reduce leaching further.
- In terms of GHG emissions, the Free-range alternative crops scenario showed the best performance.
- We suggest that the alternative scenarios represent an actual possibility in terms of reducing the impact of organic pig production on climate change.
- The alternative scenarios is suggested to have agro-ecological advantages: improved crop rotation, increased soil fertility, reduction of pest and diseases.
- In the alternative scenarios all animals are able to perform species-specific behaviour.

***Farm N balance** was estimated as the difference between input (imported feed and straw, N biological fixation, deposition) and output (live pigs). Nitrogen leaching was estimated by deducting N losses and soil N changes from N surplus.

****Green house gas emissions** included N_2O from production of feed, CH_4 from enteric fermentation, and manure management and CO_2 from production of feed, soil carbon changes and land use change. Each type of crop production (home-grown or imported) was assumed to increase pressure on land use according to the area occupied by the factor 143 g CO_2 m^{-2}

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