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Animal Production Science

Supplementary Material

Environmental impacts of the Australian poultry industry. 1. Chicken meat production

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Sensitivity analysis methodology

Each vertically integrated network was modelled using the relevant state electricity grid (ALCAS, 2017). Analysis was conducted to determine the effect on the results of modelling a given network using state-specific grids. To determine the maximum possible variation in results, two scenarios were run: one using the energy network of Tasmania and a second using the network of Victoria (Australia's lowest and highest emission intensity electricity grids). Aside from the change in electricity grid, the network was identical in both scenarios.

The sensitivity of the results to FCR was tested for both conventional and free range production. The analysis assumed an improvement of 0.1 in the industry average FCR for each housing system (e.g., 1.6 to 1.5) but the model and parameters were otherwise identical to those used to generate the baseline results.

Sensitivity of the model to dietary crude protein (CP) was also tested for free range production by reducing CP by 10% (from 18.5% to 17.5%) to examine the impact of a very low CP diet.

The methodological decision to use a five-year analysis period (2015 – 2019) for LU and dLUC emissions from Australian cropland was also tested, comparing two-year (2018 – 2019) and ten-year (2010 – 2019) analysis periods. The analysis was performed using the reported annualised emissions and sequestration from the NIR (Commonwealth of Australia, 2021) and calculating the impact on net GHG emissions from chicken meat production by following the sequestration or emissions through the supply chain using the volume of cereals per tonne of feed and the industry average FCR.

The sensitivity of the results to assumptions regarding source regions for cereal grains was also tested. The analysis compared results for a model Queensland-based (QLD) vertically-integrated processor that sourced 25% of cereal grains from Western Australian (WA) with alternative scenarios where (A) 100% of cereal grains were sourced locally and (B) 100% of cereal grains were sourced from a combined eastern seaboard market (QLD, New South Wales (NSW),and VIC). Aside from the assumptions regarding source region and transport distances, the model network was identical in each scenario.

The sensitivity of the model to allocation method was not included as this has previously been performed and reported by Wiedemann et al. (2012).

Table S1. Background databases used to model feed inputs

Feed commodity	Background database
Sorghum	AusLCI 1.39
Wheat	AusLCI 1.39
Barley	AusLCI 1.39
Other cereals	AusLCI 1.39
Soybean meal	ecoinvent 3.8
Canola meal	AusLCI 1.39
Other plant protein	ecoinvent 3.8
Tallow/poultry oil	Custom datasets
Meat meal	Custom datasets
Other animal protein	ecoinvent 3.8
Low input additives	Custom datasets, AusLCI 1.39, ecoinvent 3.8
High input additives	ecoinvent 3.8

Table S2. Background databases used to model major inputs

Input	Background database
Grid electricity	AusLCI 1.39
LPG	AusLCI 1.39
Natural Gas	AusLCI 1.39
Transport – trucks etc.	AusLCI 1.39
Refrigerants	AusLCI 1.39

Table S3. Example Nitrogen (N) mass balance per 1000kg liveweight produced

Parameter	Value
Nitrogen input (kg)	
Feed	47.6
Chicks	0.5
Total N input	**48.1**
Nitrogen output (kg)	
Chicken meat	28.5
N excretion	38.1
Gaseous NH_3-N	11.4
Gaseous N_2O-N	0.06
Total N output	**78.1**

Table S4. Sensitivity analysis for state electricity grids

	Fossil energy (MJ)	Greenhouse gases, excl. LU and dLUC (kg CO_2-e)	Greenhouse gases, LU and dLUC (kg CO_2-e)	Total GHG (kg CO_2-e)
TAS	14.5	1.7	1.8	3.5
VIC	19.2	2.2	1.8	4.0

Table S5. Sensitivity analysis for diet and performance scenarios

	Fossil energy (MJ)	Fresh water (L)	Stress weighted water (L H_2O-e)	AWARE water (m^3)	Land occupation (m^2)	Greenhouse gases, excl. LU and dLUC (kg CO_2-e)	Greenhouse gases, LU and dLUC (kg CO_2-e)	Total GHG (kg CO_2-e)
C1	17.3	169.7	121.2	22.2	9.6	2.0	1.7	3.7
F1	17.9	180.1	133.9	23.6	10.1	2.2	1.7	3.9
F2	18.5	189.6	140.8	24.5	10.6	2.2	1.8	4.0

Table S6. Sensitivity analysis for grain source region scenarios

Scenario	Fossil energy (MJ)	Fresh water (L)	Stress weighted water (L H_2O-e)	AWARE water (m^3)	Arable land (m^2)	Greenhouse gases, excl. LU and dLUC (kg CO_2-e)	Greenhouse gases, LU and dLUC (kg CO_2-e)	Total GHG (kg CO_2-e)
Control	18.6	191.4	85.3	24.6	12.8	2.1	1.8	3.9
A	18.4	225.7	99.8	24.6	12.7	2.1	1.8	3.9
B	18.7	221.8	172.1	25.7	11.5	2.1	1.8	3.9

Table S7. Data for sensitivity analysis of LU and dLUC emissions from Australian cropland

	Units	2015 - 2019	2018 – 2019	2010 - 2019
Land use (LU) emissions	kg CO_2-e/ha	-240.17	-238.57	-97.19
Land use change (dLUC) emissions	kg CO_2-e/ha	105.25	93.18	131.35
Net LU & dLUC emissions	kg CO_2-e/ha	-134.92	-145.38	34.16
LU & dLUC emissions from Australian cropland	kg CO_2-e/kg chicken meat	-0.06	-0.07	0.02

References

ALCAS. (2017). *AusLCI*. Australian Life Cycle Assessment Society (ALCAS). Available at: http://auslci.com.au/.

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