Overview of greenhouse gas calculators for measuring emissions from livestock production

Background

"You can't manage what you can't measure" - is a commonly heard saying in many facets of business and agriculture. Understanding the emissions and financial profile of a livestock enterprise is critical to being able to make improvements to reduce emissions and increase profitability.

There are 3 key calculators available that are suitable for determining greenhouse gas (GHG) emissions from livestock in Australia:
- FarmGAS (static GHG calculator)
- Sheep-GAF and Beef-GAF (static GHG calculator)
- GrassGro (dynamic GHG modelling tool)

All of these tools are based on the National Greenhouse Gas Inventory (NGGI) for Australia and will give the same results, but each has unique features which may make it more, or less, suitable for different production systems or regions.

This document summarises key information about each of these calculators suitable for use in the livestock industry to assist producers in selecting the tool that best suits their situation to assess GHG emissions from livestock on their property.

The input data listed is that required to run a livestock scenario only (ie not including cropping, forestry etc). Some of the input data (for both FarmGAS, S-GAF/B-GAF, SheepCOST) will use defaults for the region the farm is located in if the producer doesn't know actual numbers for their property (e.g. DMD, crude protein, liveweight gain).

	FarmGAS	Sheep-GAF, Beef-GAF and Beef-GAFN	GrassGro
Developed by	Australian Farm Institute	University of Melbourne	CSIRO
Latest version	October 2012 (currently being updated, due for release July 2014)	Sheep-GAF Version 6 (May 2012) Beef -GAF and Beef-GAFN Version 11 (Aug 2013)	Version 3
Cost	Free	Free	Software available to purchase. Training can also be provided for a fee.
Access	Available online only: http://calculator.farminstitute.org.au/login	Available to download: www.greenhouse.unimelb.edu.au/Tools.htm	Purchase from http://www.hzn.com.au/purchase_now.php
Brief description	An on-line calculator which calculates GHG emissions from farm activities and then enables "what-if" scenarios to be run to compare the impact of management on GHG emissions.	An excel-based calculator used to create awareness of various sources of GHG emissions on farm to stimulate thinking and action aimed at reducing emissions while improving farming efficiency	A dynamic mechanistic decision support tool for analysing opportunities and risks that variable weather, soil parameters and flock/ herd dynamics imposes on the profitability and sustainability of grazing systems.
Support material	User manual available for download.	No manual, comments are provided on cells in data input page.	Training course and manual.

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GH gases assessed			
Carbon sequestration (C)	✓	✓	
Carbon dioxide (CO_2)		✓	✓
Methane (CH_4)	✓	✓	✓
Nitrous oxide (N_2O)	✓	✓	
Enterprises and activities, other than livestock, that can be assessed			
Cropping	✓		
N_2O from nitrogen fertiliser	✓	✓	
Feedlot	✓		
Emission from savannah burning (B-GAFN)	✓	✓	
Horticulture	✓		
Carbon (C) stored through tree plantings	✓	✓	
Pigs	✓		
Energy (diesel and electricity) emissions		✓	
Input data required*			
Annual diesel consumption (L)	✓		✓
Annual electricity use (kWh)	✓		✓
Farm size (used to determine stock numbers)			✓
Areas of cropping and pasture	✓	✓	

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	FarmGAS	Sheep-GAF, Beef-GAF and Beef-GAFN	GrassGro
Area of trees planted after 1990	✓	✓	
Area of dryland pastures (both with and without legumes) and amount of N fertiliser applied	✓		
Irrigated pastures (with and without legumes) and amount of N fertiliser applied	✓		
N fertiliser applied to pasture and crop by season		✓	
Climate (select from over 100 on file or customise for own location)			✓
Crude protein by season	✓	✓	
DMD by season	✓	✓	
Dry matter availability (by class and season)		✓	
Feed On Offer (FOO) by season	✓		
Pasture species- calculator estimates feed availability and quality based on weather files, soil parameters, feeding rules, etc			✓
Flock/herd management practices (e.g. shearing, lambing/calving dates, selling conditions for non-replacements etc)			✓
Greasy wool production and clean wool yield by class		✓	
Income and expenses for economic analysis	✓		✓
Livestock numbers (by class and season)		✓	
Livestock numbers (by class and month)	✓		
Liveweight (by class and season)	✓	✓	
Liveweight gain (by class and season)	✓	✓	
Maintenance and supplementary feeding rules			✓

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No. ewes lambing in each season OR proportion of cows lactating		✓	
No. ewes/cows lactating each month (can give more detail on % ewes/cows lactating and % milk consumption by season)	✓		
Stock phenotype (liveweight, mortality rate, CFA age, wool parameters {wool production, fibre diameter etc})			✓
Stocking rate (ewes/ha)			✓
Template farm systems available which can be modified to reflect the current farm system or users can build a farm system from scratch			✓

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Description of output data	Provides a summary report in PDF or as csv file (which opens in excel) showing the input data, emissions factors and emissions results. Results can be presented as overall for the farm or for individual enterprises. Provides a comparison between emissions using default values (e.g. based on NGGI average values) and the farm-specific values entered.	Provides a summary report in spreadsheet (MS Excel) format showing input data and emissions in CO_2e^*.	Very thorough output data reporting. Several default reports which users can use without change, modify to capture additional information or can be built from scratch. Output data is based on productivity and economics. Temporal data can be presented on many scales (daily, weekly, monthly, annually and averages, minimums, maximums or other options of these). Results from this dynamic model can be entered into FarmGAS, Sheep-Gas, Beef-Gas and Beef-GasN to calculate nitrous oxide emissions from livestock.

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GHGs reported in output data			
Burning (CH_4)	✓	✓ **(B-GAFN)**	
Dung/urine (N_2O)	✓	✓	
Energy (CO_2)		✓	
Methane (CH_4) – enteric and manure	✓	✓	✓
N fertiliser (N_2O)	✓	✓	
Nitrous oxide (N_2O) - indirect	✓	✓	
Sequestrations from tree plantings	✓ (in C)	✓(in CO_2e*)	
Total meat and wool sales (tonnes carcase weight and clean fleece weight)			
Model or calculator	A calculator based on accounting standards, it is not driven by biophysical factors	Calculators based on accounting standards, they are not driven by biophysical factors	A model based on biophysical factors.

*CO_2e is carbon dioxide equivalents

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	FarmGAS	**Sheep-GAF, Beef-GAF and Beef-GAFN**	**GrassGro**
Comparing different scenarios	Multiple scenarios can be compared easily, on the same page.	The spreadsheet can be saved and the figures edited to see changes. Scenarios cannot easily be viewed side-by-side.	The data can be used to compare different management practices including altering lambing/calving dates, pasture species or stocking rates.
Financials	Gross margin calculator. Total variable costs, total gross margin and gross margin expressed per DSE, per ha and per ewe. This is based on data entry for all farm financials generally on a cost or income per head (averaged).	No financial capability	Gross margin report (default template report already embedded which can be modified by the user). Total income, total expenses and gross margin expressed per ha or per farm
Strengths	Represents the whole farm and can therefore evaluate the impacts of changing enterprises.	S-GAF & B-GAF are based on accounting standards	Dynamic model which models impacts of changed management on animal numbers & profit. Data can be imported into a GHG calculator to give livestock emissions
Limitations	Good internet connection required.	No financial capability.	N_2O emissions not covered.

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