Footprint of entire male pigs in Europe[1]

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Abstract

This document reports on the estimation of the impact of ending castration on the footprint of European farm level pig production. The footprint of pig production is calculated using the Animal Production System Footprint tool. Both observational and experimental data were collected. Selected countries were Belgium, Denmark, France, Germany and the Netherlands. This study shows that producing boars instead of barrows results in a significantly better feed utilization and thus a lower footprint. Many farms may expect a reduction in feed usage of 7% to 9% when shifting from barrows to boars, resulting in 3.5% to 4.5% lower feed costs (when also gilts are taken into account). The estimated carbon footprint of entire male pigs ranged from 3.57 to 4.00 kg CO_2 eq. per kg live weight, and from 3.93 to 4.28 kg CO_2 eq. per kg live weight for castrated male pigs. Assuming the approximately 100 million barrows annually slaughtered in the EU need 24 kg more feed compared to boars, and also assuming that the feed ingredients for growing pigs are harvested at 8 tons per ha, this equals to 300.000 ha land use saved. Assuming a reduction of 0.35 kg CO_2 eq. per kg live weight and a live slaughter weight of 125 kg per pig, this results for the 100 million barrows in the EU annually slaughtered in a lower footprint of in total 4.4 million tonnes CO_2 eq per year.

Introduction

The livestock sector has an important role in global greenhouse gas emissions. Mitigation strategies aimed at reducing the emission intensity of this sector are needed to limit the environmental burden from food production (Grossi et al., 2019). The greenhouse gas (GHG) emissions from pig houses are principally influenced by floor type, manure management and nutrition of the pigs. The climatic conditions inside the building also impact emission levels. The main dietary strategy proposed for the abatement of pollutant gas emissions is the manipulation of the levels of crude protein and fibre content in the diet. Some dietary additives have also been studied for their impact on GHG emissions (Philippe and Nicks, 2015). An alternative option to reduce greenhouse emissions is improving the feed utilization. Shifting from barrows to boars contributes to better feed utilization.

Castration of male piglets is regarded as an infringement of the wellbeing and integrity of the animal. Partly for that reason, the issue of the castration of male piglets has grown in importance in the last decade. The complexity of the subject represents a challenge for all those concerned. Not only does it involve many different parties across the pork supply chain, but the practical aspects are complex and multi-faceted. Nonetheless, major pork supply chains managed to overcome these challenges on their domestic market. Together with retail organizations they have successfully adapted best practices to end the surgical castration of piglets. It was estimated that by January 2018, large pork food supply chains in eight major pork producing countries have established successful directions for solutions for ending surgical castration, although some countries had already a tradition of not castrating male pigs. However, in most of the other countries there is still no or little sense of urgency to achieve the ambition of ending castration, and each year 100 million pigs are castrated.[2]

[2] Derived from page 6 of the Second progress report 2015 – 2017 on the European declaration on alternatives to surgical castration of pigs by the Expert Group on ending surgical castration of pigs (2018), and corrected for the increase in European pig production over the years 2015-2021.

The European Commission has published its Farm to Fork strategy in May 2020. The Farm to Fork Strategy is at the heart of the European Green Deal aiming to make food systems fair, healthy and environmentally-friendly. It aims to redesign our food systems which today accounts for nearly one-third of global GHG emissions and does not allow fair economic returns and livelihoods for all actors, in particular for primary producers. New technologies and scientific discoveries, combined with increasing public awareness and demand for sustainable food, will benefit all stakeholders. The Farm to Fork Strategy aims to accelerate our transition to a sustainable food system that should also have a neutral or positive environmental impact and help to mitigate climate change and adapt to its impacts.[3]

Taking into account that ending castration does not only improve animal welfare, but also results in improved feed efficiency and thus making the food system also more environmentally-friendly we may conclude that ending castration contributes to the goals of the farm to fork strategy in more than one way. This document reports on the estimation of the impact of ending castration on the footprint of European pig production.[4]

APS-footprint methodology for pig production

The footprint of pig production is calculated using the Animal Production System Footprint tool (Blonk Consultants, 2020). The APS-footprint framework enables to conduct environmental footprint calculations based on background datasets, parameters defined by the user and modelling of emissions according to specified standards and guidelines. Pig systems may vary in design and environmental performance due to differences in herd composition, housing types, feeding regimes and management systems. The pig APS module enables a user to model these different characteristics and investigate how they influence environmental impacts. The methodological framework regarding allocation, functional units, boundary definitions and emission modelling are based on published and recognized international guidelines (TS Red meat FCR, 2019). The processing of crops into feed ingredients is also currently based on Agri-footprint 5.0 (Van Paassen et al., 2019a) and is also compliant to the Feed PEFCR modelling rules.

