

Long-term measurement of ammonia and nitrous oxide emissions from Australian beef feedlots

Mei Bai¹, Trevor Coates¹, Thomas Flesch², Sean McGinn³, David Griffith⁴, Julian Hill⁵, Deli Chen¹

¹Faculty of Veterinary and Agriculture Science, University of Melbourne, VIC 3010, Australia

²Department of Earth and Atmospheric Sciences, University of Alberta, AB T6G 2R3, Canada

³Agriculture and Agri-Food, Canada, Lethbridge, AB T1J 4B1, Canada

⁴University of Wollongong, NSW 2522, Australia

⁵Ternes Agricultural Consulting, Upwey, VIC 3158, Australia

E-mail: mei.bai@unimelb.edu.au

Abstract

One of the major issues facing the Australian beef feedlot sector's drive to carbon neutrality by 2030 is the lack of robust long-term greenhouse gas (GHG) emissions data. Here we present part of our work at two commercial feedlots in Victoria (southern site) and Queensland (northern site) in Australia. We measured gas emissions of ammonia (NH₃) and nitrous oxide (N₂O) from feedlot cattle pens, manure stockpiling area, and effluent ponds over short-term (days to weeks) and long-term period (few months to a year) from 2015 to 2018 using a range of measurement technologies, including open-path spectroscopic techniques, and micrometeorological techniques including flux gradient (FG), eddy covariance (EC) and inverse-dispersion modelling (bLS). The results suggested that the IPCC methodologies for estimation of emissions from feedlots overestimated N₂O emissions by up to 50%, underestimated NH₃ emissions by a factor of 3 times. The use of lignite amendments to mitigate NH₃ emissions was highly successful and has been demonstrated as cost effective technique for southern feedlot systems. We also developed models to integrate the GHG emissions and economic frameworks to understand systems interdependency.

Keywords: cattle feedlots, gaseous emissions, micrometeorological techniques, lignite amendment

1. Emissions from southern feedlot

The average emission rate of NH₃ from cattle pens, manure stockpile area, and effluent ponds was 120.5, 5.8, and 5.4 kg/hr, respectively (Table 1). The N₂O emission rate from cattle pens, manure stockpile area, and effluent ponds was 0.37, 1.9 and 1.9 kg/hr, respectively. We found slightly higher N₂O emissions in winter than in summer, likely corresponding to increased wetness due to higher rainfall during the winter measurements.

2. Emissions from northern feedlot

The average emission rate of NH₃ from cattle pens was 76.0 kg/hr, respectively. The average N₂O emission rate from

cattle pens and effluent ponds was 2.8 and 5.8 kg/hr, respectively.

Table 1. Average emission rates of NH₃ and N₂O (kg/hr) from the southern and northern feedlots in Australia

	Cattle pens	Manure area [§]	Effluent ponds
Southern feedlot			
NH ₃	120.5	5.8	4.2 – 6.6
N ₂ O	0.37	1.9	1.7 – 2.1
Northern feedlot			
NH ₃	34.9 – 117.1	/	/
N ₂ O	2.8	/	5.8

§no manure handling area in northern feedlot

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