In the APS-footprint module for pigs it is possible to change parameters and implement interventions on both the piglet breeding phase and on the pig fattening phase. Both have a relevant contribution to overall impacts (piglets on average 25% and fattening around 75% of environmental impact) (TS Red meat FCR, 2019).

Feed is the main input of the pig APSs. Feed production includes the cultivation and processing of crop and minerals and additives production. Cultivation datasets in Agri-footprint include land occupation, water inputs, fuel production and burning during agricultural machinery use, electricity production, inorganic fertilizer production, pesticide production, capital goods and emissions at transport of inputs, impact of capital goods production, and emissions from pesticides, manure, urea and inorganic fertilizers (N2O direct and indirect, CO_2 and NH3 to air; nitrate, phosphorus and heavy metals leaching to water; heavy metals emission to air). Cultivation datasets are compliant with guidelines. The compound feed composition (%) in the APS reference system is presented in Table 1.

[3] https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

[4] An alternative option is to apply immunovaccination. This option will also reduce the footprint of pig production, although the reduction in footprint of immunovaccinated pigs will be lower compared to the reduction in footprint of entire male pigs. This report, however, does focus only on the footprint of entire male pigs.

Table 1. Compound feed composition (%) for fattening pigs in the APS reference system

Wheat grains	33
Barley grains	30
Rye grains	3
Maize	2
Triticale grain	2
Sugar beet/cane	2
Crude palm oil	2
Soybean	9
Rapeseed	10
Sunflower	4
Palm kernel	2
Fat from animals	1

Source: Blonk Consultants, 2021

Carbon modeling includes three different sub-indicators for climate change:[5]

1. Climate change fossil: greenhouse gas emissions originating from the oxidation and/or reduction of fossil fuels by means of their transformation or degradation (e.g. combustion, digestion, landfilling, etc.).
2. Climate change biogenic: carbon emissions (CO2, CO and CH4) originating from the oxidation and/or reduction of biomass by means of its transformation or degradation (e.g. combustion, digestion, composting, landfilling), and CO2 uptake from the atmosphere through photosynthesis during biomass growth.
3. Climate change land use and land transformation: carbon uptake and emissions (CO2, CO and CH4) originating from carbon stock changes caused by direct land-use change, soil carbon uptake (accumulation) and emissions through land management (land use).

All three sub-indicators for climate change are – in addition to land use - quantified with the Animal Production System Footprint tool.

Input data for the footprint calculations

Generic input data for calculating the footprint of pig production are the footprint of feed for fattening pigs (1.0 kg feed for growing pigs = 1.0 kg CO_2 eq) and the footprint of piglet production (1 piglet = 123 kg CO_2 eq per piglet). We also assume a mortality of 2.5%

Country specific data are collected for Belgium, Denmark, France, Germany, and The Netherlands, all being major pig producing countries. The United Kingdom, Spain and Portugal are not included as pig production in these countries already for decades is mainly based on entire male pigs.

Collected observational data are based on 2.700 French farms over the year 2020 and 420 Dutch farms over the average of the years 2016-2020. Experimental data for Belgium, Denmark, and Germany (two studies) are included in Table 2.

On French farms the feed intake between boars and barrows is almost equal, because in France restricted feeding is applied. Therefore the difference in feed conversion rate is less pronounced.

[5] https://pre-sustainability.com/articles/pef-series-carbon-modelling-in-the-pef-approach/

Table 2. Feed composition and technical results of boars and barrows

	Netherlands		Belgium		France		Denmark		Germany(1)		Germany(2)	
	Barrow	Boar	Barrow	Boar	Barrow	Boar	Barrow	Boar	Barrow	Boar	Barrow	Boar
Entry weight (kg)	25,7	25,7	23	23	25,7	25,7	30	30	28,3	27,6	30	30
End weight (kg)	124,7	124,7	119,5	119,5	124,7	124,7	116,59	116,59	122	123,3	121,13	122
Daily gain (g/day)	838	895	881	837	828	892	1.030	1.045	933	1013	815	827
Feed intake (kg/day)	2.231	2.127	2,26	1,9	2,22	2,2	2,68	2,48	2,37	2,12	2,44	2,1
Feed conversion rate	2.661	2.376	2,57	2,27	2,68	2,47	2,6	2,37	2,66	2,31	3,0	2,56
Rounds/year	2,84	3,03	3,23	3,09	2,81	3,02	4	4	3,52	3,82	3,17	3,17
Protein content feed (%)	15	15	15	15	15	15	16,56	16,56	16	16	16	16
Energy content feed (EV)*	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	13,4	13,4	13,4	13,4
Digestion coëff energy (%)	80	80	80	80	80	80	84	84	80	80	80	80

*Energy content fattener feed Germany expressed in MJ ME/kg

Results

The calculated results of the footprint of boars and barrows are presented in tables 3 and 4 and in figure 1.

Table 3. Climate change parameters of boars and barrows

	Kg CO_2 eq. of barrows	Kg CO_2 eq. of boars	% change when shifting to boars
Belgium	3.93	3.57	-9
Denmark	3.93	3.67	-6
France	4.28	4.00	-6
Germany (1)	3.84	3.35	-13
Germany (2)	4.28	3.78	-12
Netherlands	4.26	3.89	-9

The footprint of barrows expressed in kg CO_2 eq. per kg live weight at slaughter ranges from 3.92 to 4.45. Higher footprints mostly go along with higher feed conversion rates. The footprint of boars is lower compared to the footprint of barrows, the reduction in footprint ranging from 6% to 14%. However, for the countries where observational data from commercial farms are available, the reduction ranges from 6% to 9%.

Taking into account the results described in the literature regarding CO_2-, CH_4- and N_2O-production from animals and manure in pig houses, our estimates are in line. Philippe & Nicks (2015) estimated GHG emissions equal to 4.87 kg CO_2 eq. per kg carcass.[6]

[6] Philippe, F-X & B. Nicks (2015) Review on greenhouse gas emissions from pig houses: Production of carbon dioxide, methane and nitrous oxide by animals and manure. In Agriculture, Ecosystems & Environment Volume 199, 1 January 2015, Pages 10-25.

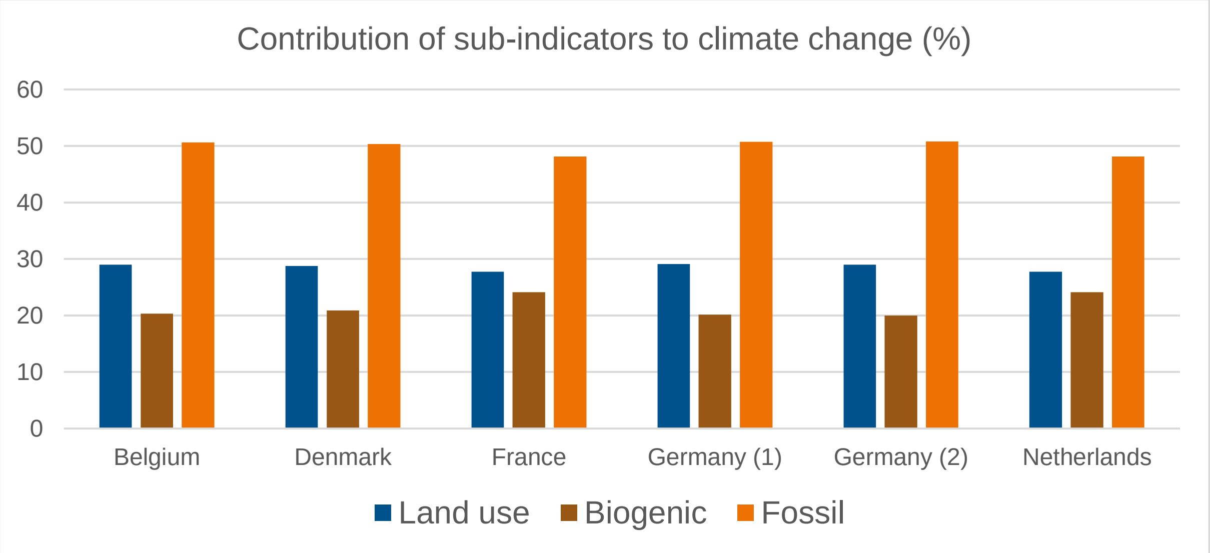
Table 4. Change in land use Land use of boars and barrows

	Land use (Pt)	% change when shifting to boars
Belgium	512	-9
Denmark	518	-7
France	531	-7
Germany (1)	507	-14
Germany (2)	576	-12
Netherlands	528	-9

The calculated change in land use as a result from shifting to boars, is quite similar to the calculated changes in kg CO_2 eq., ranging from 7% to 14%.

Figure 1 reveals that the relative contribution of the sub-indicators land use, biogenic and fossil to climate change shows a similar pattern for all five countries. Fossil contributes to 50%, land use to almost 30%, and biogenic to 20% or more.

Figure 1. Relative contribution of sub-indicators land use, biogenic and fossil to climate change



Concluding remarks

This study shows that producing boars instead of barrows results in a significantly better feed utilization and thus a lower footprint. Many farms may expect a reduction in feed usage of 7% to 9% when shifting from barrows to boars, resulting in 3.5% to 4.5% lower feed costs (when also gilts are taken into account).

Assuming the approximately 100 million barrows annually slaughtered in the EU need 24 kg more feed compared to boars, and also assuming that the feed ingredients for growing pigs are harvested at 8 tons per ha, this equals to 300.000 ha land use saved.

Assuming a reduction of 0.35 kg CO_2 eq. per kg live weight and a live slaughter weight of 125 kg per pig, this results for the 100 million barrows in the EU annually slaughtered in a lower footprint of in total 4.4 million tonnes CO_2 eq. per year.

For food companies, the estimated substantial favorable impact of producing entire male pigs on the carbon footprint may be an incentive to consider it an option to shift towards marketing meat from entire male pigs. All the more because as of January 2023 the Corporate Sustainability Reporting Directive (CSRD) entered into force. This new directive modernizes and strengthens the rules about the social and environmental information that companies have to report. A broader set of EU companies, as well as listed SMEs, will now be required to report on sustainability – approximately 50 000 companies in total.[7] The new rules will create a culture of transparency about the impact of companies on people and the environment. The first companies will have to apply the new rules for the first time in financial year 2024, for reports published in 2025. The sustainability report will be required for companies that meet at least two of the following criteria: (1) over 250 employees, (2) over €40 million annual turnover, and/or (3) more than €20 million on the balance sheet. The CSRD also makes it mandatory for companies to have an audit of the sustainability information that they report.

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[7] https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

Annex.

Reduction in climate change parameters as result of shifting from barrows to boars, total and per sub-indicator

	Category name	Kg CO_2 eq	Change %
Belgium	Climate change	3.93	-9
	– land use	1.14	-9
	– biogenic	0.80	-9
	– fossil	1.99	-9
Denmark	Climate change	4.07	-6
	– land use	1.17	-6
	– biogenic	0.85	-7
	– fossil	2.05	-7
France	Climate change	4.277	-6
	– land use	1.186	-6
	– biogenic	1.031	-7
	– fossil	2.059	-6
Germany (1)	Climate change	3.92	-14
	– land use	1.14	-13
	– biogenic	0.79	-14
	– fossil	1.99	-14
Germany (2)	Climate change	4.45	-12
	– land use	1.29	-12
	– biogenic	0.89	-12
	– fossil	2.26	-12
Netherlands	Climate change	4.255	-9
	– land use	1.180	-8
	– biogenic	1.026	-9
	– fossil	2.048	-9